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Working Paper Series

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Working Paper No. 27/20
December 2020

THE UNIVERSITY OF MELBOURNE
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Marc Chan
Department of Economics, The University of Melbourne
Tax and Transfer Policy Institute, Crawford School of Public Policy, Australian National University

Cain Polidano
Melbourne Institute: Applied Economic & Social Research, The University of Melbourne
Tax and Transfer Policy Institute, Crawford School of Public Policy, Australian National University
ARC Centre of Excellence for Children and Families Over the Life Course

Ha Vu
Department of Economics, Deakin University
Tax and Transfer Policy Institute, Crawford School of Public Policy, Australian National University

Roger Wilkins
Melbourne Institute: Applied Economic & Social Research, The University of Melbourne
Tax and Transfer Policy Institute, Crawford School of Public Policy, Australian National University
IZA Institute of Labor Economics

Andrew Carter
Australian Taxation Office

Hang To
Australian Taxation Office

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*This research is supported by an Australian Research Council Linkage Project grant (LP170101045). Analysis is based on annual curated tax and superannuation records, known as the Australian Taxation Office (ATO) Longitudinal Information Files (ALife), which is produced by the ATO. All findings, opinions and conclusions are those of the authors and do not represent the views of the Australian government or any of its agencies. Thanks to Lan Tong, Abraham Chigavazira, Daniel Fischer and Ben Leah for their research assistance and Claudio Labanca and Tim Moore for helpful comments.
Corresponding author: cainp@unimelb.edu.au, +61 03 8344 2102.

Melbourne Institute: Applied Economic & Social Research
The University of Melbourne
Victoria 3010 Australia
Telephone +61 3 8344 2100
***Fax* +61 3 8344 2111**
***Email* melb-inst@unimelb.edu.au**
***Website* melbourneinstitute.unimelb.edu.au**

Abstract

Concerns over the adequacy of retirement income of low and middle-income earners have led governments to introduce targeted matching schemes to incentivise contributions to private pensions. In this study, we estimate the impacts of a simple Australian scheme, using administrative tax-filer data and exploiting longitudinal changes in eligibility and matching rates. We find modest increases in the proportion of people making contributions, but reductions in average contributions due to dominant negative income effects. We also find stronger income effects among people with low permanent income, possibly reflecting liquidity constraints. Finally, we find asymmetry in the magnitude of responses to changes in the matching entitlement, with decreases eliciting stronger responses than increases. Taken together, our findings cast doubt on the effectiveness of targeted matching schemes to lift retirement savings.

JEL classification: I3, J14, H55.

Keywords: Private pension, matching schemes, retirement income, aging population.

1. Introduction

Faced with fiscal pressures from an aging population, many countries are resetting their retirement policy landscape to encourage greater reliance on private savings, especially via tax-favoured private pension schemes.[1] A concern with this shift is the adequacy of pension contributions of low and middle-income earners to support a comfortable retirement. The progressive nature of most tax systems means that low and middle-income earners are not incentivised to contribute to tax-favoured private pensions to the same extent as high-income earners. For this reason, governments including Australia, Austria, Chile, Czech Republic, Germany, Hungary, Mexico, New Zealand, Turkey and the United States have incorporated matching schemes for low and middle-income earners to incentivise contributions to private pensions (OECD 2018). Such schemes involve an annual government payment in return for private pension contributions up to a maximum amount, which are typically paid through tax credits (such as the U.S. Saver's Credit) or through co-contribution payments (such as the Kiwi Saver in New Zealand).

Theoretically, it is unclear whether matching schemes can lift savings of low and middle-income earners. On the one hand, by reducing the cost of contributing they encourage substitution from current to future consumption through increased private pension contributions (substitution effect). On the other hand, increases in retirement income from the matching payment can reduce the impetus to save (retirement income effect).[2] The relative strengths of these effects depend on contributions in the absence of the scheme. For those who would *not* have contributed, eligibility may encourage participation, while for those at the other extreme who would have contributed high amounts, the scheme may represent nothing more than a retirement-income windfall that may reduce contributions. These effects suggest different impacts across the distribution of contributions, with uncertain impacts on the average contribution (Madrian 2013). However, studies of matching schemes to date have focused only on estimating substitution or overall effects without estimating income effects or impacts across the distribution of contributions.

In this study, we provide first evidence on the *relative* strength of income and substitution responses across three different match rates by estimating the impacts of an Australian scheme

[1] For example, many countries have increased the eligibility age for access to public pensions and have introduced tax concessions on private pension contributions.

[2] We use "retirement income effect" for consistency of terminology but note that it is essentially the "wealth effect" in a life-cycle consumption saving model.

known as the Superannuation Co-contribution program. Under this scheme, the government offers to match voluntary personal contributions at a single rate up to a maximum eligible contribution that depends on current income. Below a lower income threshold, the maximum eligible contribution is $1000, between lower and upper thresholds, the maximum is linearly reduced (tapered), and beyond the upper income threshold individuals are ineligible. Since its inception in July 2003, the prevailing match rate has varied: 100% (2003-04 and 2009-10 to 2011-12); 150% (2004-05 to 2008-09); and 50% (2012-13 to the present). To illustrate, an individual whose income was below the lower threshold in 2005-06, would receive a government matching payment to their superannuation account of $1.50 for every dollar they contributed voluntarily up to $1,000, or a maximum co-contribution payment of $1,500. Over a working life (25-66), co-contribution payments are worth as much as $78,000, or a 16% boost in expected pension wealth of a low-income earner.[3] Since its introduction in 2003-04, the government expenditure on co-contribution payments have averaged approximately $760 million per year, or about a tenth of government expenditure on unemployment benefits.

We identify the impacts of this program using a difference-in-difference approach that exploits changes over time in individual matching entitlements. To improve the comparability of outcomes across individuals, we conduct estimation in first-differenced form. Our approach compares outcomes of those affected by consecutive-year changes in their matching entitlement from the two most salient features of the scheme — eligibility changes and match-rate changes — compared to controls who did not experience these changes at the same time either because they remained ineligible, or because they remained eligible but experienced no change in the match rate. Estimation is conducted using data from a 10% longitudinal sample of population administrative tax and superannuation records, known as the Australian Longitudinal Information Files (ALife).

Our study makes two major contributions to a small, but growing, literature on the effectiveness of targeted matching schemes for private pension contributions (e.g., Duflo *et al.* 2006, Duflo *et al.* 2007, Corneo *et al.* 2010, Ramnath 2013, Heim and Lurie 2014). Our first major contribution is in providing detailed analysis of retirement income effects associated with

[3] The projected contribution and balance are calculated for an individual aged 25 in 2003, whose income was at the income threshold for the maximum matching payment. The individual is assumed to contribute $1,000 and receive the minimum mandatory employer contribution each year until age 66. We assume a fund rate of return of 5%, administrative fees of 0.75% and $194 insurance cost per annum. At age 67, the value of the voluntary personal contributions and the total matched payment from the government is $179,806, a 37% of the balance that consists of only mandatory contributions.

matching schemes by examining impacts above the eligible maximum where only income effects apply. The focus of past studies on substitution (or total) effects may be due to data limitations and/or because authors implicitly assumed that income effects are small. *A priori,* income effects at the population level may be considered small for two reasons. First, standard life-cycle precautionary saving models tend to predict a modest effect of wealth on consumption among 'representative households', which implies that when retirement income is increased, people are not motivated to reduce contributions to increase consumption. Second, based on evidence that many people are 'passive' savers, in that they rarely adjust contributions (Chetty *et al.* 2014), it is fair to assume that few people will change their contributions in response to increased retirement income from matching schemes. While these may be true at the population level, when considering responses of low and middle-income earners, we hypothesise that income effects are likely to be much stronger because: (1) they are likely to prioritise current consumption that is limited by liquidity constraints (Deaton 1991); and (2) they may prefer building liquid (compared to illiquid) assets to insure against the adverse effects of negative income shocks (Carroll 1997). In this study, we also examine effects on income from interest and dividends that are proxies for changes in liquid assets, as well as effects on unmatched contributions to retirement savings that may be crowded out.

Our second major contribution is to help clarify conflicting evidence on the effectiveness of targeted pension matching schemes. On the one hand, evaluations of national programs have found small responses (Duflo *et al.* 2007, Corneo *et al.* 2010, Ramnath 2013 and Heim and Lurie 2014); and on the other, a field experiment with relatively simple design features found responses that were up to ten times as large (Duflo *et al.* 2006).[4] In reconciling these conflicting results, Duflo *et al.* (2007) concluded that design complexity is likely to be a key reason for the weak response to the Saver's Credit scheme (see Section 2 for an overview) and proposed a number of simplifying reforms including: (1) change the scheme from a non-refundable tax credit to a co-contribution payment to make the benefit more transparent; (2) replace the multiple match rates that vary with income with one salient match rate; and (3) allow gradual instead of discontinuous phase-out of eligible contributions by income. In this study, by estimating the impacts of the Superannuation Co-contribution scheme, which contains all these

[4] Duflo *et al.* (2006) scheme randomly allocated H&R Block clients to three groups; no matching payment (control), 20% match rate and 50% match rate. They estimate 8% and 15% response rates respectively relative to the control group.

proposed design features, we provide insight into the possible benefits of simplifying national matching schemes along the lines proposed by Duflo *et al.* (2007).

We also contribute to the literature by testing several important hypotheses that have not been examined before, but which are made possible in this study by the availability of high-quality administrative data and novel aspects of the scheme. Specifically, we test theoretical predictions about how sensitive substitution, income, and bunching effects are across a wide range of match rates by estimating impacts below, above, and at the maximum eligible contribution amount. We are also the first to test for symmetry in impacts associated with increases and decreases of the matching entitlement (loss/gain of eligibility and reduction/increase in match rate for those eligible). Insights from behavioural economics point to possible asymmetric responses if exposure to the scheme establishes habits of contributing (Cronqvist *et al.* 2018). Evidence of asymmetric responses of this type would raise the prospect of 'early targeting' to encourage greater savings over a life-course. Compared to previous studies, the use of administrative data also allows us to examine responses more thoroughly across population sub-groups, including by level of permanent income, gender and partner status, age, superannuation balances and use of a tax agent.

We find evidence of strong negative income effects associated with the matching scheme, which reduces both the proportion of people who are high contributors and the average contribution. With no evidence of increased precautionary savings, we conclude that low and middle-income earners use the windfall income from the scheme to increase consumption. We also find modest increases in the proportion of people who make contributions, which are consistent with those found in previous national studies. We find no evidence of stronger responses amongst those who file tax through an agent, which suggests that a lack of information may not be an issue. These results, together with results showing stronger income effects among those with lower permanent income, point to the possibility that liquidity constraints limit responses of low and middle-income earners. Other findings also question the effectiveness of targeted matching schemes. These findings include 'crowding-out' of *unmatched* contributions, which has been previously observed in the context of pension contributions (Corneo *et al.* 2010 and Engelhardt and Kumar 2011) and asymmetric responses to increases and decreases in the matching entitlement — reductions in the contribution rate due to losses in the matching entitlement more than unwind increases from entitlement gains.

In what follows, we present a review of current literature on matching schemes (Section 2), a summary of retirement income policy in Australia (Section 3), a theoretical model of contributions and the impacts of matching schemes (Section 4), description of the data (Section 5), our econometric models (Section 6), estimation results (Section 7) and concluding comments (Section 8).

