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The Case for Gender-Sensitive Superannuation Plan Design

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Abstract

A key feature of superannuation plan design is the assumption that members have long and continuous periods of employment over which contributions are made. This heroic design feature has led to debate on the adequacy of superannuation plans for those with interrupted employment, particularly the adverse impacts this has on the retirement income prospects of women. This paper employs non-parametric stochastic simulation to investigate two possible solutions to gender inequality in superannuation, higher contribution rates and more aggressive asset allocation. Our results suggest that while both these strategies in isolation are effective in reducing the current gender disparity in superannuation outcomes, they demand significant changes to current arrangements when employed individually to address the problem. A combined approach is found to be more powerful in ensuring a more equitable superannuation outcome for women, as it nullifies the relative disadvantage of interrupted employment with only modest changes to contribution rates and asset allocation.

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1. Introduction

The private retirement system in Australia, like most countries, is designed to reward long and continuous periods of employment and penalize breaks. However, the career profiles of most women in Australia are characterized by a broken employment pattern, particularly in the early and middle years.[1] Even where women work full-time, their earnings are significantly lower compared to men. The result is a significantly lower level of superannuation for women at retirement.[2] The body of work looking into the challenges confronting Australian women in retirement is vast, with Jefferson (2005) providing an important review of the key lines of investigation. Several authors focus specifically on the issue of gender inequity in accumulation outcomes at retirement (Brown, 1994; Donath, 1998; Preston and Austen, 2001). Others, such as Olsberg (2004), argue for greater equity for women in the workforce, more education on superannuation and investments, and increasing female representation in governance of superannuation funds. While one cannot discount the impact that these various proposals would have in addressing the problem of low retirement income for Australian women, the precise manner in which they would increase retirement savings (and to what extent) continues to be debated.

This paper considers the impact of gender-sensitive savings and asset allocation policies in alleviating differences between wealth accumulation outcomes for Australian women and men in retirement savings plans, commonly known as *superannuation funds*. While one would expect higher contribution rates for women would result in minimizing the gender-based inequality in superannuation outcomes, the role of asset allocation in addressing the inequality problem is not obvious. The importance of asset allocation as a key determinant of long term investment performance has been universally acknowledged since the publication of the seminal work by Brinson, Hood, and Beebower (1986).[3] Surprisingly, the possibility of using asset allocation to reduce the gender gap in retirement wealth has not yet been considered by academic researchers or policymakers in any country.

We show empirically that the current policy of having gender-neutral savings and investment options for the workforce is almost always bound to result in lower accumulation outcomes for women.

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1 We acknowledge the comments of one of the anonymous reviewers who suggested the importance of also highlighting the increasing number of men subject to discontinuous labour force participation, increasing casual employment and/or those on low incomes. We hope that the analysis undertaken in this paper on two possible solutions to the issue of discontinuous employment (contribution rates and asset allocation) would provide some foundation to consider explicitly these cohorts in future work.

2 Relative disadvantage in the labour market and inferior retirement wealth outcomes for Australian women is well documented by several authors (see Rosenman and Winocur, 1994; Sharp, 1995).

3 In a study conducted among pension funds in UK, it was found that more than 99 per cent of the total return generated could be explained by the long-run asset allocation specified by the plan sponsors (Blake, Lehmann, and Timmerman, 1998).

Specifically, the distribution of superannuation assets for the average male member exhibits first degree stochastic dominance over that for the average female member. However, we find that establishing a different default arrangement (by superannuation funds) for women may significantly alter this situation.[4] This can be achieved through either changing the mandatory contribution rate or changing the default asset allocation strategy of the plans (or a combination of both) for women.

2. Method

This paper uses stochastic simulation methods to compare the expected distributions of superannuation accumulation outcomes of an average female plan member to that of her male counterpart under several alternative savings and investment strategies. We assume that the average male and female member joins the superannuation plan at the age of 20 years and stays in the plan till their retirement at the age of 65 years. Our baseline case represents an average male with no voluntary break from employment whose superannuation contribution is nine per cent of earnings which is equal to the mandatory contribution rate for all Australians in employment. The contributions of this hypothetical male is assumed to be invested in a 'balanced' fund holding 60 per cent of the assets in shares, 30 per cent in bonds and the remaining 10 per cent in cash. The asset allocation structure of this classic balanced fund is akin to that of the average default investment option offered by superannuation funds in Australia.[5] The accumulation outcome of the baseline male is then compared with those of an average female under three alternative assumptions:

1. no voluntary break from employment;
2. a voluntary break of 5 years duration between the age of 26 and 30; and,
3. a voluntary break of 5 years between the age of 31 and 35.

