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Keywords

JEL Classification

E21, D14, D91, D03

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Offsets to compulsory superannuation: do people consciously choose their level of retirement saving?

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1 Introduction

Economists usually model savings behaviour by assuming a savings preference *s* that is independent of how decisions are framed. The savings preference is a share of income representing how much people think their overall savings or savings in a particular portfolio should be. In neoclassical economics, the savings preference is driven by inter-temporal optimisation. Some behavioural economists maintain that people have a savings preference, but derive *s* from models with 'irrational' biases such as hyperbolic discounting or procrastination. In this study we explore whether it is possible that people act as if they do not have a savings preference at all. We look at a large superannuation (pension) fund, UniSuper, to see if people make superannuation contributions to reach a total contribution level *s*.

UniSuper has two groups of members with accumulation accounts.¹One group (acc2) received 25.25 percent of total remuneration as a compulsory contribution to their superannuation account. Another group (acc1) received only the minimum legislated 9 per cent of their total remuneration as a compulsory contribution. The two groups of members could also make voluntary contributions on top of their compulsory contributions. Both voluntary and compulsory contributions accumulate over time in the same pool of invested funds, had the same earnings tax treatment, and were available to fund retirement income under the same conditions. They appear to be the closest of substitutes.

If individuals did have a preference about about how much total contributions should be, then they would have made voluntary contributions to close the gap between their *s* and the compulsory rate. And if *s* is distributed in a way that does not depend on which group someone belongs to, then less people would have made voluntary contributions in the group with the higher compulsory rate. The higher compulsory rate group would have also made lower average contributions, averaging across those who do and do not make voluntary contributions. We should make these observations in the data even if, as predicted by some behavioural economists, some people procrastinated from making voluntary contributions. We derive these two results in section 3.

¹These are also called defined contribution (DC) accounts.

Noting that most people (85 percent) do not make voluntary contributions at all, we employ a two-part econometric model to estimate the decision to make a voluntary contribution and the decision of how much to contribute. We find that the proportion of people making a voluntary contribution on the higher compulsory rate and the average voluntary contribution (across those who do and do not make voluntary contributions) is not statistically different to that for the lower compulsory contribution group. This result is not consistent with each person having a preference s that guided how much their total UniSuper contributions should have been.

We acknowledge that our data is only a natural experiment if we assume that individual differences not accounted for in the covariates we use in our model (age, gender, income, job permanency and PhD status) are uncorrelated with acc1 and acc2 membership. If this assumption is correct, then our results suggest that either voluntary contributions are ad hoc, made without any consideration of well-defined preferences and overall contributions, or that the higher compulsory rate influences people's subjective evaluation of *s* (anchoring or suggestion bias).

Our results are important for policy. By law, Australian employers contribute a set percent of their employees' salary to a nominated superannuation fund. The rate is 9.5 per cent at time of writing – a rate two steps into a planned ten year journey from 9 per cent to 12 per cent.² An important policy question has been whether we should expect to see people offsetting increases in compulsory contributions. Offsetting in this context means the extent to which people forced to save more decrease other savings (or increase borrowing) in order to get closer to their desired preference *s*.

Consideration of the question of offsetting in Australia has so far focused on liquidity constraints. Connolly (2007) argues people cannot offset because they do not have cash savings elsewhere or cannot borrow. However, if people do desire to offset because of a preference s, we should see higher compulsory contributions leading to less people making voluntary contributions even if they were liquidity constrained. In fact, our results suggest a higher compulsory contribution rate is carried over completely to an increase in

²The level was at 9 per cent since 2003, following phased increases from 3 per cent in 1992, when compulsory contributions were first introduced. The current Government has recently enacted law to delay further increases from 9.5 until 2021.

the total contribution pool. For the majority that do not make additional voluntary contributions, it is clear that the level of compulsory contributions is a powerful determinant of retirement accumulation and therefore retirement income. For the minority that do make voluntary contributions, the level of compulsory contributions is no less important: voluntary contributions are added to the higher base level provided by the higher compulsory contributions. Whether there is no offset in other forms of saving (such as bank deposits or housing equity) is beyond the scope of this research – such a study would require a dataset including a full household balance sheet. The relevance of this study is the finding of a lack of offsetting in two forms of saving – compulsory and voluntary superannuation contributions – that are such close substitutes.

2 Literature review

We now turn our attention to review the historical development of notions of savings by economists. Saving – the accumulation of wealth – is the primary objective of 'economic man'; explanation of different rates of accumulation between nations and individuals is a central preoccupation of economics. Early classical economists emphasised individual psychological characteristics that gave rise either to strategic acquisitive behaviour on the one hand, or short-sighted spendthrift behaviour on the other³. Writing in the 19th century, the radical perspective of Marx was that accumulation must be understood in terms of social class rather than individual predisposition; and that inequality was integral. For Keynes, writing during the Great Depression, the goal was stimulation of demand – promotion of consumption, so excessive saving was a part of the problem. In his view, consumption and saving were functions of current income, though subject to psychological factors, including a defensive reaction to uncertainty.

At the same time, Samuelson (1937) pioneered the formal mathematical approach prevalent today, with a focus on intertemporal optimisation. He was one of the first to rigorously define appropriate savings behaviour (for a rational actor with perfect information) as mo-

³Relevant comments from Adam Smith were discussed in Ashraf et al. (2005) and fellow Scot, John Rae, in Frederick et al. (2002)

tivated by consumption-smoothing (Dixit, 2011)– simplified to saving for retirement. This idea was further refined by Modigliani and Brumberg (1954) into the lifecycle hypothesis (LCH) and by Friedman (1957) into the permanent income hypothesis (PIH). The LCH emphasised consumption smoothing as income changes at different life stages, while the PIH modelled savings as a way of smoothing shocks or transitory changes to income over an 'infinite' time horizon.