2. Existing evidence on the efficacy of retirement matching schemes

The literature to date on schemes that match contributions to private retirement pensions is small with conflicting and unclear implications about their effectiveness. Evaluation studies of two national schemes, the U.S. Saver's Credit (Duflo *et al.* 2007, Ramnath 2013 and Heim and Lurie 2014) and the German Riester (Corneo *et al.* 2010) have found small responses, in the order of 1-3 percentage point increases in contribution rates for match rates of 11%, 25% and 100%. On the other hand, a field experiment in St. Louis by Duflo *et al.* (2006) found much larger responses — up to 11 percentage point increases for 50% match rate relative to a control group.

In reconciling results from the field experiment with results from those of the Saver's Credit, Duflo *et al.* (2007) pointed to design complexity of the Saver's Credit as a likely explanation for the small response. The Saver's Credit, introduced in 2001-02, is a non-refundable tax credit for the first $US2,000 of contributions, with match rates of 11%, 25% or 100% that vary with income (relative to certain thresholds). As a non-refundable tax credit, it is only available to those with a tax liability, which for low and middle-income earners is often hard to anticipate, as is the match rate that would apply. The implication is that the uncertainty about their matching payment entitlement makes it hard for low and middle-income earners to determine whether budgeting for retirement pension contributions is worthwhile. Matching payment entitlement under the Riester scheme is similarly difficult to gauge, as noted by Börsch-Supan *et al.* (2012). Riester is a government co-contribution payment to private pension plans, with the match rate, between 35% and 90%, depending on household characteristics (marital status, number of children and age of children), personal income and is conditional on making minimum contributions that are at least 4% of previous year's personal income (Corneo *et al.* 2009).

Despite the apparent design complexity of the national schemes studied to date, it is not clear that simplified national schemes that include design elements of the Duflo *et al.* (2006) field experiment will lead to more positive results. First, the Duflo *et al.* (2006) participants were H&R Block clients, which may mean that they were more highly engaged in their finances than the average low or middle-income earner. Second, the experiment was a 'one-time-only' payment and people may have reacted strongly because they knew it was their only chance to access the scheme. Third, the authors left unanswered the possibility of reduced contributions to unmatched savings accounts, such as employment plans. Related studies, although not focussed on low and middle-income earners, have found that incentives to contribute to retirement accounts can 'crowd-out' other forms of retirement savings (Benjamin 2003; Chernozhukov and Hansen 2004; Chetty *et al.* 2014; Messacar 2018).

Although the literature on targeted matching schemes is small, there are larger related literatures on employer matching schemes, especially for 401(k) plans, and public/private matching schemes for deposits to Individual Development Accounts (IDAs). Evidence from employer matching schemes (see Gelber 2011 for a review) is mixed, possibly because of issues of non-random selection into these programs. The availability and design of employer schemes are highly heterogenous to both employer and employee characteristics, including unobserved tastes for retirement saving among employees. These issues aside, results from employer schemes are not generalisable to pension matching schemes because low and middle-income people are under-represented in these schemes (see Engelhardt and Kumar 2007 for a discussion). Evidence on IDAs is more positive (Mills *et al.* 2008), but these studies cannot disentangle the effect of matching from other design features, such as financial education and encouragement to attain savings for a specific goal, such as a home deposit or school fee payments (Duflo *et al.* 2006). It is also not clear whether the savings behaviour induced by IDAs for attaining non-retirement and shorter-term goals is generalisable.

3. The Australian superannuation system

Australia's private pension system, known as superannuation, has had almost universal coverage of employees since 1992.[5] Superannuation contributions are made through three channels: (1) employer contributions; (2) voluntary concessional contributions and (3) voluntary personal contributions. Over the period of analysis, the minimum required rate of employer contributions to employee superannuation accounts was initially 9%, but increased to 9.5% in increments (in 2013-14 and 2014-15) that did not coincide with changes to the co-contribution scheme. [6] Employer contributions are not counted as taxable income for

[5] See Nielson and Harris (2010) for a chronology of superannuation.

[6] This minimum does not apply to the self-employed, and employers are not required to pay superannuation for employees who are paid less than $450 per month or are aged under 18 and work no more than 30 hours per week. The minimum rate applies to employee earnings from ordinary hours of work, which include commissions, shift

employees up to an annual cap and are taxed at a concessional rate of 15% on deposit into the superannuation fund. Returns to superannuation while in the accumulation phase are also taxed at a flat rate of 15%.

Voluntary concessional contributions are pre-tax contributions that receive the same concessional tax treatment as employer contributions. They are made by the employee 'salary sacrificing' a fixed amount of pay into their superannuation account that is on top of the employer contributions.[7] They are typically not part of a standard employment contract and are subject to an individual agreement being reached between the employer and employee. The self-employed can also make voluntary concessional contributions through a special provision that allows them to claim a tax-deduction on contributions.

Voluntary personal contributions are after-tax contributions by individuals which are not taxed upon entering the fund and, subject to eligibility, attract government co-contribution payments (discussed in detail below). Because they are made independently from employer-employee agreements, personal contributions are not subject to the same adjustment costs as voluntary concessional contributions. Such frictions have been previously found to impact retirement savings (Bosch and Rubli 2021).

As is typical for private pensions, there is a minimum age for access to superannuation (55 until 2015, but progressively increasing to 60 by 2024), with the added requirement that the holder of the account is retired if aged under 65. Benefits are paid as either a lump-sum or as an income stream. If the latter option is taken, there are requirements for minimum rates of drawdown. Prior to July 2007, benefits paid as an annuity were taxed at personal income tax rates less a 15% rebate, and those paid as a lump sum were taxed at 15%.[8] Since 1 July 2007, all withdrawals from the fund in the retirement phase have been tax free, as have been returns accrued during this phase.

The focus of our analysis is on voluntary personal contributions, which are eligible for matching payments, but we also consider impacts on unmatched voluntary concessional

loadings and allowances, but not overtime payments. Note that employers may, and in some cases do, contribute more than the statutory minimum.

[7] Total concessional contributions are subject to an annual cap that is not likely to be binding for low- and middle-income earners.

[8] Lump sum benefits under $135,590 were tax free.

contributions that may be displaced by voluntary personal contributions induced by the matching scheme.

3.1. *Superannuation Co-contribution Scheme*

To incentivise greater contributions among low and middle-income earners, the Australian Government introduced the Co-contribution Scheme in July 2003 (announced May 2002) as part of the Australian government's *A Better Superannuation System* (Liberal Party of Australia 2001). The first co-contribution payments to superannuation accounts were made in July 2004 for contributions made during the 2003-04 financial year.[9]

Under the scheme, every dollar of voluntary personal contributions by eligible individuals is matched by a government co-contribution at a fixed rate, known as the matching rate (ϕ), up to a maximum eligible contribution ($\overline{pc}$). This maximum eligible contribution is \$1,000 for individuals with incomes below a lower threshold (inc_L).[10] Contributions beyond $\overline{pc}$ do not attract any additional co-contribution payments. Unlike the Saver's Credit, there is no sharp discontinuity in the relationship between the match rate and income that incentivises income manipulation, and unlike Riester, the matching rate does not vary by income. Instead, $\overline{pc}$ is phased-out at a constant taper rate ($\tau_{\overline{pc}}$) from \$1,000 to 0 between lower and upper-income thresholds (inc_L and inc_U respectively), which can be described as:

$$\overline{pc}(inc, inc_U, inc_L) = \begin{cases} \$1000 & if\ inc \leq inc_L \\ \$1000 - \tau_{\overline{pc}}(inc - inc_L) & if\ inc_L < inc \leq inc_U \\ 0 & if\ inc > inc_U \end{cases} \tag{1}$$

where $\tau_{\overline{pc}} := \frac{\$1000}{inc_U - inc_L}$ is the taper rate of $\overline{pc}$.

In Table 1, we present the key parameters of the co-contribution program. Importantly, the taper rate for the maximum co-contribution is very low, in all years less than 10 per cent, which further disincentivizes income manipulation. Because of this design feature, and the inability of most wage earners to manipulate their income at the margins, we treat income as exogenous in our evaluation approach. While this is a strong assumption, in Section 6 we examine this issue further by presenting income distributions either side of inc_L and inc_U.

[9] The other major change as part of these reforms was the abolition of the superannuation surcharge, which was a levy imposed on contributions of high-income earners.

[10] The self-employed became eligible from 1 July 2007.

Table 1: Superannuation co-contribution eligibility and annual co-contribution payments

Financial Year	Income thresholds ($) Lower ($inc_L$)	Upper (inc_U)	Match rate (ϕ)	Maximum co-contribution payment ($) ($\overline{pc}$(inc) × ϕ) when $inc \leq inc_L$	Taper rate of maximum eligible contribution ($\tau_{\overline{pc}}$)
2003/04	27,500	40,000	100%	1,000	0.080
2004/05	28,000	58,000	150%	1,500	0.033
2005/06[a]	28,000	58,000	150%	1,500	0.033
2006/07	28,000	58,000	150%	1,500	0.033
2007/08	28,980	58,980	150%	1,500	0.033
2008/09	30,342	60,342	150%	1,500	0.033
2009/10	31,920	61,920	100%	1,000	0.033
2010/11	31,920	61,920	100%	1,000	0.033
2011/12	31,920	61,920	100%	1,000	0.033
2012/13	31,920	46,920	50%	500	0.067
2013/14	33,516	48,516	50%	500	0.067
2014/15	34,488	49,488	50%	500	0.067
2015/16	35,454	50,450	50%	500	0.067
2016/17	36,021	51,021	50%	500	0.067

Note: The implied taper rate for the maximum government co-contribution payment is $\tau_{\overline{pc}}\phi$.

Another implication of the low taper rate is that a large proportion of the eligible population is in the ‘tapered zone’, so that their $\overline{pc}(inc, inc_U, inc_L)$ is less than the scheme’s maximum of $1,000. In practice, people whose income falls within the ‘tapered zone’ may find it difficult to figure out their $\overline{pc}(inc, inc_U, inc_L)$), which may encourage them to contribute at the salient maximum of $1,000. While a calculator on the Australian Taxation Office (ATO) website can be used to estimate the co-contribution payment for a given personal income and contribution size, it does not report $\overline{pc}(inc, inc_U, inc_L)$.[11]

To be eligible for the co-contribution payment, in addition to income being below the upper income threshold, an individual must: derive at least 10% of their taxable income from employment; be an Australian citizen or permanent resident; be aged under 71 at the end of the financial year (30 June); and file a tax return.[12] The co-contribution payment amount is determined annually by the ATO, based on income reported in personal tax returns and superannuation contributions reported to the ATO by fund managers in annual Superannuation

[11] ATO co-contribution calculator: https://www.ato.gov.au/Calculators-and-tools/Super-co-contribution-calculator/

[12] From 1 July 2009, concessional superannuation contributions were included as part of total income for the purpose of calculating co-contribution entitlement. New Zealand citizens working in Australia are also eligible, subject to meeting the other requirements.

Member Contribution Statements (MCS).[13] As a result, to be eligible for the payment, contributions must be made during the financial year prior to lodging their tax return.