Under each of these alternative scenarios, we use different contribution and asset allocation rules for modeling the wealth outcomes at retirement. To estimate the terminal wealth outcomes for different contribution rates and asset allocation strategies, we use a simple accumulation model which uses stochastic simulation of asset class returns to determine the expected distribution of wealth outcome at retirement (the specification of which is provided in Appendix 1).

[4] We focus on default savings and investment arrangements since a vast body of contemporary scholarly work (for example, Choi, Laibson, Madrian, and Metrick, 2003; Cronqvist and Thaler, 2004) indicates that majority of employees passively accept the default contribution rates and investment strategies chosen by the trustees of their respective funds. In the Australian superannuation context, the importance of default choices is highlighted in Gallery, Gallery, and Brown (2004). As per the estimate of Australian Prudential Regulatory Authority (APRA), nearly two-third of all superannuation assets are invested in default investment options of various plans (APRA, 2005).

[5] At the end of June 2004, the average default investment option had 33 per cent of assets held as Australian shares and 21 per cent in international shares. A further 15 per cent was invested in Australian fixed interest, 6 per cent in international fixed interest, 7 per cent in cash, 6 per cent in property, and 12 per cent in other assets (APRA, 2005).

To compare the distribution of terminal superannuation wealth outcomes of women under different assumptions about employment breaks, contribution rates, and asset allocation strategies with that of the baseline male ("the baseline"), we compute the mean, median, and the quartiles of the distribution in every case. Comparing these parameter estimates would give us some idea about the relative standing of different savings and asset allocation rules in improving superannuation outcomes for women. However we are more interested in finding out how effective these strategies are in offsetting the gender inequality in superannuation. To be effective any strategy should be able to reduce the chance of women underperforming the baseline. Also, as long as a strategy does not diminish that chance of underperformance to zero, we need to estimate the magnitude of such underperformance.

We compute a statistic called the probability of shortfall which represents the chance of women ending with less accumulated wealth than the baseline. This probability of shortfall is given by

$$P_s = \frac{1}{n}\sum_{t=1}^{n} Max[0,(W_m - W_f)]^0 \quad (1)$$

where W_m and W_f represents the terminal superannuation wealth for the male and female worker respectively, and *n* the number of trials. While P_S estimates the odds of the hypothetical woman doing worse than the baseline in different situations, it does not describe the how large the shortfall in wealth outcome for the former would be compared to that of the latter. To estimate the magnitude of underperformance by women, we measure the expected shortfall which is given by:

$$E_s = \frac{1}{n}\sum_{t=1}^{n} Max[0,(W_m - W_f)] \quad (2)$$

It is also particularly important to compare the extremely adverse outcomes for the baseline who uses a relatively conservative allocation strategy and those generated by the more aggressive strategies used by the hypothetical female in our model. To evaluate the extreme retirement wealth outcomes of alternative strategies, we use two common measures of estimating tail risk - value at risk (*VaR*) and expected tail loss (ETL). In the context of our problem, if p represents the probability of worst percentage of terminal wealth outcomes that the member workers are concerned about, α is the confidence level and *p* is set such that $p = 1-\alpha$, and if Q_p represents the *p*-quantile of the wealth distribution, then the VaR at that confidence level is given by:

$$VaR = Q_p \quad (3)$$

An outcome worse than *VaR* can occur only in extreme circumstances, the probability of which can be specified by the user by specifying α , which indicates the likelihood that the member would not get an outcome worse than *VaR*. We set α as 95 per cent which implies that only the worst 5 per cent outcomes would fall below the VaR estimate at this confidence level.

However, the VaR estimate gives us no idea about how bad things would be if the member unfortunately ends up with a 'below VaR' outcome. For this we compute the expected tail loss (ETL) estimate which is the probability weighted average of 100(1- α) per cent outcomes i.e. outcomes that fall below VaR at the given confidence level α .[6] If W_i is the *i*-th outcome and *i* is the probability of the *i*- th outcome, then:

$$ETL_{\alpha} = \frac{1}{1-\alpha}\sum_{i=0}^{\alpha} W_i.i \qquad (4)$$

As for VaR, we compute expected tail loss (ETL) estimate at 95 per cent level of confidence for different allocation strategies which is the probability weighted average of outcomes that are below the 5th percentile estimate of the terminal wealth distribution.