The LCH and particularly the PIH inform the basis of modern macroeconomic or rational expectations theory in which representative agents maximise their inter-temporal utility. However, by around 1980, several studies had found that these interpretations of the PIH did not agree with how consumption actually tracked transitory or life-cycle income in the data (Carroll and Summers, 1991; Flavin, 1985; Hayashi, 1982; Sargent, 1978).⁴

A number of mechanisms consistent with intertemporal optimisation have been suggested to explain the high dependence of consumption on income in the data. This includes liquidity constraints where households, particularly the very young, simply cannot borrow or insure against shocks to smooth consumption (Aiyagari, 1994; Flavin, 1985) or the presence of investment adjustment costs (Mckibbin and Wilcoxen, 1998). However these cannot be the complete picture. Households also typically save less than they even feel they should (Bernheim, 1995). Research conducted prior to the introduction of the superannuation guarantee in Australia also suggests most households reached retirement age without financial assets of any significance, holding wealth if any in illiquid housing equity and claims on public pension systems (Gallagher, 1996). This under-saving translates to one-off drops in consumption seen upon retirement - again inconsistent with the consumption smoothing in the LCH (Battistin et al., 2009; Bernheim and Scholz, 1992) Authors such as Diamond and Köszegi (2003) and Laibson (1998) go beyond market imperfections and incorporate behavioural and psychological insights into consumer optimi-

⁴The first part of Carroll and Summers (1991) criticises the neoclassical growth model by showing that the correlation of income and consumption growth across nation is inconsistent with the PIH. This is not entirely accurate – as pointed out by Mankiw in a response published with the book chapter at http://www.nber.org/chapters/c5995. It is a standard result to show that the growth rate of output driven by productivity growth should equal consumption growth in the steady state. However, the authors also present some evidence showing how consumption tracks income within the life-cycle of an individual, a finding inconsistent with a formal LCH/PIH model.

sation. In particular, they propose LCH models augmented with quasi-hyperbolic preferences. Rather than having a geometric discount rate as used in standard PIH or Ramsey-Brock/Mirman type models, consumers discount any two points in the future less than they would a point in the future and a point today. There is a dynamic inconsistency between future selves and the present self –resulting in less than 'optimal' savings.

Quasi-hyperbolic discounting can also be used to generate procrastination or inertia (an early model is Akerlof, 1991). This approach has been applied to pension saving by Carroll et al. (2009) where individuals may desire to save a certain level, but will not do so because of action costs which they avoid in the short-term. O'Donoghue and Rabin (1999) also introduce the notion of naivety, where an individual may indefinitely procrastinate from taking an unpleasant action if they overestimate the ability of their future self to undertake that action. The models of procrastination still however assume that there are individual preferences. These are revealed once an individual acts, and may be sub-optimal from an LCH perspective.

As funded defined contribution (DC) pension systems became more prevalent from the 1980s onwards, the question of how savings behaviour would respond to such schemes has been explored several times. A simplistic application of the LCH or standard macroe-conomic theory would see voluntary savings fall as compulsory or incentivised default workplace savings increase. This offsetting effect should also be present in models where savings targets are derived from quasi-hyperbolic preferences, as consumers would simply borrow more now to satisfy their dynamic inconsistencies. Implicit in these ideas is the notion of a savings target – as individuals would offset an increase in forced savings by an equal decrease in other savings (Martin Feldstein, 1977).

In the theoretical models mentioned so far, there are three mechanisms that could generate incomplete offsets. The first is liquidity constraints or incomplete markets where consumers simply cannot borrow to compensate for increased forced savings. Second, if individuals are procrastinating then compulsory pensions should result in savings that would not have occurred otherwise. Finally, there may be incomplete offsetting if pensions are not viewed as substitutable with other forms of savings.

Early examples of empirical work examining the question of offsetting are Cagan (1965)

and Katona (1965) who found that employer pension savings actually increased other savings. Green (1981) suggested similar results amongst employees who were eligible for employer contributions and Poterba et al. (1996) also show data suggesting 401(k) plans increase savings following the *same* households over time. None of these studies are consistent with any offsetting at all.

A study by Madrian and Shea (2001) showed that inaction could in fact play a major role in explaining the low rates of participation in 401(k) pension schemes where the participation is voluntary. The authors found that if employers switched the default for employees from non-participation to participation, then there was a substantial increase in 401(k) enrollment rates. More interestingly, the default scheme and asset allocation had a long-term effect on the contribution levels of participants- even after they had made an active decision to change their contribution.

In Australia context, Connolly (2007) examined differences in assets of those who were eligible for the Australian Superannuation guarantee (waged workers) against those who were exempt (certain groups such as contractors, self-employed individuals etc.). This study estimated that 91 cents of each dollar of forced savings was carried over to an increase in total assets. Connolly (2007) attributes the missing 9 cents to offsetting. However, their study also finds that voluntary superannuation contributions increased among those eligible for the compulsory contribution. In another study, Morling and Subbaraman (1995) find that superannuation has a negative effect on other assets of about 70 percent, though the authors themselves recognise the poor quality of their data.

The empirical results on offsetting so far have given mixed results. Arguably studies also suffer from identification issues (Engen et al., 1996) for failing to account for the possibility that employees who have a stronger preference for saving self-selected into employers with contribution schemes. But self-selection could only be an explanation for studies such as Green (1981) if employees perfectly matched themselves to firms based on savings preferences (Thaler, 1990). Notwithstanding the identification issues, lack of substitutability, illiquidity and procrastination alone cannot explain results where individuals increase voluntary contributions as a result of employer contributions in Connolly (2007) or the power of the default in effecting preferences in Madrian and Shea (2001). This leads us to behavioural notions of saving that question whether individuals actually form a priori savings targets by way of a formal optimisation process. Individuals may be overloaded with information and face fundamental uncertainty leading them to save according to ad hoc heuristics, without forming any firm preferences of how much they ought to be saving (Benartzi and Thaler, 2002 and Redelmeier and Shafir, 1995). Individuals may also *prefer* the status-quo portfolio or savings position as they prefer to avoid losses (in this case, a loss of the default position, see Kahneman, 1992). Similarly, people's estimates or beliefs of how much they ought to be saving could be influenced by irrelevant cues such as the default itself – this is referred to as anchoring or suggestion bias (Beggs and Graddy, 2013). Our results are most consistent with this literature.