As well as administering the Co-contribution Scheme, a key responsibility of the ATO is to raise and maintain public awareness of the scheme. They do this directly through mass media campaigns, through the upkeep of an online co-contribution calculator and, indirectly, through participation in consultative committees with tax accountants, fund managers and other stakeholders. (See Appendix A for details of their promotional activities.) Based on two independent surveys (McNair Ingenuity Research 2008 and Australian National Audit Office 2010) around 80% of Australian superannuants are aware of the Co-contribution Scheme.

4. Theoretical model

The impact of a matching scheme on private pension contributions is theoretically ambiguous, depending on competing income and substitution effects, the relative strengths of which depend on individual contributions in the absence of the matching scheme. To demonstrate these competing effects and how they are influenced by counterfactual contributions and changes in the match rate, consider a simple two-period graphical model that has been sketched previously in Duflo *et al.* (2006) and Madrian (2013) but is formalized here using the same notation as introduced above.

In the first period of this model, people choose their voluntary personal contributions to a private pension (pc_1), and in the second period, they retire on the balance of the retirement pension, which depends on the personal contribution, the government matched contribution and the return on the sum of the two (R). After-tax labour income (inc_1) is assumed exogenous and disposable income in periods 1 and 2 is expressed as:

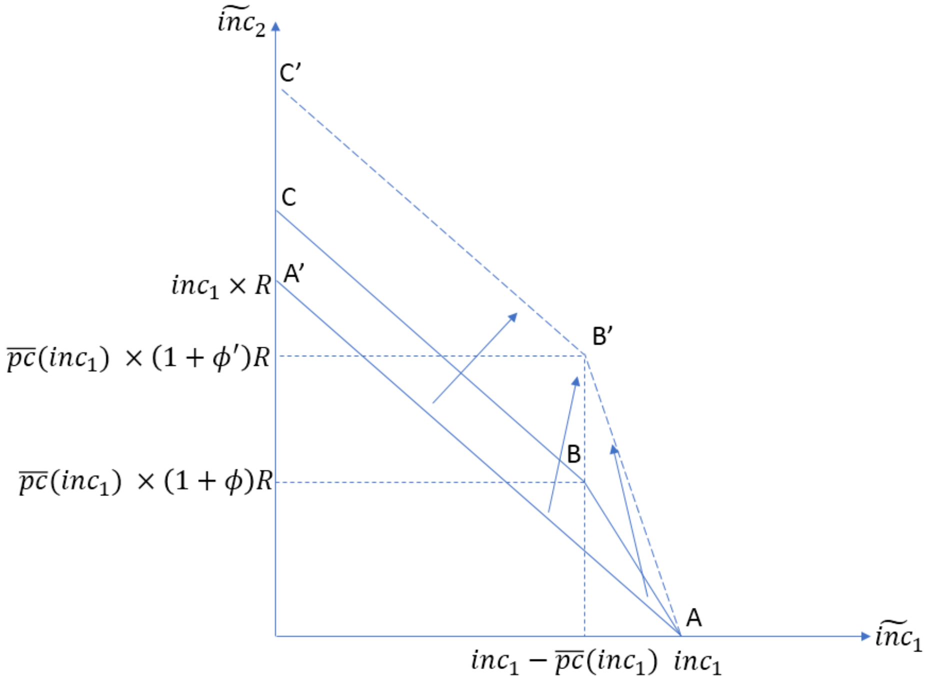
$$\widetilde{inc}_1 := inc_1 - pc_1 \tag{2}$$

$$\widetilde{inc}_2 := R[pc_1 + \phi Min\{pc_1, \overline{pc}(inc_1)\}]. \tag{3}$$

As defined previously, ϕ is the matching rate and $\overline{pc}(inc_1)$ is the maximum personal contribution that is eligible for matching. In Figure 1, the availability of the matching scheme increases retirement income for a given pc_1, which shifts the intertemporal budget constraint from AA' to ABC, creating a kink at point B or a personal contribution equal to $\overline{pc}(inc_1)$.

[13] Member Contribution Statements include both balance and contribution information. However, prior to 2013, fund managers were only required to lodge statements for accounts that received contributions during the financial year.

Figure 1: Two-period savings model with a matching contribution



In theory, people will choose the value of pc_1 that maximizes their intertemporal utility subject to their intertemporal budget constraint, but the kink point will draw mass from either side. Those who are optimally to the right of B on the original budget constraint A'A contribute less than $\overline{pc}(inc_1)$ in the absence of the matching scheme. For these individuals, the matching scheme reduces the cost of making personal contributions (holding $\widetilde{inc}_2$ constant), which is reflected by the change in slope of the intertemporal budget constraint. The cheaper cost of contributions up to $\overline{pc}(inc_1)$ encourages people to substitute $\widetilde{inc}_1$ for more future income $\widetilde{inc}_2$ by increasing pc_1, although the extent to which they do this may be tempered by a negative income effect – a reduction in the appetite to save because of the increased retirement income from the matching payment.

In contrast, for people who contribute more than $\overline{pc}(inc_1)$ in the absence of the matching scheme, those to the left of B on the original budget constraint A'A, the matching contribution produces a retirement income windfall. Because their optimal pc_1 is greater than $\overline{pc}(inc_1)$, they will not experience a positive substitution effect, but will experience a negative income effect that will lead them to reduce contributions and gravitate towards $\overline{pc}(inc_1)$. Increases in the matching rate from ϕ to ϕ' will lead to a further shift in the intertemporal budget constraint from ABC to AB'C' and intensify income and substitution effects, resulting in more bunching at the $\overline{pc}(inc_1)$ contribution level. The main prediction of this model is that the impacts of matching schemes on extensive and intensive margins depend on the distribution of contributions on either side of the kink point in the absence of the reform.

The two-period model abstracts from several complexities of the superannuation system and retirement savings behaviour, such as the different types of contributions and the precautionary motive respectively. In Appendix B, we build a multi-period model with both liquid and illiquid assets, which incorporates employer contributions, voluntary concessional contributions, and voluntary personal contributions. A key novelty is that it distinguishes between *both* types of voluntary contributions, assuming that voluntary concessional contributions (made through salary sacrifice) are subject to an adjustment cost that makes them less flexible than personal contributions (see Section 3). The model generates two main results: (1) individuals, especially low-income individuals who are likely to be liquidity constrained, tend to underutilize concessional contributions to maintain accessibility of their savings in case of emergency; and (2) an increase in retirement wealth will shift the resources of low-income earners toward "higher priority use" such as consumption or building liquid wealth.

5. Data

Analysis presented in this paper is based on an extract of the ATO's Longitudinal Information Files (ALife) that consists of a 10 percent random sample of all registered tax filers (since 1980) as at 30 June 2018. Tax record data for the sample is available for each year from 1990-91 and superannuation records are available for each year from 1996-97, linked via each individual's unique tax file number.[14] For each annual release of ALife, the sample is updated with a further 10% random sample of people added to the tax filer register since the previous release. For more details of the ALife data and its construction, see Polidano *et al.* (2020).

Importantly for this paper, ALife includes comprehensive information from all superannuation member contribution statements. In all years from 1996-97, superannuation account statements are available for all individuals with a positive contribution from any source, and from 2012-13, statements of all accounts are available. Contribution information in ALife includes separate records for concessional and personal contributions, with only the latter eligible for the co-contribution payment. A limitation of the data is that employer contributions cannot be separated from voluntary salary sacrifice contributions prior to 2009-10. Thus, for the purposes

[14] Lodgement of a tax return is compulsory for those with taxable income above the tax-free threshold. Many individuals who earn less than the tax-free threshold also lodge a return to have tax withheld by their employer refunded. The tax-free threshold over the period of analysis was $6,000 from 2007-08 to 2011-12 and $18,200 from 2012-13 onwards.

of examining whether the co-contribution scheme displaces voluntary before-tax contributions, we must restrict the analysis to the period 2009-10 to 2016-17, when the prevailing match rates were 100% and 50%. More information on the contents of member contribution statements is available on the ATO website.[15]

Our sample of analysis comprises all individuals in the ALife sample with at least one tax return lodged between 1999-2000 and 2016-17. We remove individual-year observations where work, residency or age requirements for the matching scheme are not met—that is, we exclude: those with less than 10% of their income from employment; non-residents; and those aged 71 and older. Also removed are individual-year outliers, defined as those with total voluntary personal superannuation contributions of more than $10,000 and those with negative incomes. We keep individuals who have at least one year of earnings lower than $80,000 between 1999 and 2017.[16]

5.1. Descriptive statistics

In Table 2, we provide descriptive statistics for the sample of analysis on key variables of interest, before and after the introduction of the superannuation co-contribution scheme. The pre-reform 'eligible' statistics are for those who would have met eligibility criteria in 2003-04 had they been in place in 2001-02 to 2002-03 (pre-reform). Post reform, a little over half of all observations in our sample were eligible between 2003-04 and 2016-17, with around a quarter eligible for the maximum matching payment. For low and middle-income earners who are eligible for the scheme, voluntary personal contributions are a more important channel than concessional contributions for making voluntary contributions: 15.6% make the former type of contribution, while 4.6% make the latter type. This contrasts with the higher use of voluntary concessional contributions by high-income earners who are not eligible — 20.4% make voluntary concessional contributions, while 17.6% make voluntary personal contributions. In terms of the value of personal contributions, the average annual contribution for low and middle-income earners is $215.10, which translates to a mean of $1,379 among the 15.6% who make a voluntary personal contribution.

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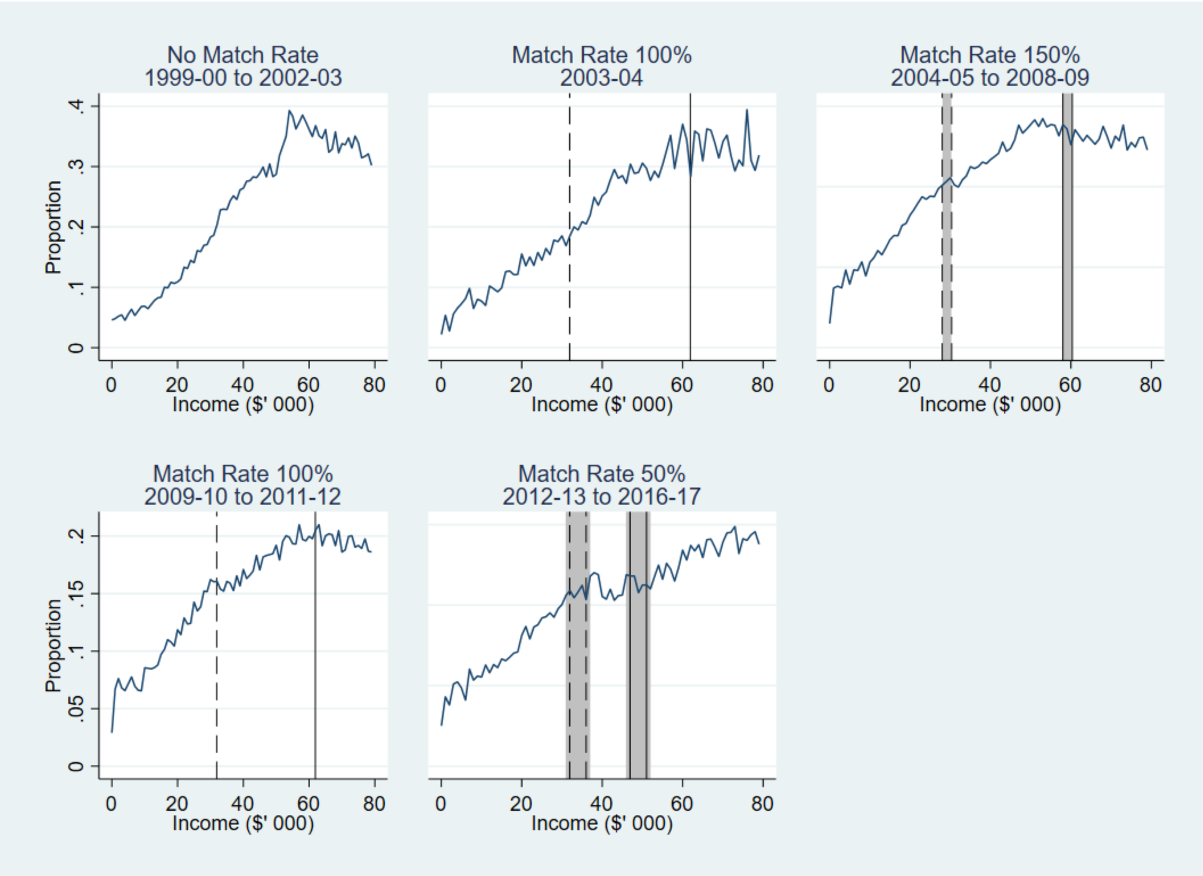
[15] See https://www.ato.gov.au/Forms/Super-member-contribution-statement-for-2012-13-and-later-financial-years/ (accessible as at 1 December 2021).