For modeling wage and contributions, we employ weekly income data for individuals from Australian Bureau of Statistics (ABS) 20XX Census of Population and Housing. To resample asset class returns, this paper uses an updated version of the dataset of real returns for Australian stocks, bonds, and bills reported by Dimson, Marsh, and Staunton (2002) and commercially available through Ibbotson Associates. This annual return data series covers a period of 105 years between 1900 and 2004. Since the dataset spans over several decades, it captures wide-ranging effects of favourable and unfavourable events of history on returns of individual asset classes within our test. The returns include reinvested income and capital gains (for further discussion, see Appendix A).

3. Results and Discussion

Initially, we focus on the impact of changing the superannuation contribution rates in addressing the gender inequity in accumulation outcomes. Therefore, we need to hold the asset allocation strategy constant for men and women. For the hypothetical male (our baseline case) the contribution rate is 9 per cent. For the hypothetical female, we examine the impact of a continuous career as well as that of a voluntary career break of 5 years. In our simulation model, we assume that this break occurs either at the age of 25 years or at 30 years although we acknowledge that these breaks can happen at different ages for different woman (moreover, our assumption of a continuous break for 5 years may not be representative of many women who may experience more than one career break). The

6 Expected tail loss is an important risk measure used in actuarial science (see Dowd, 2005) and satisfy the criteria of coherent risk measures proposed by Artzner et. al., (1999)

contribution rates for women range from 9 per cent to 16 per cent. For every trial undertaken for the hypothetical female under various assumptions about employment breaks, a parallel trial is conducted for the baseline (see Table 1).

For the female with no career break (Panel A), the results indicate the stark differences between the accumulation outcomes of Australian men and women. In case the contribution rate is same for both the genders, the projected outcomes for the male dominate those of the females for all 5,000 simulation trials (i.e. there is stochastic dominance of the first order). The mean and median accumulation of the male worker exceeds that of his female counterpart by more than $186,000 and $156,000 respectively. This result is significant as it gives an idea about the quantum of shortfall in accumulation that would be experienced by women under the current regime of gender-blind superannuation plans even if she does not take any voluntary break during her career!

Table 1: Accumulation Outcomes for Different Female contribution Rates

Table 1 reports the superannuation wealth accumulation estimates from simulation trials for a hypothetical male and female worker in Australia who join the workforce at the age 20 and retire at the age of 64 for different contribution rates of the latter. The accumulation outcomes of the male worker are compared to those for a female with no voluntary break in employment (Panel A), with a voluntary break in employment between 25 and 30 years (Panel B) and with a voluntary break in employment between 30 and 35 years (Panel C). The contribution rate for the male worker remains constant at 9% while contribution rate for the female worker is changed for each set of simulation experiment consisting of 5,000 trials. P_S represents the probability of the accumulation of the female worker falling below that of the male worker. E_S is the expected shortfall of the female accumulation outcome i.e. the probability weighted average of the amounts by which the simulated wealth outcomes for the female worker falls short of that of the male worker.

Contribution Rate	Mean	Median	25th Percentile	75th Percentile	P_S	E_S
PANEL A						
MALE: 9%	660,322	551,392	373,595	820,129		
FEMALE: 9%	476,274	395,222	265,286	591,562	100%	184,047
MALE: 9%	656,535	552,043	378,813	820,179		
FEMALE: 12%	622,897	520,463	354,068	781,262	100%	33,638
MALE: 9%	656,127	554,317	371,646	814,304		
FEMALE: 12.5%	647,603	544,548	362,465	806,628	86%	9,974
MALE: 9%	659,953	546,966	367,199	831,464		
FEMALE: 12.75%	663,940	547,558	364,778	837,870	49%	2,850
PANEL B						
MALE: 9%	654,039	544,186	361,446	822,651		
FEMALE: 9%	365,554	306,831	205,162	459,603	100%	288,485
MALE: 9%	662,048	559,897	370,630	822,965		
FEMALE: 12%	492,761	420,946	282,163	610,859	100%	169,287
MALE: 9%	660,129	554,277	368,665	825,380		
FEMALE: 15%	614,193	520,776	349,338	762,904	92%	46,630
MALE: 9%	669,069	561,338	373,178	835,128		
FEMALE: 16%	663,421	564,586	378,691	828,662	47%	15,993
PANEL C						
MALE: 9%	660,051	555,442	369,869	820,576		
FEMALE: 9%	396,069	331,281	222,340	492,675	100%	263,981
MALE: 9%	666,186	555,535	368,005	838,751		
FEMALE: 12%	533711	442,640	294,861	664,923	100%	132,475
MALE: 9%	655,380	545,769	362,952	821,870		
FEMALE: 15%	655,179	542,623	363,448	816,312	49%	12,000