3 Theoretical predictions of voluntary contribution behaviour with saving preferences

This section develops predictions of what we should observe in the data if individuals were offsetting higher compulsory savings to reach a savings preference *s*. We study two simple scenarios; one where individuals immediately make decisions to reach their savings preferences and one where some procrastinate from acting.

Before proceeding to a formal analysis, let's consider a simple example to illustrate the key question. Suppose there are two identical individuals earning \$100 but on two different compulsory contribution rates: 5 percent (person A) and 10 percent (person B). Both person A and person B also make voluntary contributions. If they both had an identical savings preference *s* then person B would contribute \$5 less than person A.

Now consider a large number of A- and B-type persons. This time all individuals do not have the same preference *s*. Instead each person's *s* is a random variable. People will make voluntary contributions if their preference *s* is above the compulsory rate. If both group A and B draw *s* from the same distribution, then group B will have less people making contributions and will also make less total voluntary contributions on average (average over contributors and non-contributors). Furthermore, the decrease in the average voluntary contribution rate will be less than the difference between the B and A group

compulsory rates because there will always be some people with a saving preference less than the lower compulsory rate who cannot decrease their voluntary contributions.

3.1 Rational behaviour

We begin with a basic model of voluntary contribution behaviour where individuals have an independent superannuation savings preference *s* with support [0, 1]. This model is rational in the sense that individuals make voluntary contributions to achieve this *s*. The savings share itself may be a function of current and/or future income and also incorporate hyperbolic discounting. If an individual with saving preference *s* is placed on a compulsory contribution d < s, they would make up the difference through voluntary contributions v = s - d. If s < d then they cannot adjust below *d*, and *v* will be zero.

This next assumption allows us to make the distribution of *s* mathematically tractable.

Assumption 1. *The distribution of the superannuation saving share s has a density representation f and*

$$\int_{d}^{1} f(s) \, \mathrm{d}s < 1 \qquad \forall \, d \in (0,1) \tag{1}$$

where $s \mapsto f(s) : [0,1] \to \mathbb{R}_+$

The second part of this assumption just states that there is always a probability that we will find someone with an s lower than d.

For the next result, observe that the probability of making a voluntary contribution is

$$\mathbb{P}(v > 0) = \mathbb{P}(s > d) = \int_{d}^{1} f(s) \, \mathrm{d}s$$

and the expected voluntary contribution is

$$\mathbb{E}(v) = \mathbb{E}(v|v>0) \mathbb{P}(s>d)$$

$$= \int_{d}^{1} (s-d) f(s) ds$$
(2)

Proposition 1. Let assumption 1 hold, then for all $d \in (0,1)$

$$\frac{\partial \mathbb{P}\left(v>0\right)}{\partial d}<0$$

and

$$-1 < \frac{\partial \mathbb{E}\left(v\right)}{\partial d} < 0$$

Proof. The first part of the proof is straight-forward since the value of the integral in (1) decreases as d increases. For the second part, take the derivative of (2) with respect to d

$$\frac{\partial \mathbb{E}(v)}{\partial d} = \int_{d}^{1} -f(s) \, \mathrm{d}s > -1$$

This result tells us that the probability of making a voluntary contribution and the expected value of the voluntary contribution decrease as the compulsory rate increases. Given an individual who has a savings share s > d, if d were to increase to d' < s, we should expect them to offset every dollar of the increase in the compulsory rate with a decrease in voluntary savings. However, since s < d for some individuals in the data, we would not expect to see a one for one offset in $\mathbb{E}(v)$.

3.2 Modeling procrastination

Our simple illustration of procrastination is motivated by Carroll et al. (2009). Individuals have a savings preference *s* and experience a loss from being on a compulsory rate $d \neq s$. We assume this loss is given by $\phi |s - d|$ where ϕ is a constant.⁵ Each year, members draw an action cost *c* which is uniformly distributed over the interval $[0, \bar{c}] \subset \mathbb{R}_+$. This is the

⁵Carroll et al. (2009) derive the decision rule $\phi(s-d) > c$ from a dynamic problem where people consider future losses from not taking action today. In their model, contributions are permanent decisions to move to a new contribution rate.

See also the proof of Proposition 4 in the online appendix for (Carroll et al., 2009) paper. Footnote 31 in the same appendix gives a characterisation of the cut-off if we assume c is uniformly distributed. The online appendix is available at http://web.stanford.edu/~gdc/odad-onlineapp.pdf.

cost for someone to take action and make a voluntary contribution to reach *s* for that year. If $\phi(s-d) \leq c$, the individual procrastinates and does not make a voluntary contribution. If $\phi(s-d) > c$, the individual incurs the cost *c*, makes a voluntary contribution and moves to *s*. People face the same problem again next year. We assume $\bar{c}\phi^{-1} + d < 1$, so it is possible to have a savings preference so high that a contribution is made regardless of the action cost.

Proposition 2. Let assumption 1 hold. Then for all $d \in (0, 1)$

$$\frac{\partial \mathbb{P}\left(v>0\right)}{\partial d}<0$$

and

$$\frac{\partial \mathbb{E}\left(v\right)}{\partial d} < 0$$

Proof. See appendix.

The result says that even in the case with procrastination, the expected value of voluntary contributions and the probability of someone making a voluntary contribution should decrease with a higher compulsory rate.

Our UniSuper data is made up of people who make one-off contributions or may opt-in to make contributions that automatically recur; there are some people who do not face the procrastination hurdle each period. We do not attempt a formal decision model of this process. However we should still expect a smaller proportion of people making voluntary contributions under the higher compulsory rate. This is because there would be less people passing the procrastination hurdle when they first decided to make a contribution under the higher default. Recurring contributions could affect our results if the higher compulsory rate increased the chance that someone makes a recurring contribution. We discuss this issue further when we interpret our results.