[16] Those whose earnings are above $80,000 in *all* years between 1999-2017 are almost certainly not impacted by the matching scheme. They constitute about 1% of the sample. The contribution outliers constitute another 1% of the sample.

The preference for voluntary personal contributions is consistent with predictions from our dynamic life-cycle model (Appendix B) that adjustment costs and the desire for liquidity steers low and middle-income earners away from voluntary concessional contributions made through salary sacrifice. Prior to the introduction of the scheme, in 2001-02 and 2002-03, 14.5% of low and middle-income earners were making voluntary personal contributions, half of whom were making contributions above the eligible maximum of $1,000 (or to the left of the kink point in Figure 1). The preference for voluntary personal contributions over concessional contributions is also related to the lower tax advantage of concessional contributions for low and middle-income earners due to the progressivity of the income tax schedule.

Figure 2: Proportion who make voluntary personal contributions



Notes: The broken line represents the threshold for maximum matching payment and the unbroken line represents the threshold for eligibility. Data are pooled over multiple years where the same matching rate is applied. Grey shading between the bars represents changes in the range of thresholds over the period. The graphs are truncated at $80,000 for illustration only; our sample contains individuals whose earnings exceed $80,000.

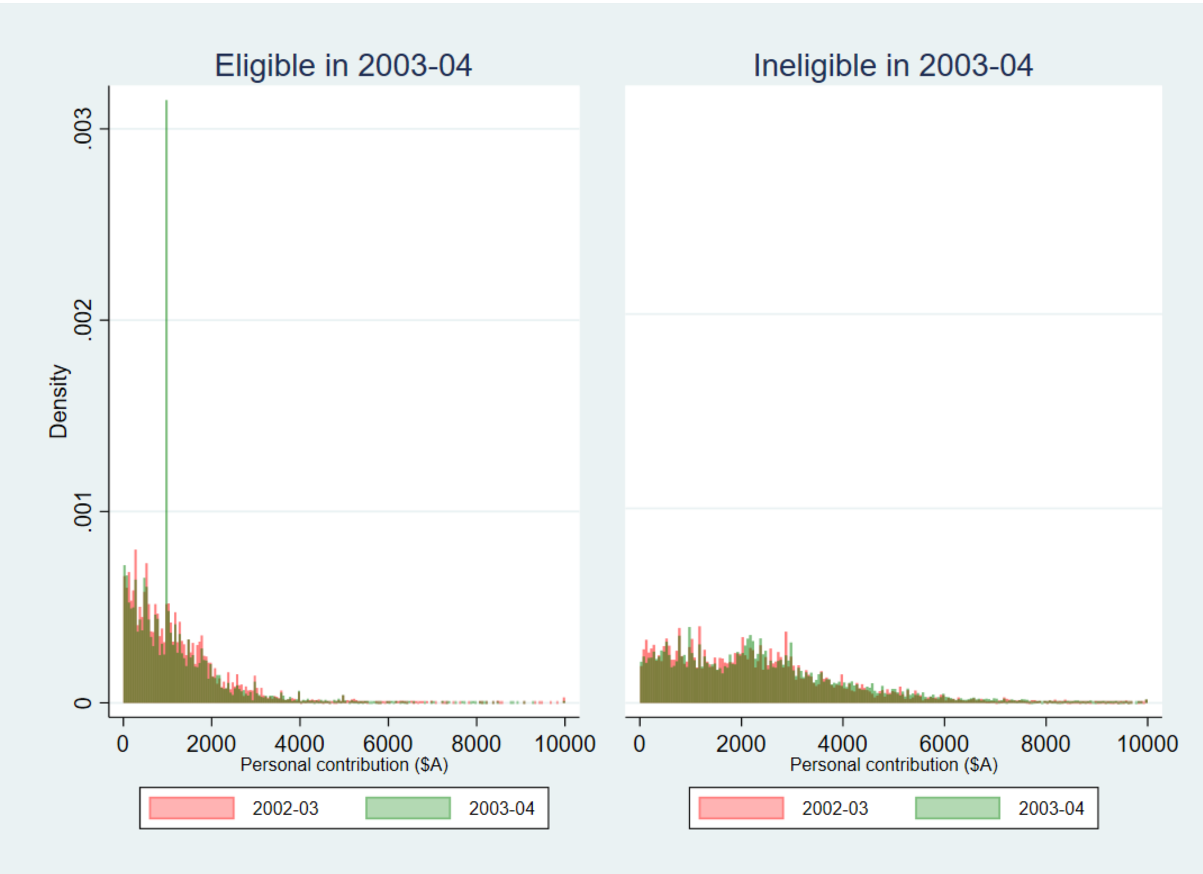
Table 2: Descriptive statistics for the analysis sample

	Pre-reform, 2001-02 to 2002-03 ‘Eligible’ in 2003-04		**Post-reform, 2003-04 to 2016-17** All observations		Eligible observations		Ineligible observations	
	Mean	Std. dev.	**Mean**	Std. dev.	**Mean**	Std. dev.	**Mean**	Std. dev.
Co-contribution eligibility (%)								
Eligible for matching payment	-	-	**57.4**	49.5	-	-	-	-
Eligible for the maximum matching payment	-	-	**27.0**	44.4	**46.9**	49.9	-	-
Contribution rates (%)								
Voluntary personal contribution	**14.5**	35.2	**16.3**	36.9	**15.6**	36.2	**17.6**	38.0
Voluntary personal contribution above $1,000	**7.2**	25.9	**9.6**	29.4	**7.3**	26.0	**12.9**	33.6
Voluntary concessional contribution[a]	**n.a.**	n.a.	**12.4**	32.9	**4.6**	21.0	**20.4**	40.3
Employer contribution	**n.a.**	n.a.	**91.3**	28.2	**90.1**	29.8	**94.9**	22.0
Contribution amounts ($)								
Voluntary personal contribution	**191.8**	683.8	**325.8**	1,056.2	**215.1**	702.9	**485.3**	1,397.1
Voluntary concessional contribution[a]	**n.a.**	n.a.	**989.1**	4,352.0	**147.3**	1,241.62	**1,859.9**	5,951.7
Total concessional contribution	**1,759.5**	2,808.1	**5,299.8**	7,180.3	**2,724.6**	3,873.57	**8,972.0**	8,935.2
Total personal income ($)	**31,980.4**	17,835.6	**55,318.7**	46465.5	**32,450.9**	15,276.7	**88,154.1**	54,692.0
Count	98,009		1,264,509		725,244		526,534	

[a]Data is only available from 2009-10 onward. Not shown in the table are descriptive statistics of observations in 1999-2001, and observations in 2001-2003 that would have been ineligible if they were subject to program rules in 2003-04.

The minimal differences in voluntary personal contribution rates by eligibility status (Table 2) do not necessarily translate into small causal impacts of the scheme because those in the eligible group have less capacity to make contributions due to their lower incomes. In Figure 2, we show the relationship between income and the proportion making voluntary personal contributions for different match rates. In each of the panels, we observe that the proportion contributing increases with income, although this relationship has weakened over time. The contribution-income relationship is also highly nonlinear (even in the absence of the scheme), which motivates the use of first-differenced outcomes in our model for identification. Nevertheless, in panels where the co-contribution scheme is in place, except for the panel for the 50% matching rate, the positive relationship appears to soften around the upper-income (eligibility) threshold, represented by the unbroken vertical line(s), which is suggestive of small program impacts. We observe no apparent break in the relationship associated with the lower-income threshold (broken vertical line) that would suggest responses to full/partial eligibility.

Figure 3: Histogram of voluntary personal contributions for those affected and unaffected by the introduction of the co-contribution scheme in 2003-04



Notes: The data is truncated at an annual contribution amount of $10,000. To put the figure on an appropriate scale, those who do not contribute are excluded.

Predictions from our theoretical model suggests that matching schemes will impact the distribution of contributions. We present preliminary analysis in Figure 3 that shows the distribution of contributions before (2002-03) and after the introduction of the program (2003-04) for groups that would have been ineligible or eligible based on 2003-04 eligibility criteria. For those who would have been ineligible, we see no noticeable shift in the distribution of contributions associated with program introduction. In contrast, for those who would be eligible, we observe induced bunching of contributions at the maximum eligible contribution of \$1,000, with contributions being drawn from both from above and below \$1,000 in 2003-04. The spike in contributions at \$1,000 is consistent with theoretical predictions and points to the saliency of the maximum eligible contribution in determining the choice of contribution level.

6. Econometric models

To test the theoretical predictions presented in Section 4, we estimate the effects of the co-contribution scheme on extensive and intensive margins and on the distribution of contributions using a *base model* that exploits variation in eligibility and match rates over time. We also estimate variants of the base model that test hypotheses from our lifecycle model with liquid and illiquid assets, symmetry of responses to entitlement gains and losses, and heterogeneity of responses associated with the degree of liquidity constraints.

6.1. Base model

In the base model, we assume that people respond to the two most salient features of the scheme: their eligibility status (E_{it}) and the match rate (ϕ_t). We first define an individual i's matching entitlement C_{it} as:

$$C_{it} = \phi_t E_{it}$$
$$\text{where } \phi_t \in \{0, 0.5, 1.0, 1.5\};\; E_{it} \coloneqq 1\{\overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) > 0\}. \tag{4}$$

The implicit assumption is that people do not distinguish between full and partial eligibility. Partial eligibility occurs when personal income falls in the tapered zone (between inc_{Lt} and inc_{Ut}) and requires an individual to calculate their maximum eligible contribution ($\overline{pc}$) by applying a taper rate. Difficulty in calculating $\overline{pc}$ suggests that many people may not be aware of it and respond as if they have full eligibility. This assumption is supported by results from a model where we extend the base model to estimate separate impacts of partial and full eligibility. Results from this model, presented in Appendix C (Table C.1), are consistent with those from the base model presented here, albeit there is stronger bunching at the maximum eligible contribution under full eligibility than under partial eligibility.