The gap in accumulation between the genders grows even further if the hypothetical female has a voluntary career break, a distinct possibility confronted by most Australian women. As expected, every outcome for women under this condition is dominated the corresponding outcome of the male counterpart. A 5-year break from employment at the age of 25 (Panel B) results in a mean accumulation for the average female which is almost $300,000 less compared to that of the average male. The median account balance for the former is also less than that of the latter by more than $237,000. The average wealth differential between the male and the female also increases to $288,485. If the female defers this career break until she is 30 (Panel C), the probability of underperforming the baseline outcome still remains at 100 per cent. However, the average shortfall in this case slightly declines to $263,981.[7]

One way of reducing the imbalance in wealth outcomes would be to increase the superannuation contribution rate for women. But the key question is to what extent it needs to be increased. Our simulation results throw light on this issue. For women with no voluntary break from employment, increasing the contribution rate to 12 per cent reduces the average size of the terminal wealth shortfall to $33,638 (compared to $184,087 in the case of a 9 percent contribution). But still every accumulation outcome falls short of the corresponding outcome for the baseline. However, if the contribution rate for the female goes up further to 12.5 per cent, the probability of underperforming male accumulation outcomes at retirement comes down to 86 per cent and the size of underperformance dramatically decreases to below $10,000. A further increase of female contribution rate to 12.75 per cent actually turns the odds slightly in favour of women. The probability of underperforming the male baseline is now only 49 per cent, i.e. there is now a 51 per cent chance of the female retiring with a higher superannuation balance. The corresponding average shortfall is now below $3,000. At a contribution rate of 13 per cent, the female accumulation outcomes dominate corresponding male projected outcomes in 86 per cent of cases.

While a contribution rate of 12.5 per cent would give women with continuous employment almost an even chance of doing as well as men in superannuation, this is not a realistic scenario for most Australian women who spend less time in paid work than typical men. To assess the amount of contribution for women with broken employment record required to match the outcome of the baseline, we look at the results presented in panels B and C. As expected an increase in female contribution rate to 12 per cent does not lead to a dramatic reduction in the size of average shortfall. A break for 5 years at the age of 25 (Panel B) would lead to an expected shortfall of $169,287 relative to men with no break in employment. If the break is experienced at the age of 30 (Panel C), the

7 The above results are no surprise given the existence of the gender wage gap in the Australian labour market. Lower earnings for women over the lifecycle are bound to result in lower superannuation contributions which in turn would produce less terminal wealth at retirement relative to male workers in the same cohort as both the sexes experience the same investment return path. The likelihood of longer absence from paid work for women further widens the mismatch.

expected shortfall would be still very large at $132,475. A contribution rate of 16 per cent (if break occurs at 25) or 15 per cent (if break occurs at 30) would be necessary for the female to bring down the probability of shortfall relative to the baseline below 50 per cent. But the average size of shortfall at $15,993 and $12,000 respectively in these cases are still higher than that of the woman with no career break and contribution rate of 12.75 per cent.

While these results underline the significance of higher contributions for Australian women to reduce the gender disparity in retirement wealth outcomes, a novel approach to tackling this issue may lie in the investment strategy chosen by the participants in the fund. Since the only investment decision made by superannuation fund members in Australia is asset allocation, we examine the impact of changing the asset allocation strategy on terminal wealth at retirement. Therefore, it as an attractive option for the researcher to investigate whether resorting to a more aggressive investment strategy can help women to overcome the gender inequity in retirement wealth outcomes.[8] For all simulation trials conducted in this part of our investigation, we hold the contribution rate for both women and men constant at the current mandatory rate of 9 per cent. For the sake of simplicity, we assume investments are made only in Australian equities, bonds, and bills. The asset allocation strategy adopted by the baseline always again resembles a balanced fund holding. For women, in addition to the classic balanced fund described above, we explore wealth outcomes under alternative strategies with increasing allocation to equities. This is compensated by an equal reduction in the proportion of assets invested in bonds and cash.[9]

8 Empirical evidence suggests that the probability of stocks underperforming like bonds over longer holding periods is extremely low, see Mehra and Prescott (1985) and Siegel (1994).