4 The UniSuper data

UniSuper

UniSuper is the workplace superannuation fund of the Australian university sector. It was formed in 1983, and at the end of financial year 2013 it had around 456,000 members and over \$36.3 billion in assets (APRA, 2013). It is also possibly the only major non-government superannuation fund with a defined benefit-style scheme currently open to new members. UniSuper is not a 'public-offer' fund. It is only possible to join UniSuper while working with an employer in the university or research sector, although the period of work necessary to qualify can include brief casual engagements, and members, once in the fund, are under no obligation to leave and may instruct other employers to send contributions to the fund long after they have ceased employment in the university and research sector.

UniSuper provides a useful case study to examine how compulsory rates relate to voluntary savings as it has two groups of members, each on very different levels of compulsory workplace contributions. Academic, management and general staff of universities and research institutes on contract lengths of 12 months or more generally qualify for employer contributions of 17 per cent of salary. New qualifying members on such contracts join a defined benefit (DB) scheme by default, but may opt to transfer to an accumulation fund – "acc2".

Fund members with other employers (that is, former employees of the university or research sector), or with these same employers but on contracts of shorter than 12 months, receive the statutory minimum of 9 per cent (8 per cent prior to 2002) employer contributions and cannot join the DB scheme, being placed instead in another accumulation product – "acc1". Up to 30 June 2006, Acc2 and DB members (on 17 per cent employer contributions) were also required to contribute 8.25 per cent of salary, resulting in total compulsory workplace contributions of 25.25 per cent of salary. This employee contribution was made non-compulsory as of 1 July 2006, becoming instead a default option that members are allowed to partially or completely opt-out of.

To keep the focus on the effect of the compulsory rate, our analysis is focused on the years

2002/03 to 2005/06. We exclude the years 2001/2002 as this allows us to include a dummy to control for whether a member saved in the previous year.

The present study is restricted to the two types of accumulation fund members. A defined benefit pension is framed in a very different way to members, with a focus on income replacement based on a formula (which includes averaged income and years of service) rather than a focus on accumulated assets. Risks are pooled across all members (and some members may believe that these risks are fully borne by the employer). How the voluntary savings behaviours of DB and accumulation members differ is an interesting question but a separate one that is beyond the scope of this paper.

Descriptive statistics

Table 1 gives the basic summary statistics for all members (refer to the appendix for details of data manipulations we make to variables such as remuneration). There are important demographic differences between acc1 and acc2 members. Members in acc2 tend to have higher incomes and are more likely to be males. These differences may be due in part to the greater tendency for acc1 members to be casual or contract staff. Higher skilled workers who intend to participate longer in the labor force may attract higher wages and have a greater representation in acc2 schemes.

product			Me	ean			
-	% male	age	remun.	remun. (adjusted)	voln. savings rate	% savers	n
acc1 (15%)	46.41%	39	\$60,447	\$44,495	1.30%	11.38%	37,485
acc2 (28%)	58.41%	44	\$75,855	\$54,556	1.77%	17.46%	69,419
DBD (56%)	52.99%	45	\$75,548	\$54,235	1.86%	15.49%	136,104
Total (100%)	53.52%	44	\$73,306	\$52,824	1.75%	15.42%	243,008

Source: raw.dta

Table 1: Summary statistics for all members 2001/02 -2005/06. The voluntary contribution rate is averaged across volutnary contributors and non-contributors. Adjusted remuneration is after-tax remuneration adjusted for inflation

However, labour market permanency and skill level cannot completely account for the differences between acc1 and acc2 members. Tables 4 and 5 in the appendix show the same summary statistics for members with a PhD and members in the data (hence employed) for at least five years. The differences between acc1 and acc2 members are still apparent within these groups. This suggest an important driver of the higher incomes and contribution rates among acc2 members could be age. One explanation is that permanent staff at universities tend to be older, even amongst those with a PhD. The acc1 PhD group could comprise of younger staff who start off on recurring contracts or those who started with UniSuper as PhD students, but then left the university sector at the early stages of their careers.

The relationship between age and average contributions is explored further in figure 1. Voluntary contributions of contributors increases at a constant rate each year, starting below 1 percent of income at the age of 25 and reaching about 20 percent by the age of 60. We also see that the increase in the proportion of individuals making a voluntary contribution is slow between the ages of 30 and 40, but then rises dramatically after 40 to about the late 50s, and then tapers off again. By the age of 65, approximately a third of individuals are making a voluntary contribution.



Figure 1: Average voluntary contribution share amongst contributors and proportion of members making contributions

Figure 2 shows a histogram of the total contribution share (compulsory plus voluntary) for a younger and older group. As expected, the distribution is dominated by the compulsory savings rate. Interestingly, even when comparing members of a similar age group, acc2 members look like they are more likely to make voluntary contribution and also make higher voluntary contributions. This is inconsistent with what we should expect if people had an overall contribution preference or target. If acc2 and acc1 members' of the same age-group had even somewhat similar preferences then we should have seen a lower number of people to the right of the compulsory rate in the acc2 histogram, or a higher number of people to the right of the compulsory rate on the acc1 histogram.



Figure 2: Distribution of total contribution share 2002-2005

5 Econometric analysis

In this section we test the predictions of proposition 2 to see whether members in our data are making contributions to reach a savings preference s. To account for the large number of people who do not make voluntary contributions, we use a two-part model (Greene, 2008; Mullahy, 1998; Cragg, 1971) where the decision to make a voluntary contribution and the decision about how much to contribute are separate. The expected observed voluntary contribution share of total remuneration, v, conditioned on the covariates X is

$$\mathbb{E}(v|X) = \mathbb{P}(v > 0|X) \mathbb{E}(v|v > 0, X)$$

The marginal effects of the covariates on $\mathbb{P}(v > 0|X)$ and $\mathbb{E}(v|v > 0,X)$ can be easily

related to the marginal effects on $\mathbb{E}(v|X)$ using ordinary calculus.

We use a logit regression for the binary part of the two-part model, and a generalised linear model (GLM) to estimate $\mathbb{E}(v|v>0,X)$. We estimate a pooled regression with clustered standard errors to account for possible correlation of individual errors through time. We assume that savings decisions are not independent across the years for each person, that is, each person's decision to save is correlated with their decisions in other years. Further restrictions on the correlation structure are not made and the correlation structure is allowed to vary from individual to individual. Further detailed discussion of the econometric model is provided in the appendix.