To estimate the effect of matching entitlement on contributions, we use a difference-in-differences approach. Naturally, one could use high-income individuals as the control group and low-income individuals as the treatment group. However, as shown in Figure 2, the cross-sectional contribution-income relationship is highly nonlinear, which would require parametric assumptions on the functional form of this relationship (e.g., a polynomial) to estimate this model, which is a threat to identification. To avoid imposing parametric restrictions, we use a first-differenced framework, exploiting only within-person variation for identification.

Table 3: Changes in co-contribution entitlement used for identification

Eligibility		Match rate		Within-person changes in entitlement	Number of treatment-group observations by source of variation[a]		
E_{it-1}	E_{it}	ϕ_{t-1}	ϕ_t	$\Delta C_{it} = C_{it} - C_{it-1}$	Policy changes	Within-person income changes	Indeterminate[b]
Control group (N=1,152,178)							
Remain ineligible (or no program):							
0	0	-	-	0	-	-	-
Remain eligible, no change in match rate:							
1	1	0.5	0.5	0	-	-	-
1	1	1.0	1.0	0	-	-	-
1	1	1.5	1.5	0	-	-	-
Treatment group (N=336,061)							
Lose eligibility:							
1	0	0.5	0.5	−0.5	-	26,568	
1	0	1.0	1.0	−1.0	-	14,383	20,278[c]
1	0	1.5	1.5	−1.5	-	28,311	
Gain eligibility:							
0	1	0.5	0.5	+0.5	-	21,482	
0	1	1.0	1.0	+1.0	44,016	9,875	
0	1	1.5	1.5	+1.5	-	11,745	16,511[d]
Remain eligible, match rate drops:							
1	1	1.0	0.5	−0.5	38,944	-	
1	1	1.5	1.0	−0.5	58,029	-	
Remain eligible, match rate rises:							
1	1	1.0	1.5	+0.5	45,919	-	
Total					186,908	112,364	36,789

[a] The numbers of within-person changes in matching entitlement each year are available in Table C.2 in Appendix C. [b] In some years, the magnitude of entitlement changes from income-triggered eligibility changes are the same as entitlement changes triggered by changes in the upper-income threshold. We cannot disentangle the source of variation. [c] Corresponds to 2012-13 decrease in the income eligibility threshold. [d] Corresponds to 2004-05 increase in the income eligibility threshold.

Our base model exploits within-person variations in matching entitlement over time.[17] We compare outcomes of those who experience consecutive-year changes in their matching entitlement to a control group whose entitlement is unchanged. The definitions of control and treatment groups are summarized in Table 3. In all, we have nine within-person changes in the matching entitlement that comprise the treatment group, and four scenarios where the entitlement is unchanged that comprise the control group. The last three columns show the count of treatment group observations by the two sources of variation in the matching entitlement: policy changes — match rate and income eligibility threshold (inc_{Ut}) changes as described in Table 1 — and eligibility changes triggered by personal income crossing the eligibility threshold. The last column reflects counts of indeterminate cases, which occur in specific years when entitlement changes associated with eligibility changes from the two sources of variation are confounded. Policy changes are the more important source of identification — 63% (186,908 observations) among within-individual changes that are not indeterminate, most of which comes from changes in the match rate (142, 892).[18]

These rich variations allow us to express the matching entitlement C_{it} as a function with three indicators for the three match rates: $C_{\phi,it} \coloneqq 1\{\phi_t = \phi\}E_{it}$, where $\phi \in \{0.5,1.0,1.5\}$, or more explicitly:

$$C_{0.5,it} = 1\{\phi_t = 0.5\}E_{it}; \quad C_{1.0,it} = 1\{\phi_t = 1.0\}E_{it}; \quad C_{1.5,it} = 1\{\phi_t = 1.5\}E_{it} \tag{5}$$

We then estimate the following difference-in-differences model:

$$\begin{aligned}\Delta y_{it} = {} & \tilde{\alpha}_{0.5}\Delta C_{0.5,it} + \tilde{\alpha}_{1.0}\Delta C_{1.0,it} + \tilde{\alpha}_{1.5}\Delta C_{1.5,it} + \tilde{\tilde{\alpha}}_{0.5}\Delta C_{0.5,it-1} + \tilde{\tilde{\alpha}}_{1.0}\Delta C_{1.0,it-1} \\ & \tilde{\tilde{\alpha}}_{1.5}\Delta C_{1.5,it-1} + \sum_{m=1}^{M} [\tilde{\beta}_m \Delta(inc_{it}^m) + \tilde{\tilde{\beta}}_m \Delta(inc_{it-1}^m)] + x_{it}'\gamma + \delta_t + \epsilon_{it}\end{aligned} \tag{6}$$

where $\Delta y_{it} \coloneqq y_{it} - y_{it-1}$; $\Delta C_{\phi,it} = C_{\phi,it} - C_{\phi,it-1}$, $\phi \in \{0.5, 1.0, 1.5\}$; $\Delta(inc_{it}^m) \coloneqq inc_{it}^m - inc_{it-1}^m$ are first-differences for contributions, entitlement and income, respectively (The superscript m is the polynomial order, setting the max order $M = 3$), x_{it} is a vector of socio-demographic characteristics that may impact Δy_{it}, such as marital status, age, gender, self-employment and spousal income, δ_t is the year-specific trend in y, and ϵ_{it} is an idiosyncratic

[17] It nets out the effect of unobserved personal traits, such as contribution preference, that may be correlated with income and matching entitlements.

[18] Based on the relatively small number of people who change eligibility in years where there is no policy change (see Table C.2 in Appendix C), most are related to changes in the upper income threshold.

shock.[19] Also included in this model are lagged first-difference terms for the entitlement $\Delta C_{\phi,it-1} \coloneqq C_{\phi,it-1} - C_{\phi,it-2}$ and income $\Delta(inc_{it-1}^{m}) \coloneqq inc_{it-1}^{m} - inc_{it-2}^{m}$ that allow for the possibility of delays in contribution responses, e.g., people may take time to realise changes in their entitlement and/or to evaluate alternative savings options before adjusting their contributions. Results presented in Appendix C without lags suggest that failure to allow for delayed responses is likely to under-estimate the true effects of the scheme. When reporting responses in the following section, we report the *total* responses to changes in the entitlement defined as: $\alpha_{\phi} \coloneqq \tilde{\alpha}_{\phi} + \tilde{\tilde{\alpha}}_{\phi}$, where $\tilde{\alpha}_{\phi}$ and $\tilde{\tilde{\alpha}}_{\phi}$ are current-period and lagged responses, respectively.

Core to this model is a conditional mean independence assumption which, is given by $E\left(\epsilon_{it}\middle|\, \Delta C_{\phi,it},\ \Delta(inc_{it}^{m}), x_{it}, \delta_t\right) = E(\epsilon_{it}|\Delta(inc_{it}^{m}), x_{it}, \delta_t)$. That is, controlling for *income shock* $\Delta(inc_{it}^{m})$, other covariates x_{it} and year effects δ_t, the change in entitlement $\Delta C_{\phi,it}$ is exogenous.[20] In practice this means, for two individuals in the same year who have the same socio-demographic characteristics and magnitude of income shock, contribution adjustments from differences in the entitlement change, from one crossing-over the eligibility threshold or being exposed to a policy change, will be used to identify the effects of the program.

We estimate the model using OLS with clustered standard errors at the individual level.[21]

6.1a Threats to identification and robustness checks

There are several potential threats to identification. First, our model assumes conditional mean independence given the income shock and other covariates, and a parametric relationship between contribution adjustment Δy_{it} and the income shock $\Delta(inc_{it}^{m})$. If model misspecification is a serious threat, then results from models based only on income-induced eligibility changes would differ substantially to those where identification is based on policy changes. To test this, we split the sample into two sub-samples based on source of identification

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[19] x_{it} includes age at the time of tax lodgement, age squared, gender, marital status, whether a tax accountant is used and self-employment status. We also include the first difference for marital status, tax accountant use, self-employment status and spouse income.

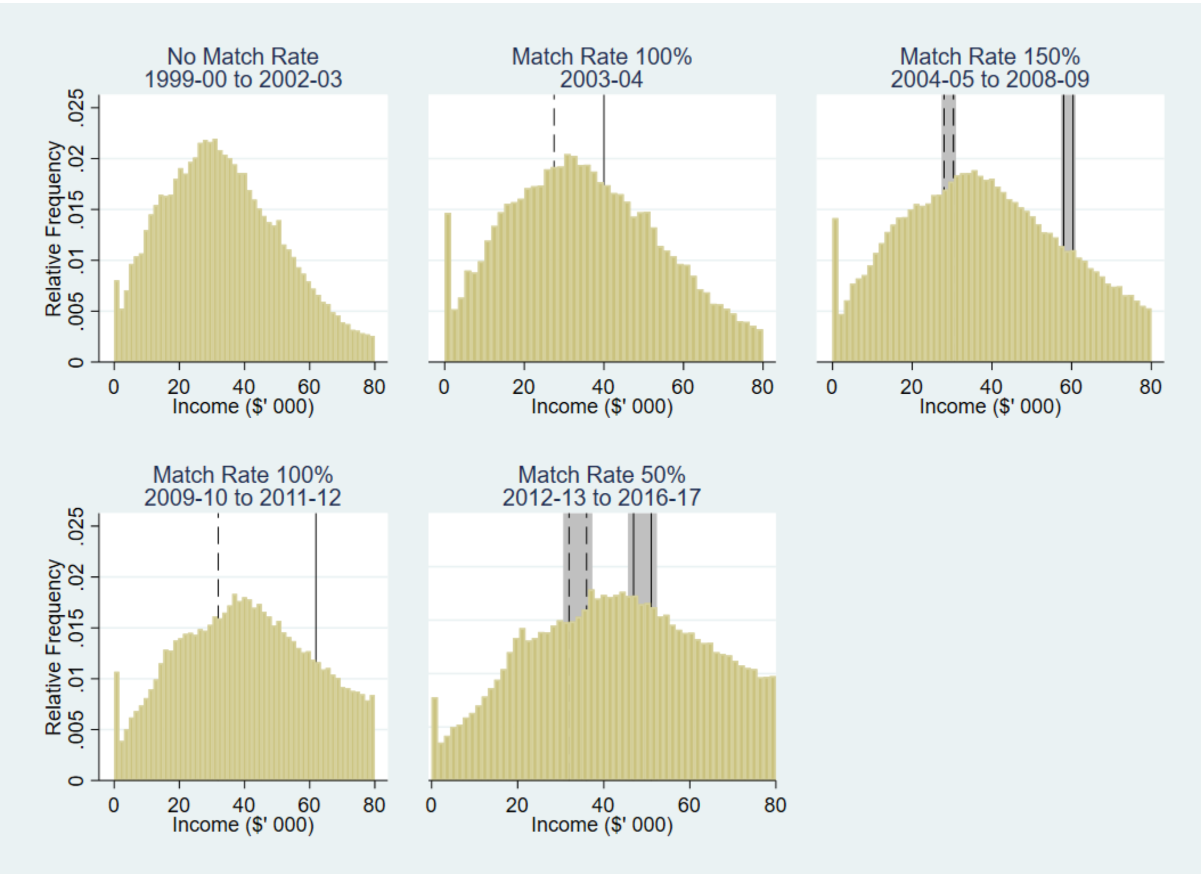
[20] We do not require the conditional expectation to be zero, only assuming that it is invariant over $\Delta C_{\phi,it}$ given $\Delta(inc_{it}^{m}), x_{it}, \delta_t$.