9 However, to meet liquidity requirements of the fund, the allocation to cash is assumed to never go below 5 per cent (apart from the extreme case where allocation to equities is 100 per cent). For example, a 10 per cent increase in allocation to equities from 60 per cent to 70 per cent is matched by a 5 per cent decline in allocation to bonds (from 30 per cent to 25 per cent) and 5 per cent decline in allocation to cash (from 10 per cent to 5 per cent). But a further increase of investment in equities to 80 per cent leads to a 10 per cent decline in allocation to bonds (from 25 per cent to 15 per cent) while the allocation to cash remains unchanged at 5 per cent.

Table 2: Accumulation Outcomes for Different Female Asset Allocation Strategies

Table 2 reports the superannuation wealth accumulation estimates of simulation trials for a hypothetical male and female worker in Australia who join the workforce at the age 20 and retire at the age of 64 for different asset allocation strategies employed by the latter. The accumulation outcomes of the male are compared to those for a female with no voluntary break in employment (Panel A), with a voluntary break in employment between 25 and 30 years (Panel B) and with a voluntary break in employment between 30 and 35 years (Panel C). The allocation of the male to shares is constant at 60% while allocation to shares for the female worker is changed for each set of simulation experiment consisting of 5000 trials. P_S represents the probability of the accumulation of the female falling below that of the male. E_S is the expected shortfall of the female accumulation outcome i.e. the probability weighted average of the amounts by which the simulated wealth outcomes for the female falls short of that of the male.

Allocation to Shares	Mean	Median	25th Percentile	75th Percentile	P_S	E_S
PANEL A						
MALE: 60%	664,015	561,477	372,063	830,892		
FEMALE: 70%	597,295	480,357	301,116	746,496	94%	71,427
MALE: 60%	668,332	559,850	372,673	832,108		
FEMALE: 75%	669,681	518,907	323,422	840,281	69%	38,036
MALE: 60%	659,571	553,586	368,400	823,700		
FEMALE: 80%	726,348	559,311	343,222	909,111	49%	24,081
PANEL B						
MALE: 60%	662,048	559,897	370,630	822,965		
FEMALE: 70%	455,140	372,421	239,193	571,582	100%	206,908
MALE: 60%	660,129	554,277	368,665	825,380		
FEMALE: 80%	550,210	432,049	272,157	687,667	93%	117,130
MALE: 60%	669,069	561,338	373,178	835,128		
FEMALE: 90%	686,090	508,750	303,123	856,292	66%	61,792
MALE: 60%	650,186	540,071	359,247	814638		
FEMALE: 95%	729,388	521,922	306,261	905812	56%	50,834
MALE: 60%	653,648	540748	376,424	804,847		
FEMALE: 100%	824,474	577415	335,566	999,982	43%	35,733
PANEL C						
MALE: 60%	659,571	553,586	368,400	823,700		
FEMALE: 70%	493,391	397,345	255,693	613,685	100%	166,280
MALE: 60%	668,332	559,850	372,673	832,108		
FEMALE: 80%	617,311	469,332	288,962	770,442	82%	79,834
MALE: 60%	651,560	541,275	360,441	817,378		
FEMALE: 90%	734,711	526,463	311,239	905,739	55%	44,318

MALE: 60%	652,260	539,453	375,357	804,919		
FEMALE: 95%	814,457	574,486	338,685	992,775	43%	33,870

The results under different asset allocation rules adopted by the female vis-à-vis the baseline is presented in Table 2. For women who do not go through any voluntary break in employment (Panel A), an increase in allocation to shares to 70 per cent slightly reduces the chance of underperforming the male outcome to 94 per cent (compared to 100 per cent in case both the genders follow the same balanced allocation strategy). But it leads to a remarkable decline in the average size of the underperformance. The average size of shortfall relative to the accumulation outcome for the baseline male worker is now $71,427 which is less than 40 per cent of what it would be ($184,087) had the female invested in the same balanced strategy chosen for the male worker. If the allocation to shares is increased by another 5 per cent to 75 per cent, the impact is a dramatic drop in the probability of shortfall to 69 per cent. In other words, there is almost a 1 in 3 chance now that the female would outperform the baseline. A further increase in allocation to equities to 80 per cent for the former gives her more than an even (1 in 2) chance of ending with a higher superannuation account balance in retirement than the latter.

For the alternative scenario of women experiencing 5-year breaks from employment, the impact of pursuing more aggressive investment strategies is far less spectacular in terms of reducing the chance of underperforming the baseline. If the break happens at the age of 25 (Panel B), even an investment strategy with 80 per cent allocation to equities would result in a modest improvement in shortfall probability to 93 per cent. The results indicate that unless the entire superannuation contribution is invested in a portfolio with almost 100 per cent allocation to equities, the female has less than an even chance to match the accumulation of the baseline. If the break happens later in her career at the age of 30 (Panel C), a similar result is achieved with an allocation of 95 per cent to equities, which is still very high. The aggressive asset allocation strategies, however, prove effective in trimming down the magnitude of underperformance relative to the baseline male case. For example, by employing an allocation rule which invests 90 per cent of assets in shares, the female worker with 5 year employment break at the age of 25, reduces the expected shortfall to $61,792 which is less than a quarter of the expected shortfall she would be exposed to by investing using the same allocation rule as the baseline male.