Sample selection

By assuming a clustered effects model, we assume that belonging to the high compulsory rate is independent of individual characteristics not observed in the data. To control for these possible unobserved individual characteristics, we restrict the sample in many ways to run the model over 'similar members'.

To control for education and profession, our sample is restricted to individuals with a PhD (inferred from salutation). It is possible to include PhD status as dummy variable in our analysis. However, we suspect that many employees with a PhD continue to indicate 'Mr' or 'Mrs' as their salutation. This could be a result of obtaining a PhD after an individual becomes a UniSuper member. Thus our sample restriction is made under the assumption that underestimating PhD status is independent of the voluntary contribution process.

Because we suspect there may be a higher number of temporary employees with acc1 accounts, we also restrict analysis to individuals who are full-time employed in the data for at least four years. We do not exclude new members who joined in the later years of our analysis since our data extends to 2009/2010, though we only conduct the analysis for the financial years 2002/2003 - 2005/2006.

The data included a small number of records for individuals below the age of 20 and above 65, and these were excluded. The data also included a small proportion of records with total savings at very high levels. Records with total post-tax contributions of over 50 per cent of remuneration were excluded. These records are likely to be the result of

contributions from other income sources or from transfers of assets into the fund. Records with irregular contributions were also excluded, as were records where the estimate of remuneration based on workplace contributions was significantly (>20 per cent) different from the UniSuper salary record.

Results

The results for the two-part regression are shown in table 2. Our primary variable of interest is the higher compulsory savings share which is included as a dummy variable. The *govtcocont* dummy is for those eligible for a government co-contribution⁶ on their voluntary savings. *New* is a dummy for a member who appears in the data for the first time. *Pre-saver* is a dummy for those individuals who were savers in the previous period. The first two columns of table 2 give the logit and glm estimates of the two-part model. The marginal effects for the logit, glm and average effects are presented in the following three columns. The logit marginal effects represent the effect of a one unit (the units are noted under the variable name) change in independent variable on the probability of being a volunteer contributor $-\frac{\partial \mathbb{P}(v>0)}{\partial X_j}$. The glm marginal effects represent the effect of a unit change in the independent variable on the expected voluntary contribution share (between 0 and 1) given that someone is making a contribution $-\frac{\partial \mathbb{E}(v|v>0)}{\partial X_j}$. Finally, the average effects represent the effect on the expected voluntary contribution share across contributors and non-contributors $-\frac{\partial \mathbb{E}(v)}{\partial X_j}$. The marginal effects are presented at the means of the data.

The effect of the higher compulsory rate on the probability of being a saver is positive but not significantly different from zero. The effect of the higher compulsory rate on voluntary contributions conditional on being a contributor is negative and significant. Our estimate suggests that those on the higher compulsory rate who are made a voluntary contribution contributed a 2.7 percentage point lower share of their income. This is a .16 percentage point decrease in $\mathbb{E}(v|v>0)$ per percentage point increase in the compulsory rate. To give some context, the average voluntary contribution rate of those who contribute across both

⁶Individuals with a taxable income below \$58,000 (\$40,000 in 2003) were eligible for a co-contribution from the Australian government from 2003.

		D		D	
	(1)	(2)	(3)	(4)	(5)
	estimates(logit)	estimates(glm)	mfx(logit)	mfx(glm)	mfx(average)
main					
age	0.0632*** (0.000)	0.00338*** (0.000)	0.00517*** (0.000)	0.00432*** (0.000)	0.000639*** (0.000)
gender (d)	-0.228**	0.00926*	-0.0186**	0.00623	-0.000849
(F=0)	(0.003)	(0.043)	(0.005)	(0.337)	(0.179)
Adj. remun	0.0474^{*}	0.00227	0.00409^{**}	0.00220	0.000387*
(10,000)	(0.011)	(0.326)	(0.007)	(0.304)	(0.023)
high rate (d)	0.132	-0.0154+	0.00912	-0.0268*	-0.000850
	(0.210)	(///0.0)	(502.0)	(0.016)	(0.324)
yrs in data	-0.0417	-0.00472*	-0.00359+	-0.00452+	-0.000524*
	(0.110)	(0.046)	(060.0)	(0.055)	(0.014)
govtcocont (d)	0.333*	-0.0106	0.0294+	-0.0254+	0.000259
	(0.036)	(0.172)	(0.070)	(0.061)	(0.858)
presaver (d)	5.271***	0.0139^{**}	0.857^{***}	0.0244^{***}	0.0766^{***}
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
new (d)	1.337^{***}	0.0194^{*}	0.164^{***}	0.0412**	0.0181^{***}
	(0.000)	(0.020)	(0.000)	(0.001)	(0.000)
year dummies	Yes	Yes	Yes	Yes	Yes
Observations	16281	2799	16281	2739	2799
Marginal effects; p	-values in parentheses				
(d) for discrete cha	nge of dummy variabl	e from 0 to 1			
+ $p < 0.10, * p < 0.10$	0.05, ** p < .01, ***	p < .001			

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acc1 and acc2 members was approximately 12 percent.

However, the estimated effect of the higher compulsory rate on overall expected voluntary contributions is not statistically significant from zero. An increase in the higher contribution rate appears to be have been translated entirely to an increase in the overall contribution pool.

Our analysis confirms initial observations that age is an important determinant both of making a voluntary contribution and the level of contributions made. The marginal effects show that each year is associated with a .5 percentage point increase in the probability of being a contributor. This is an important effect considering that only 17 percent of members made a voluntary contribution. Each year is also associated with a .06 percentage point increase in $\mathbb{E}(v)$ and a .4 percentage point increase in $\mathbb{E}(v|v > 0)$.

The marginal effect of income on average voluntary contributions is also positive. The increase in probability of saving is .4 percentage points per 10,000 dollars of increased income. The estimate for the effect of income on the conditional contribution is surprisingly small, and not significantly different from zero. It seems that while those on a higher income were more likely to make a contribution, the share of income they save remained similar to those on a lower income.