[21] This is different to the fixed-effects estimation that relies on strict exogeneity assumption, namely, that the regressors in any period are orthogonal to all past, present and future errors. The first-difference model assumes that first-differenced regressors are contemporaneously uncorrelated with the first-differenced error. This is well-known to be satisfied when there is orthogonality between the regressor and error contemporaneously and one-period apart. This is substantially weaker than strict exogeneity in multiple periods.

(see Table C.2 in Appendix C): (1) years that involved changes in the policy settings; and (2) years with the program in place without changes in policy settings (see Appendix C for details). For sub-sample (1), identification is mainly through changes in the policy, while for sub-sample (2), identification is mainly through within-person eligibility changes triggered by income changes. Results for the two sub-samples are very similar (see Table C.3 in Appendix C), which suggests that misspecification is not a serious threat.

A second possible threat is diverging trends in outcome (contribution adjustment Δy) between treatment and control groups that cannot be controlled for by our explanatory variables. To test the sensitivity of our results to this possibility, we estimate a variant of Equation (6) with 'placebo' income eligibility thresholds that coincide with those in Table 1 in terms of changes between years, but setting them at a higher overall level (e.g., \$90,000 in 2003-04). Placebo results (Appendix C) suggest that this is not a major threat to identification.

Figure 4: Relative frequency distributions of personal income



Notes: The broken line represents the threshold for maximum matching payment and the unbroken line represents the threshold for eligibility. Data are pooled over multiple years where the same matching rate is applied. Grey shading between the bars represents changes in the range of thresholds over the period. The graphs are truncated at \$80,000 for illustration only; our sample contains individuals whose earnings exceed \$80,000.

Finally, a possible concern is that income, and hence the matching entitlement, is endogenous because people may manipulate their income to take advantage of the difference in eligibility either side of the income threshold. In practice, such incentives are likely to be weak due to the gradual tapering of the maximum eligible contribution. This is also supported by the absence of bunching around the income eligibility thresholds (vertical bars) in Figure 4.[22] Thus, our conclusion is that while there may be a psychological motivation to respond to changes in eligibility at the margin because it is a salient feature of the scheme, there is no strong evidence supporting the manipulation of income to gain eligibility.

Overall, our identification strategy exploits within-person variations in matching entitlement over time, driven by policy changes and/or income shocks. The evidence consistently supports the notion of competing substitution and income effects that shape the distributional effects of the program. It is important to stress that any major threat to identification must generate a direction of bias that can explain these competing effects.

6.1b Testing theoretical predictions on the distribution of contributions

We estimate a range of base models with different measures of personal contributions (y_{it}) to evaluate distributional hypotheses from the theoretical model, which are presented in Table 4. Key predictions are that the matching scheme increases the extensive margin (Prediction 1), the kink in the intertemporal budget constraint entices bunching at $1,000 (Prediction 2) and the intensity of these responses is predicted to increase with the match rate.

In terms of the intensive margin (Prediction 3), the effect is ambiguous because of competing substitution and income effects. The theoretical model predicts that individuals who initially do not contribute, or contribute less than $1,000, will start or increase contributions due to a dominant substitution effect up to $1,000. In contrast, individuals who initially contribute above $1,000 will reduce contributions due to the income effect. Thus, we expect an increase in the proportion of people who contribute up to $1,000 (Prediction 4) and reductions in the proportion of high contributors, using three times the bunching point as the benchmark (Prediction 6). For the residual range, contributions between $1,001 and $3,000, the effect of the matching scheme on contributions is ambiguous (Prediction 5). While the income effect

[22] The only clear evidence of bunching appears to be at the top of the bottom tax bracket (at around $37,000).

will lower contributions among existing contributors in this range, it may also shift contributions into this range from people who were previously contributing more than $3,000.

Table 4: Theoretical predictions tested with the base model

Predictions[a]	Personal contributions (y_{it})
Overall responses	
1. Extensive margin ($0 < \alpha_{0.5} < \alpha_{1.0} < \alpha_{1.5}$)	$1\{pc_{it} > 0\}$
2. Bunching ($0 < \alpha_{0.5} < \alpha_{1.0} < \alpha_{1.5}$)	$1\{pc_{it} = \$1000\}$
3. Intensive margin. The signs of $\alpha_{0.5}, \alpha_{1.0}, \alpha_{1.5}$ are ambiguous	pc_{it}
Responses within contribution ranges	
4. Combined substitution effect below $1,000 and some income effect above $1,000 ($0 < \alpha_{0.5} < \alpha_{1.0} < \alpha_{1.5}$)	$1\{0 < pc_{it} \leq \$1000\}$
5. The signs of $\alpha_{0.5}, \alpha_{1.0}, \alpha_{1.5}$ are ambiguous	$1\{1000 < pc_{it} \leq \$3000\}$
6. Only income effect ($0 > \alpha_{0.5} > \alpha_{1.0} > \alpha_{1.5}$)	$1\{pc_{it} > \$3000\}$

[a] $\alpha_{\phi} := \tilde{\alpha}_{\phi} + \tilde{\tilde{\alpha}}_{\phi}$.

To more fully examine distributional effects predicted by the theoretical model, we test predictions in Table 5 by estimating the base model for incremental changes in contributions. Specifically, we estimate models for incremental increases of $100 from $0 to $10,000, or $y_{it} = 1\{0 \leq pc_{it} \leq c\}$, where c=0, $100, $200, ..., $10,000. The expected parameter signs for different values of c, which are consistent with distributional predictions of the theoretical model, are presented in Table 5.[23]

Table 5: Theoretical predictions tested on the distribution of personal contributions

Values of c	Outcome (y_{it})	Expected sign of $\alpha_{0.5}^c, \alpha_{1.0}^c, \alpha_{1.5}^c$	Justification
0	$1\{pc_{it} = 0\}$	Negative	Mirror of the extensive margin (fewer non-contributors)
<1000	$1\{0 \leq pc_{it} \leq c\}$	Negative	Outflow due to the substitution effect (fewer low contributors)
≥1000 and <∞	$1\{0 \leq pc_{it} \leq c\}$	Positive	Inflow due to the income effect (fewer high contributors). Note that there is no outflow because the substitution effect only applies up to $1,000.
∞	1	0	By definition

[23] Note that it is not appropriate to compare the relative magnitudes of $\alpha_{0.5}^c$, $\alpha_{1.0}^c$ and $\alpha_{1.5}^c$ at a given c because the underlying outcome, $y_{it} = 1\{0 \leq pc_{it} \leq c\}$, is effectively an integral (cumulative response).

6.2. Base model variants

We also estimate base model variants to test for more nuanced behavioural responses, including asymmetric responses to entitlement increases and decreases; cross-effects on other forms of savings and heterogenous responses. For simplicity, we depart from the base model by estimating these nuanced responses on average across the different match rates. To test whether people's reactions to increases and decreases in matching entitlement are symmetric, we separate the effects of increasing and decreasing the matching entitlement ($C_{it} \coloneqq \phi_t E_{it}$):

$$\begin{aligned}\Delta y_{it} &= \tilde{\alpha}^{+}\Delta C_{it}1\{\Delta C_{it} > 0\} + \tilde{\alpha}^{-}\Delta C_{it}1\{\Delta C_{it} < 0\} + \tilde{\tilde{\alpha}}^{+}\Delta C_{it-1}1\{\Delta C_{it-1} > 0\} \\ &+ \tilde{\tilde{\alpha}}^{-}\Delta C_{it-1}1\{\Delta C_{it-1} < 0\} + \sum_{m=1}^{M}[\tilde{\beta}_m\Delta(inc_{it}^{m}) + \tilde{\tilde{\beta}}_m\Delta(inc_{it-1}^{m})] + x_{it}^{'}\gamma + \delta_t + \epsilon_{it}\end{aligned} \tag{7}$$

We report the *total* responses, defined as $\alpha^{+} \coloneqq \tilde{\alpha}^{+} + \tilde{\tilde{\alpha}}^{+}$ and $\alpha^{-} \coloneqq \tilde{\alpha}^{-} + \tilde{\tilde{\alpha}}^{-}$, where α^{+} reflects the effect of increasing the matching entitlement (by becoming eligible and/or subject to a match rate increase when eligible) and α^{-} reflects the effect of reducing the entitlement.

Matching schemes can have cross-effects on other forms of savings, especially unmatched contributions and liquid forms of savings. For unmatched contributions, our life-cycle model (Appendix B) shows that *both* substitution and income effects will act in the same direction to displace (unmatched) concessional contributions. This is because personal and concessional contributions accumulate the same type of illiquid wealth. For liquid savings, while they can be displaced by substitution effects, income effects can increase them (and/or consumption) at the expense of pension contributions. To test these theoretical predictions, we estimate a model that allows for cross-effects to differ by whether previous year's personal contributions (y_{it-1}) are \$1,000 and above (only subject to income effects) or not (subject to substitution effects as well):

$$\begin{aligned}\Delta 1\{\mathrm{z_{it}} > 0\} &= (\tilde{\gamma}_{\le 1000}\Delta C_{it} + \tilde{\tilde{\gamma}}_{\le 1000}\Delta C_{it-1})1\{\mathrm{y_{it-1}} \le 1000\} + (\tilde{\gamma}_{>1000}\Delta C_{it} \\ &+ \tilde{\tilde{\gamma}}_{>1000}\Delta C_{it-1})1\{y_{it-1} > 1000\} + \sum_{m=1}^{M}[\tilde{\beta}_m\Delta(inc_{it}^{m}) + \tilde{\tilde{\beta}}_m\Delta(inc_{it-1}^{m})] \\ &+ x_{it}^{'}\gamma + \delta_t + \epsilon_{it}\end{aligned} \tag{8}$$

where $1\{z_{it} > 0\}$ is an indicator variable for *other* forms of saving. We report the *total* responses defined as $\gamma_{\le 1000} \coloneqq \tilde{\gamma}_{\le 1000} + \tilde{\tilde{\gamma}}_{\le 1000}$ and $\gamma_{>1000} \coloneqq \tilde{\gamma}_{>1000} + \tilde{\tilde{\gamma}}_{>1000}$. When z_{it} denotes voluntary concessional contributions, we expect both $\gamma_{\le 1000} < 0$ and $\gamma_{>1000} < 0$. When z_{it} denotes income from interest and dividends, proxies for the liquid assets of bank deposits and shares, we expect $\gamma_{\le 1000} < 0$ and $\gamma_{>1000} \ge 0$. We also estimate heterogenous impacts on personal contributions across selected sub-groups.[24] The sub-groups include gender, marital status, age, previous period superannuation balances, whether a tax consultant is used, and quintile of permanent income. Following Heim and Lurie (2014), permanent income is the predicted value, inclusive of an individual fixed effect, from a Mincer-style log income regression model of total personal income on individual characteristics. We then group individual predicted values each year into quantiles.