However employing highly aggressive asset allocation strategies to improve terminal wealth outcomes for women (or reducing the expected shortfall) may have pitfalls. The higher volatility of returns from share market is the key concern here. While mean reversion is a well demonstrated feature of past history of stock market returns (Poterba and Summers, 1988; Fama and French, 1988), theoretically, the chance of many consecutive years of low or negative returns from investments in equities in future cannot be ruled out. In the case of such an occurrence, the wealth outcome for a highly aggressive strategy can be extremely adverse. A large number of simulation trials (5,000 in this

study) which resample past returns, positive and negative, with replacement can potentially capture these extremely adverse outcomes at the lower end of the wealth distribution for each investment strategy. We report the results for these extremely adverse outcomes in Table 3.

Table 3: Extreme Adverse Outcomes for Different Asset Allocation Strategies

Table 3 reports estimates of the most adverse outcomes for different asset allocation strategies employed by a hypothetical female in Australia who join the workforce at the age 20 and retire at the age of 64. The Value-at-Risk (VaR) estimate is computed at 95% level of confidence. The Expected Tail Loss (ETL) which is a conditional measure given by the probability weighted average of all accumulation outcomes that are below VaR, is also computed at 95% level of confidence. Panels A, B, and C represents the accumulation outcomes for a female with no voluntary break in employment with a voluntary break in employment between 25 and 30 years and with a voluntary break in employment between 30 and 35 years respectively.

Allocation to Shares	VaR	ETL
PANEL A		
60%	150,557	121,550
70%	160,141	130,509
75%	170,147	133,984
80%	169,519	131,978
PANEL B		
60%	122,870	100,646
70%	131,662	107,764
80%	137,945	109,093
90%	150,471	116,962
PANEL C		
60%	129,018	104,652
70%	136,643	109,155
80%	150,902	117,670
90%	152,912	117,752

Contrary to expectations, they show that the risk of encountering extremely adverse outcomes by pursuing a more aggressive strategy is not much different from following a less aggressive one. For the women with continuous employment (Panel A), the VaR estimates at 95 per cent confidence level are actually better for strategies with higher allocation to shares. For example, an allocation of 70 per cent to shares results in a VaR estimate of $160,141 whereas increasing the allocation of shares to 75 per cent produces a corresponding outcome ($170,147) which is higher by more than $10,000. Increasing the allocation to shares further to 80 per cent, however, results in a slightly lower VaR estimate at $169,519. The conditional shortfall or ETL estimates are also extremely close for different asset allocation strategies. When we look at women with breaks (Panels B and C), the results indicate that more aggressive strategies generally produce better outcomes at the lower tail of the wealth distribution. This is clear from the increasing trends in both the VaR and the ETL estimate with an

increase in allocation to stocks. This is apparently confounding due to their inconsistency with the conventional notion of risk and return going hand in hand. Yet our results are well supported by the empirical evidence showing that the risk of investing in shares over less volatile assets like bond and cash decrease over longer holding periods. This is demonstrated to be true both under assumptions that future returns are random drawings from distribution of past returns (Butler and Domian, 1991) and stock returns are mean reverting in the long run (Thaler and Williamson, 1994).

So far we have demonstrated the effectiveness of increasing contribution rates and adopting aggressive asset allocation approaches in mitigating the gender inequality in superannuation outcomes. Yet one cannot discount the fact that prescriptive changes of this scale are difficult to implement in practice. To give women, who have a very high chance of experiencing a career break, an even chance of accumulating as much in superannuation as the baseline male, her contributions have to be raised between 15 to 16 per cent from the current 9 per cent level. To fill this gap is no easy task for the policymakers as it is bound to meet with strong opposition from employers or the employees depending on who is made to pay for this increase in contributions. If the mandatory employer contribution rates are increased significantly for women, it may give rise to discrimination by many employers. On the other hand, women themselves are subjected to a compulsory or voluntary contribution regime to fill this gap, it is unlikely to find much favour as it involves substantial trade-off with their current consumption needs.