Whether someone contributed in a previous year is a very important predictor of the contribution decision. This is to be expected in large part due to members who opted for recurring contributions. The dummy for a new member also increased the probability of someone making a contribution by 16 percentage points. This is also to be expected, signing a new employment contract and associated paper-work may have reduced the perceived action costs of making a decision to contribute. Finally, the dummy for co-contribution eligibility is positive and significant, associated with a 3 percentage point increase in the probability that someone is a saver. However, the conditional contributions of those eligible for a government co-contribution is 2.6 percentage points lower.

6 Interpretation of results

If we assume that after controlling for the covariates in our model, acc1 or acc2 membership is unrelated to how people make voluntary contribution decisions, then our results are not consistent with people having a preference about their total superannuation contributions.

There are two broad possibilities to consider. The first is that people still have an *s* but it is influenced by the compulsory rate. The discussion of results in Madrian and Shea (2001) focuses on this effect. The compulsory rate could act as an anchor (Tversky and Kahneman, 1982) that primes individual evaluations of how much they should save. Individuals still make saving decisions based on personal characteristics and the economic environment, but as adjustments from the compulsory rate. A related mechanism is that the compulsory rate plays an informative role in people's decision making because the decision making implied by formal optimisation models is just too complex (Samuelson, 1988), or perhaps because of fundamental uncertainty about the future (Dequech, 2001).

Our results add another possibility to those suggested by Madrian and Shea (2001): that target total contributions *s* play no role in decision making. People's voluntary contributions appear to reflect age, income and other personal circumstances, but do not appear to reflect well-defined preferences about overall contributions, perhaps because it is difficult or impossible to make optimising decisions (Benartzi and Thaler, 2002). Our finding that there is a small but significant reduction in the voluntary contributions of those who contribute is also consistent with voluntary contribute slightly less, but without any consideration of how much their overall savings should have been; otherwise there would be less people making voluntary contributions on the higher rate.

Our study is not able to strictly distinguish between whether *s* is anchored through some mechanism to the compulsory rate or whether it does not exist at all; and this is an interesting area of further theoretical and empirical work. We suspect a combination of anchoring bias and ad hoc decision making about voluntary contributions are at play.

What do our results say about preferences for total saving across an individual's portfolio, not just superannuation? People could still have an overall independent savings level *s*,

so they offset higher compulsory contributions with borrowings or reduced savings elsewhere such as housing equity. However, we would still expect individuals in our study to reduce voluntary contributions, instead of offsetting elsewhere, as voluntary and compulsory superannuation contributions are such close substitutes. It remains possible that there is an overall *s* for savings across all household assets, but no preference about how savings allocated. In this case, a higher compulsory rate still plays an important role in influencing overall saving levels since the bulk of most people's liquid savings at retirement consists of superannuation accounts (Gallagher, 1996).

Our analysis assumes that acc1 and acc2 membership is unrelated to the voluntary contribution decision after controlling for the covariates in our model. One qualification could be that PhDs with higher contribution targets selected themselves into permanent jobs in the University sector (Engen et al., 1996). But for self-selection to adequately explain our findings, the selection of jobs must match perfectly with the compulsory contribution rates (Green, 1981).

We also assumed acc2 members are no more likely than acc1 members to make recurring contributions. A higher chance of making recurring contributions means more people are making voluntary contributions without having to pass the procrastination hurdle in each period. This could offset the negative effect of compulsory contributions on $\mathbb{P}(v > 0)$ if people had well-defined savings preferences. We manage this issue by controlling for consistent fund membership and contribution record, as a proxy for job market permanency.

7 Conclusion

In this study we asked whether people have an independent superannuation savings preference representing target total contributions as a share of income. We analysed how members of a large Australian superannuation fund, UniSuper, made voluntary contributions on top of their compulsory contributions. Did they make voluntary contributions to reach a target rate?

Our econometric analysis compared the voluntary contributions of two groups with different compulsory contribution rates. We found that those on a higher compulsory rate were equally likely to make voluntary contributions. We did find a small but significant reduction in voluntary contributions among those who contribute, but this did not carry over to a significant drop in average contributions (among contributors and non-contributors). Both these results are inconsistent with people targeting their overall contributions to a savings preference independent of their compulsory rate.

A recent conversation with a colleague illustrates our findings well. Asked about their expected behavioural response when compulsory contributions increase in future, they said: "Well, I'll probably continue making the same voluntary contributions. Because under the higher compulsory savings, I'll have more savings and I want that." When we responded: "But you could have made those higher savings even on a lower compulsory rate if you wanted to," they said "Yes true, I get what you are saying, but I do not think like that." Although an engaged and committed saver, this person – consistent with most of the UniSuper members in our study – is either not set on a particular total amount of savings, or their evaluation of how much they ought to be saving in total increased when they imagined a higher compulsory rate.

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Appendix A – mathematical results

Proof of proposition 2

Proof. Recall that someone makes a voluntary contribution if

$$\phi\left(s-d\right) > c$$

where s is distributed according to Assumption 1 and c is uniformly distributed on $[0, \bar{c}]$. Assume also that the *c* and *s* are independent.

The probability of making a voluntary contribution is the probability that the savings share is above the cutoff for which a voluntary contribution is made and the probability that $\phi(s-d) > \bar{c}$

$$\mathbb{P}(v > 0) = \mathbb{P}\left(\phi^{-1}c + d < s < \phi^{-1}\bar{c} + d\right) + \mathbb{P}\left(s > \phi^{-1}\bar{c} + d\right)$$
$$= \int_0^{\bar{c}} \left(\int_{\phi^{-1}c + d}^{\phi^{-1}\bar{c} + d} f(s) \,\mathrm{d}s\right) \frac{1}{\bar{c}} \,\mathrm{d}c + \int_{\phi^{-1}\bar{c} + d}^1 f(s) \,\mathrm{d}s$$

Take the derivative with respect to d

$$\frac{\partial \mathbb{P}(v>0)}{\partial d} = -\int_0^{\bar{c}} \frac{f\left(\phi^{-1}c + d\right)}{\bar{c}} \, \mathrm{d}c < 0$$