7. Results

In Table 6 below, we present key estimated coefficients from the base model (equation (6)), with t-statistics reported in parentheses below each estimate (see Appendix D for estimates of all coefficients). The focus of our discussion is on the total effects ($\alpha_{0.5}$, $\alpha_{1.0}$ and $\alpha_{1.5}$). Our results are consistent with the predictions of the theoretical model. On the extensive margin (Prediction 1), we estimate that eligibility for the co-contribution matching scheme is associated with 1.15 percentage point, 1.51 percentage point and 3.49 percentage point increases in the rate of personal contributions of low and middle-income earners for 50%, 100% and 150% match rates, respectively. The magnitude of these are broadly consistent with what has been estimated in previous national studies (Duflo *et al.* 2007; Ramnath 2013; Heim and Lurie 2014), but modest compared to the 11 percentage-point increases found in the Duflo *et al.* (2006) field experiment (with a 50% match rate). We estimate that eligibility is associated with an increase in the probability of contributing at the salient eligible maximum of $1,000 and that this response increases with the matching rate (Prediction 2).

Consistent with differences in strength of competing income and substitution effects, our results show differences in effects on contributions above and below $1,000. For contributions up to $1,000, the matching scheme is associated with significant increases in the contribution rate of 1.39, 2.42 and 3.30 percentage points for matching rates of 50%, 100% and 150% respectively (Prediction 4). In contrast, there is a fall in the rate of high contributions — above $3,000 (Prediction 6) of 1.46, 2.12 and 2.25 percentage points, respectively. For those already contributing more than $1,000, the matching scheme represents a retirement-income windfall that reduces personal contributions in this range, which is reflected by the increase in the contributions up to $1,000 being greater than the increase in the extensive margin. An exception

[24] The equation is $\Delta y_{it} = \sum_{j=1}^{J} \tilde{\alpha}^j \, \Delta C_{it}. G_{it}^j + \tilde{\tilde{\alpha}}^j \Delta C_{it-1}. G_{it-1}^j + \sum_{m=1}^{M} [\tilde{\beta}_m \Delta(inc_{it}^m) + \tilde{\tilde{\beta}}_m \Delta(inc_{it-1}^m)] + x_{it}' \gamma + \delta_t + \epsilon_{it}$, where G_{it}^j and G_{it-1}^j are binary indicators for group *j=1,..,J.* We report the *total* responses, defined as $\alpha^j := \tilde{\alpha}^j + \tilde{\tilde{\alpha}}^j$.

is results for the 150% match rate, where there is a relatively large increase in contributions between \$1,001 and \$3,000 that may reflect strong substitution effects beyond the eligible range or ‘over-shooting’ of the contribution response (see Figure 5). However, the positive estimates in this range are hard to interpret because they also reflect movement out of the top \$3,000 bracket. Compared to impacts below and equal to \$1,000, that are dominated by substitution effects, the income effects above \$3,000 are relatively invariant to the match rate, which indicates that people may not be cognisant of how much their retirement income has increased, but instead respond to the more salient knowledge that it has increased. These results highlight the importance of income effects for matching schemes that are targeted at low and middle-income earners.

We estimate a reduction in the intensive margin that is associated with the negative income effects. While negative intensive margins may sound surprising, comparable unconditional estimates of the Saver’s Credit from Duflo *et al.* (2007) that are *inclusive* of the matching payment are small — \$9.40 and \$1.40 for match rates of 100% and 25%, respectively. These small increases suggest negative intensive margins *net* of the matching payment. In the far right-hand-column in Table 6, we report impacts on contributions that are inclusive of the co-contribution payments, which are larger than reported in Duflo *et al.* (2007) for a comparable match rate of 100%.

Table 6: Effect of co-contribution entitlement on voluntary personal contributions

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$ (Prediction 1)	$1\{pc_{it} = \$1{,}000\}$ (Prediction 2)	$1\{\$0 < pc_{it} \leq \$1{,}000\}$ (Prediction 4)	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$ (Prediction 5)	$1\{pc_{it} > \$3{,}000\}$ (Prediction 6)	Voluntary personal contribution ($) (Prediction 3)	Voluntary personal plus gov. co-contribution ($)
$\alpha_{0.5}$	0.0115***	0.00207**	0.0139***	0.0121***	-0.0146***	-34.38***	-23.85***
	(6.66)	(3.05)	(8.79)	(9.31)	(-15.77)	(-7.61)	(-5.13)
$\alpha_{1.0}$	0.0151***	0.0129***	0.0242***	0.0121***	-0.0212***	-50.48***	15.49**
	(9.14)	(19.09)	(16.05)	(9.34)	(-21.65)	(-10.95)	(3.19)
$\alpha_{1.5}$	0.0349***	0.0171***	0.0330***	0.0243***	-0.0225***	-19.99***	113.0***
	(19.14)	(21.57)	(19.65)	(15.98)	(-18.92)	(-3.80)	(20.27)
Contemporaneous coefficients							
$\tilde{\alpha}_{0.5}$	0.0050***	0.00089	0.0096***	0.0041***	-0.0088***	-27.8***	-18.5***
	(4.39)	(1.91)	(8.71)	(4.67)	(-14.75)	(-9.51)	(-6.18)
$\tilde{\alpha}_{1.0}$	0.0064***	0.0089***	0.016***	0.0041***	-0.014***	-40.6***	18.7***
	(5.78)	(19.46)	(15.47)	(4.68)	(-21.31)	(-13.76)	(6.10)
$\tilde{\alpha}_{1.5}$	0.021***	0.013***	0.025***	0.011***	-0.015***	-21.5***	100.4***
	(15.92)	(22.14)	(19.42)	(10.08)	(-18.34)	(-6.00)	(26.20)
Lagged coefficients							
$\tilde{\tilde{\alpha}}_{0.5}$	0.0065***	0.0012**	0.0043***	0.0080***	-0.0058***	-6.54*	-5.36
	(5.56)	(2.58)	(3.89)	(9.25)	(-9.51)	(-2.19)	(-1.73)
$\tilde{\tilde{\alpha}}_{1.0}$	0.0087***	0.0040***	0.0080***	0.0080***	-0.0073***	-9.89***	-3.23
	(8.45)	(8.67)	(7.90)	(9.66)	(-12.32)	(-3.65)	(-1.10)
$\tilde{\tilde{\alpha}}_{1.5}$	0.014***	0.0039***	0.0080***	0.013***	-0.0073***	1.53	12.6***
	(11.32)	(6.94)	(6.70)	(12.83)	(-9.41)	(0.43)	(3.33)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839

Notes: Estimated results from Equation (6) where $\alpha_{\phi} \coloneqq \tilde{\alpha}_{\phi} + \tilde{\tilde{\alpha}}_{\phi}$, t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In Table 7, we report results from Equation (8) on the effect of the matching entitlement on other forms of savings, by previous year's personal contributions. Among those who contributed more than \$1,000 in the previous year, we do not find an increase in the proportion who report interest or dividend income if they become entitled to a co-contribution (Table 7). Our conclusion is that the increase in retirement income from the matching scheme induces increases in consumption and not an increase in the holding of more liquid assets. For voluntary concessional contributions, consistent with a 'crowding-out' effect, we observe negative effects of the matching entitlement as people substitute away from this form of contribution towards more personal (matched) contributions. We estimate stronger responses among those who contributed above \$1,000 last year, which is consistent with predictions of our life-cycle model (Appendix B) that, as well as negative substitution effects, concessional contributions may also be affected by negative income effects.

Table 7: Effect of co-contribution entitlement on other savings

Personal contributions in the previous year	Any voluntary concessional (unmatched) contributions	Any income from liquid assets (any dividends/interest income)
Less than or equal to \$1,000 ($\gamma_{\leq 1000}$)	-0.0271*** (-12.99)	-0.00648*** (-3.91)
More than \$1,000 ($\gamma_{>1000}$)	-0.0496*** (-7.73)	-0.00163 (-0.51)
N	610,162	1,287,839

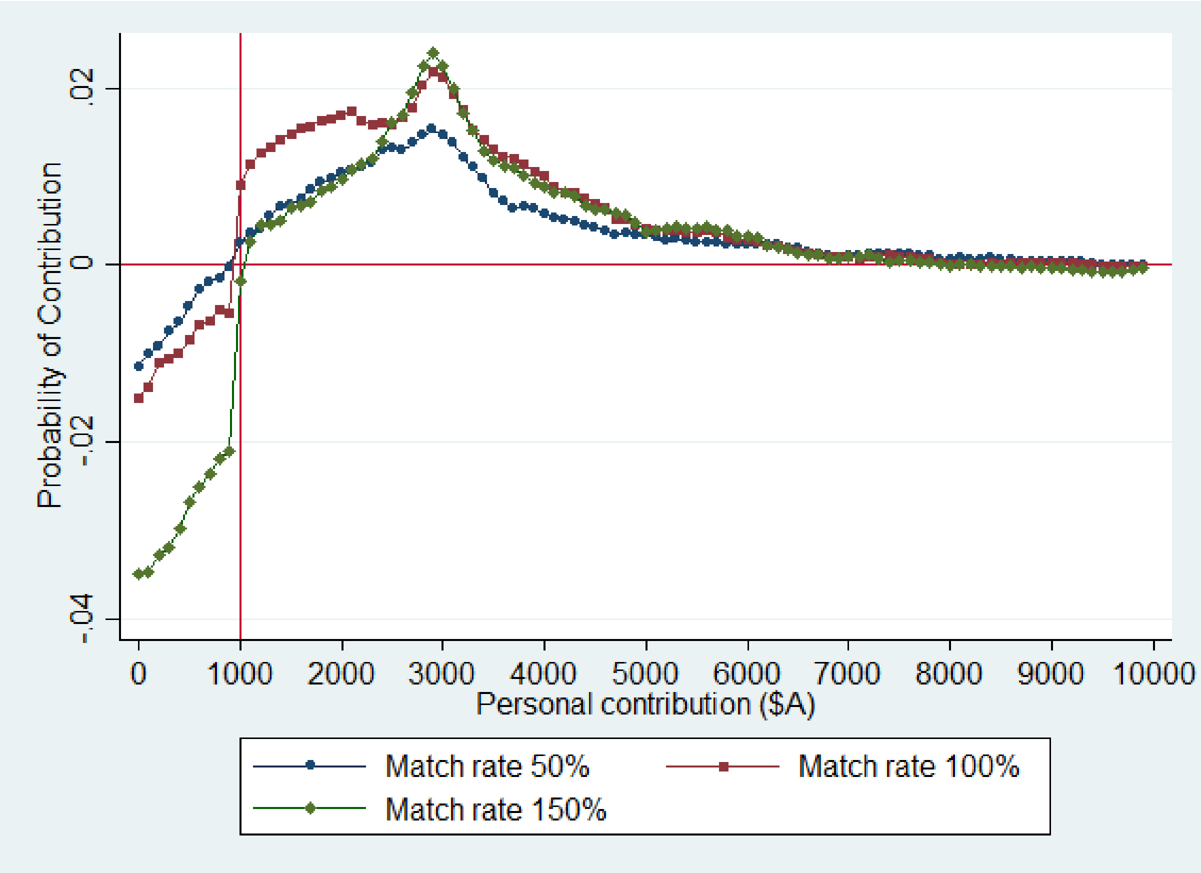
Notes: Estimated results from Equation (8) , *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Data on salary sacrifice, one of the two key elements of voluntary concessional contributions, is only available from 2009-10 onward.