The alternative solution of setting aggressive portfolio strategies for women may be even more controversial although this does not require any extra contributions from the employer or the employees. International research evidence finds women to be more risk averse than men and this is reflected in their preference for relatively conservative investment strategies (see Bajtelsmit, Bernasek, & Jianakoplos, 1999; Bernasek & Shwiff, 2001).[10] Therefore, any default arrangement that allocates more than 90 per cent of female superannuation assets to the equity market (as our results suggest) in order to match male retirement outcomes could be viewed as reckless by current standards.

A third approach to address the problem would be to use a combination of higher contributions and aggressive asset allocation for women. We put this to the test by conducting simulations that set female contributions at a slightly higher level of 12 per cent and then adjust the asset allocation to match the superannuation outcomes of the baseline male. The results appear in Table 4. For women with no voluntary break in employment (Panel A), the consequence is very encouraging. With a

[10] In Australia, Gerrans and Clark-Murphy (2004) finds support for this assertion. Some researchers, however, find that with equal access to financial knowledge and information, there is little difference between the investment behaviour of men and women (see Dwyer, Gilkeson and List, 2002).

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modest increase in contribution rate (to 12 per cent) and exposure to shares (to 70 per cent), the accumulation outcomes for the woman now dominates those of her male counterpart most of the time. The probability of the female doing worse than a male is reduced to a meager 9 per cent with an expected shortfall of only $800. The median outcome for the female outperforms that of the baseline male by nearly $80,000.

Table 4: Accumulation Outcomes for Different Female Asset Allocation Strategies

Table 4 reports the superannuation wealth accumulation estimates from simulation trials for a hypothetical male and female in Australia who join the workforce at the age 20 and retire at the age of 64. The contribution rate and asset allocation for the male is constant while the female has a constant but higher contribution rate and employs a range of different asset allocation strategies. The accumulation outcomes of the male are compared to those for a female with no voluntary break in employment (Panel A), with a voluntary break in employment between 25 and 30 years (Panel B) and with a voluntary break in employment between 30 and 35 years (Panel C). The contribution rate of the male remains constant at 9 % and allocation to shares is also constant at 60%. The contribution rate for the female remains constant at 12% but the allocation to shares change for each set of simulation experiment consisting of 5000 trials. P_S represents the probability of the accumulation of the female falling below that of the male worker. E_S is the expected shortfall of the female accumulation outcome i.e. the probability weighted average of the amounts by which the accumulation outcomes for the female falls short of that of the male.

	Cont. Rate	Alloc. Shares	Mean	Median	25th Percentile	75th Percentile	P_S	E_S
PANEL A								
MALE	9%	60%	661,619	558,777	371,128	819,093		
FEMALE	12%	70%	794,187	637,462	401,755	988,134	0.09	800
PANEL B								
MALE	9%	60%	660,322	551,392	373,595	820,129		
FEMALE	12%	70%	605,406	491,184	323,197	757,062	0.92	59,461
MALE	9%	60%	656,535	552,043	378,813	820,179		
FEMALE	12%	80%	725,501	576,141	360,670	910,521	0.43	18,927
PANEL C								
MALE	9%	60%	662,048	559,897	370,630	822,965		
FEMALE	12%	70%	648,023	524,302	333,364	809,337	0.75	33,693
MALE	9%	60%	669,069	561,338	373,178	835,128		
FEMALE	12%	75%	730,192	570,722	360,411	916,911	0.44	15,581

The above results for females using a *combination* of 'higher contribution rate' and 'aggressive asset allocation' are far superior to those obtained previously when we employed these strategies individually. For instance, with a contribution rate of 12 per cent alone, the female with no voluntary break in employment was always certain to accumulate less than the baseline male i.e. probability of

shortfall was 100 per cent. The average size of the shortfall was also much larger (more than $33,000). On the other hand, if the female contributed the same 9 per cent as the baseline male but invested in a more aggressive portfolio of 70 per cent of assets in shares, she would still be underperforming the male worker in 94 per cent of cases with an even larger expected shortfall exceeding $71,000.