Next, let the expected value of the observed voluntary contribution be given by (2)

$$\mathbb{E}(v) = \int_0^{\bar{c}} \left(\int_{d+\phi^{-1}\bar{c}}^{d+\phi^{-1}\bar{c}} (s-d)f(s) \, \mathrm{d}s \right) \frac{1}{\bar{c}} \, \mathrm{d}c + \int_{d+\phi^{-1}\bar{c}}^1 (s-d)f(s) \, \mathrm{d}s$$

and take the derivative using Leibniz rule

$$\begin{aligned} \frac{\partial \mathbb{E}(v)}{\partial d} &= -\phi^{-1} \bar{c} f\left(d + \phi^{-1} \bar{c}\right) - \int_{d+\phi^{-1} \bar{c}}^{1} f\left(s\right) \, \mathrm{d}s \\ &+ \int_{0}^{\bar{c}} \left(\bar{c} \phi^{-1} f\left(d + \phi^{-1} \bar{c}\right) - c \phi^{-1} f\left(d + c \phi^{-1}\right) + \int_{d+c\phi^{-1}}^{d+\bar{c}\phi^{-1}} - f\left(s\right) \, \mathrm{d}s \right) \frac{1}{\bar{c}} \, \mathrm{d}c \\ &= -\int_{d+\phi^{-1} \bar{c}}^{1} f\left(s\right) \, \mathrm{d}s - \int_{0}^{\bar{c}} c \phi^{-1} f\left(d + c \phi^{-1}\right) \frac{1}{\bar{c}} \, \mathrm{d}c - \int_{0}^{\bar{c}} \int_{d+c\phi^{-1}}^{d+\bar{c}\phi^{-1}} f\left(s\right) \frac{1}{\bar{c}} \, \mathrm{d}s \, \mathrm{d}c \\ &< 0 \end{aligned}$$

Appendix B – further discussion of data and econometric analysis

Data manipulations

Our econometric model uses voluntary contributions as a share of after-tax total remuneration as its dependent variable. Total remuneration is calculated as salary plus compulsory contributions. We estimate salary by dividing compulsory contributions by the compulsory rate. Tax is calculated on salary using annual tax tables for each financial year. Pre-tax contributions are not taxed as per the tax-tables; rather the Australian government taxes superannuation contributions at 15 percent. Thus 15 percent tax is applied to the compulsory superannuation guarantee and standard member contribution component of remuneration, and to salary sacrifice voluntary contributions. The voluntary contribution share is calculated by dividing voluntary contributions (minus tax) by after-tax total remuneration.

Applying a reduced tax rate to the portion of remuneration that goes towards pre-tax voluntary contributions presents an endogeneity problem. Making a pre-tax contribution inflates after-tax income if the marginal tax rate is over 15 percent. This creates a correlation between contributions and after-tax income unrelated to the behavioural effect of income on contributions. We remove this effect in the data by applying the tax tables to any pre-tax voluntary contribution portion of remuneration when calculating after-tax remuneration. However, the 15 percent tax is applied to the contribution itself when calculating the voluntary contribution share. Our implied assumption is that an increase in after-tax remuneration (including superannuation) as a result of making a pre-tax contribution does not in turn effect the behaviour of making the contribution.

Another issue arising from the progressive tax-structure is that compulsory contributions as a share of after-tax income increases with income. If the compulsory savings share as a share of after-tax income was used as the main independent variable of interest, the estimate could be imprecise as it picks up some income effects. We thus include a dummy for being an acc2 member as our primary variable of interest. Repeating the estimation with the compulsory savings share as the independent variable does not change our qualitative results. Finally, after-tax remuneration (our independent variable) is adjusted to December 2001 dollars using the Australian Bureau of Statistics consumer price index (CPI).

Econometric analysis

The motivation for the logit is more as a generalised linear model (GLM) rather than a latent variable one. Let $y_i \in \{0,1\}$ denote whether or not the i^{th} individual makes a voluntary contribution. We make distributional assumptions on this random variable as opposed to assumptions on the distribution of latent overall savings share. Specifically, y_i has a binomial distribution, with parameter p linked to the covariates through a logistic function.

Determining the appropriate distributional assumptions for the observed voluntary contribution share is less immediate. The most important feature of the data is the relationship between the independent variable we expect to be most important - age-and observed voluntary contributions. This is shown by figure 3 which suggests a model that estimates $log(v|v > 0) = \beta X$ may be appropriate. To perform ordinary least squares (OLS), we could proceed manually, taking logs of the dependent variable. However, the coefficients are interpreted as the effect of X on $\mathbb{E}(log(v|v > 0))$. To recover the marginal effects of the covariates on $\mathbb{E}(v|v > 0, X)$ and eventually $\mathbb{E}(v|X)$, a re-transformation that may also need to correct for heteroscedasicity will be required.

Rather than manually transforming the independent variable and then re-transforming the estimators, we can also estimate $\mathbb{E}(v|X, v > 0)$ directly. Assume that the *i*th observation is Gaussian with mean $exp(\beta X_i)$. The parameters β can be recovered as quasi-maximum likelihood estimators for a generalized linear model (GLM) with a log link function (Manning and Mullahy (2001)). GLM also allows for the possibility of explicitly modeling non-constant variance of the dependent variable. The Gaussian distribution has a constant variable parameter σ , but based on figure 3 there may be a case to explicitly model the increase in variance as the expected value of v|v > 0 increases - using a gamma distribution. The quasi-maximum likelihood (QML) estimators do not require the assumed distribution of v|v > 0 to be the true data generating process. The QML estimators are still consistent even if the assumed distribution of v|v > 0 is incorrect. However, a less correct distribution

may result in a loss of precision which could influence the inferences we make. Manning and Mullahy (2001) present a number of tests to choose the optimal distribution. However we do not pursue this model selection exercise in the present paper as the choice of distribution does not change the qualitative interpretation of our results. See Appendix C for regression output for a Gaussian GLM model.

There are a number of less appropriate alternatives to the two-part model. OLS estimates are inconsistent when there are large number of zeros in the data. One could proceed to use a Tobit model. However, this fails to account for the 'separateness' of the two decision making processes. A Tobit assumes that the effects of X on the probability of making a voluntary contribution is the same sign as on the expected value of the voluntary contribution. This may not be the case in general. It is also hard to motivate the Tobit model as there is no interpretation for a latent voluntary contribution below zero, unless one assumes the contribution decision is made according to the 'rational' model in section 3. An alternative model is a fractional logit model suggested by Papke and Wooldridge (1996). The fractional logit explicitly considers the dependent variable with distribution between 0 and 1 and does not assume some sort of underlying latent voluntary contribution share. However, once again, the process driving the zeros is the same as the process driving the strictly positive values.

A criticism of the two-part model is that it assumes the two process being are *independent*. This is unlikely in our case. Unobserved effects making someone more likely to make a contribution may also lead them to make a higher contribution. The independence assumption is only required however if the modeler is interested in the effects of the covariates on an underlying latent variable. To illustrate this point, denote $f(v|y = 1, \beta X)$ as the conditional distribution of the voluntary contribution share. The likelihood function of the two-part model is

$$\Pi_{i=1}^{n} \left(1 - \frac{1}{1 + e^{-\gamma X_{i}}}\right)^{1 - y_{i}} \left(\frac{1}{1 + e^{-\gamma X_{i}}}\right)^{y_{i}} f(v_{i} | y_{i} = 1, \gamma \beta X_{i})$$

We estimate parameters for the distribution of *s* conditioned on the event that it is observed. If the process of making the contribution were independent of the distribution of the vol-

untary contribution, then $f(v_i|y_i = 1, \beta X_i) = f(v_i|\beta X_i)$ and we could use our estimation to infer the unconditional distribution of v. This is the Heckman selection model, where the modeler is interested in the distribution of wages, even if they were not observed through employment. In our case, we are not interested in the latent voluntary savings function. We want to evaluate the effect of the covariates on precisely the average *observed* conditional contributions. We can then allow the process driving the voluntary contribution amount and the decision to contribute to be distinct but related.

Specification test for link function

Our justification for the log-link function has so far been informal. To formally test our selection of the log link function, we run a regression (using STATA linktest) of the independent variable on the predicted values and the square of the predicted values. If the link function between $\mathbb{E}(v)$ and the covariates is correctly specified, then we should not see the square of the predicted values as being significant predictors. In table 3, the identity link ($\mathbb{E}(v) = \beta X$) is rejected since the coefficient for the square of predicted values is significant, while the log specification is supported by the link test.

	(1) identity link	(2) log link
predicted	0.45^+ (0.091)	0.56 (0.38)
sq. predicted	3.83* (0.023)	-0.091 (0.5)
<i>p</i> -values in parenth $+ p < 0.10, * p < 0$	eses 0.05, ** p < .01, *** p < .	001

 Table 3: Specification test for link function

Appendix C – further descriptive statistics and regression results

product			Mea	an		
-	% female	age	remuneration	remun(adjusted)	voln. savings rate	% savers
acc1 (9%)	47.77%	40	\$58,957	\$43,581	1.09%	12.19%
acc2 (30%)	59.70%	45	\$76,763	\$55,034	1.61%	17.33%
DBD (59%)	54.09%	46	\$76,633	\$54,846	1.74%	15.47%
Total (100%)	55.19%	45	\$74,932	\$53,794	1.63%	15.72%

Source: raw.dta

Table 4	1:	Summary	statistics f	for meml	bers in	data	for	atleast 5	years

product			Mea	an		
	% female	age	remuneration	remun(adjusted)	voln. savings rate	% savers
acc1 (10%)	59.67%	42	\$70,549	\$50,905	2.10%	11.57%
acc2 (31%)	73.17%	46	\$96,083	\$66,947	2.25%	18.39%
DBD (57%)	68.52%	48	\$98,253	\$68,162	2.32%	17.84%
Total (100%)	69.01%	47	\$94,568	\$65,909	2.28%	17.33%

Source: raw.dta

Table 5: Summary statistics for members with a PhD



Figure 3: Scatter plots of of conditional voluntary share and log of conditional voluntary contribution share



Figure 4: Histogram of conditional voluntary share and log of conditional voluntary contribution share

	(1)	6	(2)	(V)	(2)
	estimates(logit)	estimates(glm)	(C) mfx(logit)	(4) mfx(glm)	(C) mfx(average)
main age	0.0632*** (0.000)	0.00458^{***} (0.000)	0.00517*** (0.000)	0.00466*** (0.000)	0.000631*** (0.000)
gender (d)	-0.228**(0.003)	0.00980 (0.151)	-0.0186** (0.005)	0.0104 (0.138)	-0.000487 (0.441)
effectiveincometti	0.0474* (0.011)	0.00192 (0.530)	0.00409** (0.007)	0.00141 (0.613)	0.000303+ (0.091)
highcomp (d)	0.132 (0.210)	-0.0298** (0.008)	0.00912 (0.253)	-0.0303* (0.029)	-0.000841 (0.386)
yrsindata	-0.0417 (0.110)	-0.00677* (0.014)	-0.00359+ (0.090)	-0.00596* (0.013)	-0.000587** (0.004)
govtcocont (d)	0.333* (0.036)	-0.0104 (0.520)	0.0294+ (0.070)	-0.0219 (0.249)	0.00124 (0.531)
saveym1 (d)	5.271*** (0.000)	0.0278*** (0.000)	0.857*** (0.000)	0.0309*** (0.000)	0.0776*** (0.000)
new (d)	1.337^{***} (0.000)	0.0330** (0.002)	0.164^{***} (0.000)	0.0508** (0.004)	0.0184^{***} (0.000)
year dummies	Yes	Yes	Yes	Yes	Yes
Observations	16281	2799	16104	2739	16281
Marginal effects; p -val (d) for discrete change	lues in parentheses of dummy variable fr	om 0 to 1			
+ p < 0.10, * p < 0.05	$a_{x^{*}} p < .01, a^{*} p < .01$.001			

Table 6: Estimates and marginal effects for Gaussian GLM regression