The combination approach also seems to work well for the hypothetical woman with voluntary breaks in employment (Panels B and C) although the break in contributions needs to be compensated by holding a more aggressive portfolio if her contribution rate remains unchanged at 12 per cent. To give women a more than even chance to outperform the baseline accumulation at retirement (i.e. $P_S <$ 0.5), our results indicate that her portfolio exposure to shares has to be between 75 per cent and 80 per cent depending on the timing of the break. Again had the female relied on an increased contribution rate of 12 per cent alone, she had almost no chance of matching the accumulation of the baseline male. The expected shortfall, for the woman with career breaks at the age of 25 and 30 years would be $169,287 and $132,475 respectively which is considerably higher compared to $18,927 and $15,581, the value of expected shortfalls in case the same woman employed the combination approach. Similarly by holding a portfolio with 80 per cent of assets invested in shares (without altering the contribution rate), she would have struggled to match the male accumulation outcomes in most cases (93 per cent and 82 per cent respectively for breaks at the age of 25 and 30) and confronting a higher expected shortfall ($117,130 and $79,834 respectively for breaks at the age of 25 and 30).

4. Concluding Comments

Many authors like Hill and Tigges (1995) point out that pension systems were historically developed 'by men with men in mind'. The Australian superannuation system, which has assumed a prominent place in the retirement income landscape of the workforce, is no exception. Inequality in labour market performance is bound to put Australian women at a serious disadvantage in retirement compared to men. In this paper, we have examined the effectiveness of two alternative strategies – higher contribution rates and aggressive asset allocation for women – in addressing this inherent, albeit inadvertent, discrimination in the current superannuation arrangement. Whilst our results suggest that both these approaches are individually useful in mitigating the gender inequality in wealth outcomes at retirement, we find that their effectiveness grows manifold when used in tandem. A combined approach is also appealing from the policymaker's perspective since it demands relatively modest changes to current mandatory contribution rates and default asset allocation of the average superannuation fund.

Thomson (1999) points out that an equal treatment of the genders by the superannuation system would result in unequal outcomes in presence of women's enduring disadvantage in the labour

market. We find evidence that supports this contention and suggests that there is a compelling case for instituting gender specific contribution and investment strategies in superannuation plans. However this presents a significant challenge to policymakers considering many women have little labour market flexibility to cope with higher contributions and are believed to be fairly risk averse to be willing to increase exposure to equities. Also it may be argued, perhaps not entirely without merit, that such a policy would actually hope to nullify women's inferior performance in one market (labour) partly by increasing their exposure to the performance risk in another market (investment). But while women's relative disadvantage in the former market is almost certain to continue for many years in future, our past experience of superior long term performance of stocks over other asset categories provides strong ground for optimism that the policy would be effective in nullifying such disadvantage to a large extent.

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Appendix 1

The terminal value of superannuation assets is given by:

$$W = k\sum_{t=0}^{R-1}(1-p_t)S_t(1+r_t)\prod_{u=t+1}^{R-1}(1+r_u)$$

where: W = value of plan assets accumulated at the point of retirement

k = Plan contribution rate

p_t = Probability of unemployment in year *t*

S_t = Annual salary in year *t*

r_t = Real rate of investment return earned in year *t*

R = Number of years in the plan before retirement

To estimate *W*, we need to model the: (i) contribution cash flows; and, (ii) investment returns for each period. The contribution cash flows depend on annual salary, contribution rate, and probability of unemployment in any period. The annual salary every year is modeled using weekly income data from Australian Bureau of Statistics (ABS). Based on this data we build career wage profiles for an average male and female worker between the ages of 20 and 65 years. No contribution is made during periods of unemployment, the probability of which is assumed to be 5 per cent. Investment returns are dependent on returns on individual asset classes (stocks, bonds, and bills) and the weights assigned to them. The latter is determined by the asset allocation strategy of the plan. The returns for any period *t* is given by

$$r_t = \sum w_{i,t} r_{i,t}$$

where: $w_{i,t}$ is the weight assigned to the i^{th} asset in year *t* and $r_{i,t}$ is the real return on the i^{th} asset in year *t*. We assume uninterrupted contributions are made into the superannuation accounts of workers as long as they are not unemployed or not having voluntary breaks from employment. For the sake of simplicity, we assume that the contributions are credited annually to the accumulation fund at the end of every year. The portfolios are also rebalanced at the end of each year to maintain the target asset allocation. We assume that plan contributions and investment returns are not subject to any tax. We also ignore any transaction cost that may be incurred in managing the investment of the plan assets.

For generating asset class returns, this study employs non-parametric bootstrapping which draws asset class returns from the empirical return distribution. The asset class return vectors are then combined with the weights accorded to the asset classes in the portfolio (which is governed by the asset allocation strategy) to generate portfolio returns for each year in the 45 year horizon. The simulated investment returns are applied to the retirement account balance at the end of every year to arrive at the terminal wealth in the account. Each set of simulation experiments is iterated 5,000 times for all workers under different employment scenarios resulting in a range of wealth outcomes confronting the employee at the point of retirement.