Figure 5 presents the distributional impact of the matching scheme. It plots base model estimates for $\alpha_{0.5}^{c}, \alpha_{1.0}^{c}, \alpha_{1.5}^{c}$ -- the scheme's effect on the proportion contributing between \$0 and \$*c*. By plotting $\alpha_{0.5}^{c}, \alpha_{1.0}^{c}, \alpha_{1.5}^{c}$ for c = \$0, \$100, \$200, ..., \$10,000, the figure shows the scheme's effect on the cumulative distribution function of contributions. Consistent with the theoretical predictions presented in Table 5, we observe negative coefficients for *c* below \$1,000, implying reductions in the proportion of low contributors due to the substitution effect; a steep jump between c=\$900 and c=\$1,000, which is consistent with bunching at \$1,000.[25] The positive coefficients for *c* above \$1,000 imply reductions in the proportion of high contributors due to

[25] For c = 800 and 900, we observe $\alpha_{0.5}^{c}$ close to zero, possibly due to the income effect kicking in among some individuals with an eligible maximum strictly less than \$1,000.

the income effect. Interestingly, for c between \$1,000 and \$2,500, $\alpha_{1.5}^{c}$ is less positive than $\alpha_{0.5}^{c}$ and $\alpha_{1.0}^{c}$. This suggests that the 150% match rate generates substitution effects beyond the eligible maximum, that is, the high match rate entices some people to 'over-shoot'. This is consistent with a strong substitution effect for the 150% match rate below \$1,000, given by a strongly negative $\alpha_{1.5}^{c}$ coefficient.

Figure 5: Distributional impacts of the superannuation co-contribution scheme



Note: This represents $\alpha_{0.5}^{c}, \alpha_{1.0}^{c}, \alpha_{1.5}^{c}$ from the estimation of Equation 6 where $y_{it} = 1\{0 \leq pc_{it} \leq c\}$ and c = 0, \$100, \$200, ..., \$10,000.

Differences in responses to gains and losses in the matching entitlement (α^{+} versus α^{-}) are presented in Table 8. While we find asymmetric extensive margin responses, the most striking result is the stronger income effect under gains in matching entitlement relative to losses. Gains in retirement income from increases in matching entitlement are associated with reductions in high contributions, resulting in a \$45 reduction in average contributions. However, mirrored expected losses in retirement income from reductions in matching entitlement do not motivate a commensurate increase in contributions above the eligible maximum, resulting in a small \$5 increase in average contributions. Without corresponding increases in contributions above the eligible maximum, which would counter-act decreases below the eligible maximum, the net effect is that decreases in the contribution rate from entitlement losses are larger than increases from entitlement gains.

Table 8: Effect of gains and losses in co-contribution entitlement on voluntary personal contributions

Change in co-contribution entitlement	Contributions within defined ranges					Continuous measures
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1000\}$	$1\{\$0 < pc_{it} \leq \$1000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3000\}$	$1\{pc_{it} > \$3000\}$	Voluntary personal contribution (\$)
Increases	0.0172***	0.0160***	0.0253***	0.00822***	-0.0163***	-44.69***
(α^{+})	(11.07)	(24.69)	(18.37)	(6.60)	(-16.93)	(-9.91)
Decreases	0.0252***	0.00806***	0.0208***	0.0215***	-0.0170***	-4.67***
(α^{-})	(19.47)	(14.43)	(17.27)	(20.00)	(-20.73)	(-1.31)
Difference	-0.0080***	0.0080***	0.005**	-0.0132***	0.0008	-40.02***
($\alpha^{+} - \alpha^{-}$)	(-4.81)	(11.73)	(3.10)	(-9.99)	(0.76)	(-8.63)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839

Note: Estimated results from Equation (7), *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The asymmetric income effects are consistent with the Shefrin and Thaler (1988) mental accounting life-cycle model that suggest consumption-savings paths are set by people categorising choices into mental accounts and applying decision heuristics. In the context of our results, the model implies that people categorise increases in retirement income from the matching scheme as a 'current income bonus' that can be consumed straight away, but that the loss of the bonus is typically treated as external to consumption-savings decisions, and hence, does not motivate a boost in contributions (and a possible reduction in consumption). Similar asymmetric mental accounting has been observed in response to tax outcomes, where tax receipts lead to increased consumption, but tax payments lead to income smoothing to avoid reducing consumption (Baugh *et al*. 2021).

7.1. Heterogeneity in effects

In Table 9, we present effects by demographic characteristics, income level, use of a tax agent and level of superannuation balance, which provide several insights. First, indicative of the presence of liquidity constraints, we find that the cost of foregoing consumption to save more for retirement appears to be important in explaining differences in responses to the scheme. Specifically, we find eligibility for the scheme is associated with a relatively small extensive margin response among people with lower permanent income — a 1.1 percentage point increase in the proportion making voluntary personal contributions among those in the bottom two quintiles of permanent income, compared to a 4.1 percentage point increase for those in the top quintile. More importantly, we find stronger negative income effects among those in the lower two quintiles of permanent income. We find larger increases in contribution rates for those with higher discretionary income — a 4 percentage point increase in contributions for partnered females, compared with less than two percentage points for singles (males and females). Table 9 also shows an increasing response with age, which is likely to reflect the decreasing liquidity cost associated with making contributions the closer one is to the minimum age to access the pension fund.

Second, we find no evidence that the matching scheme helps people with low balances catch-up. For those with low balances (less than $25,000), the increase in the rate of contributions associated with treatment is around 0.7 percentage points, compared to around 2.26 percentage points for those with balances greater than $100,000. Interestingly, we observe an overall non-linear relationship between existing balances and the extensive margin, which appears to be because of very strong income effects for those with a balance over $100,000. Despite strong substitution effects that increase contributions below $1,000 by around 4.08 percentage points, we estimate a 4.07 percentage point reduction in contributions above $3,000.

Finally, we find no evidence that the low (extensive margin) response is due to information deficiencies. If a lack of information about the scheme was responsible for the low response rates, then we might expect that those who file their tax return through an agent should respond more strongly than those who file themselves because agents are likely to have better information. However, we estimate similar response rates among those who do and do not use a tax consultant. This is consistent with evidence from the ATO that suggests a high level of public awareness of the scheme. That said, we cannot rule out the possibility that low and middle-income earners use 'low-cost' tax agents that provide low quality or no financial advice.

Table 9: Effect of co-contribution entitlement on voluntary personal contributions, by select sub-groups

	Contribution within defined range				Continuous contribution measure	
Sub-group	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1000\}$	$1\{\$0 < pc_{it} \leq \$1000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3000\}$	$1\{pc_{it} > \$3000\}$	Voluntary personal contribution ($)
Individual permanent income						
Bottom quintile	0.0107***	0.00343***	0.0183***	0.0133***	-0.0209***	-46.01***
	(5.89)	(4.91)	(10.93)	(9.99)	(-23.25)	(-12.12)
2nd quintile	0.0107***	0.00239***	0.0134***	0.0143***	-0.0170***	-30.51***
	(6.60)	(4.03)	(8.64)	(11.12)	(-18.53)	(-8.53)
3rd quintile	0.0193***	0.00697***	0.0209***	0.0144***	-0.0159***	-24.77***
	(10.70)	(9.43)	(12.01)	(9.79)	(-16.33)	(-6.05)
4th quintile	0.0264***	0.0151***	0.0242***	0.0186***	-0.0164***	-17.10***
	(12.95)	(15.44)	(12.44)	(11.29)	(-13.98)	(-3.36)
Top quintile	0.0406***	0.0310***	0.0399***	0.0166***	-0.0158***	-2.458
	(16.85)	(22.28)	(17.72)	(8.86)	(-11.31)	(-0.35)
Partner and gender						
Single male	0.0105***	0.00454***	0.0142***	0.0120***	-0.0158***	-30.98***
	(6.29)	(6.86)	(9.31)	(9.34)	(-17.34)	(-7.61)
Partnered male	0.0156***	0.0102***	0.0167***	0.0123***	-0.0134***	-18.60***
	(9.05)	(13.51)	(10.41)	(8.85)	(-12.95)	(-3.90)
Single female	0.0186***	0.00737***	0.0240***	0.0139***	-0.0193***	-35.11***
	(10.18)	(9.09)	(14.16)	(9.76)	(-19.50)	(-7.91)
Partnered female	0.0398***	0.0230***	0.0365***	0.0231***	-0.0198***	-13.29**
	(21.67)	(23.29)	(20.89)	(15.85)	(-18.91)	(-2.92)

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Table 9 continued

Age						
Below 30	0.00941***	0.00253***	0.0157***	0.0135***	-0.0198***	-43.00***
	(6.21)	(4.53)	(11.24)	(11.43)	(-23.62)	(-12.50)
30-39	0.0134***	0.00397***	0.0154***	0.0135***	-0.0154***	-26.45***
	(8.35)	(6.26)	(10.10)	(10.58)	(-17.42)	(-7.27)
40-49	0.0256***	0.0130***	0.0239***	0.0185***	-0.0168***	-21.46***
	(13.66)	(15.49)	(13.47)	(12.20)	(-15.69)	(-4.69)
50-59	0.0353***	0.0238***	0.0340***	0.0169***	-0.0156***	-5.232
	(15.00)	(18.76)	(15.26)	(8.99)	(-11.66)	(-0.81)
60+	0.0439***	0.0398***	0.0463***	0.0139***	-0.0163***	-1.629
	(10.56)	(14.84)	(11.91)	(4.49)	(-6.59)	(-0.12)
Lagged superannuation balance[a]						
$S_{t-1} \leq \$25{,}000$	0.00734*	0.00309**	0.0164***	0.00341	-0.0125***	-29.89***
	(2.41)	(3.03)	(5.94)	(1.56)	(-8.36)	(-3.98)
$\$25{,}001 < S_{t-1} \leq \$50{,}000$	0.0257***	0.00922***	0.0245***	0.0152***	-0.0140***	-0.751
	(6.32)	(5.53)	(6.15)	(5.04)	(-6.56)	(-0.08)
$\$50{,}000 < S_{t-1} \leq \$100{,}000$	0.0302***	0.0162***	0.0231***	0.0244***	-0.0173***	-10.95
	(6.31)	(7.39)	(4.80)	(6.18)	(-6.33)	(-0.89)
$S_{t-1} > \$100{,}000$	0.0226**	0.0218***	0.0408***	0.0225***	-0.0407***	-99.41***
	(3.02)	(6.15)	(5.62)	(3.34)	(-7.47)	(-3.88)
Tax return lodged through a tax consultant						
Yes	0.0202***	0.0116***	0.0209***	0.0147***	-0.0154***	-20.55***
	(16.16)	(21.01)	(18.23)	(14.49)	(-19.96)	(-5.85)
No	0.0246***	0.0117***	0.0282***	0.0172***	-0.0208***	-32.49***
	(14.56)	(15.56)	(17.64)	(12.90)	(-21.58)	(-7.91)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839

Notes: Estimated results from a variant of Equation (6). [a] Estimated for matching rate of 50% only (N=439,528) because balances are only available in Alife from 2012-13 onward. t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

8. Conclusions and discussion

Targeted matching schemes are used in many OECD countries to incentivise low and middle-income earners to contribute to private pensions, but their effectiveness is theoretically ambiguous because of competing retirement income and substitution effects. For low and middle-income earners, negative income effects may be particularly important because of a priority for current consumption and/or precautionary savings. Studies to date on national targeted matching schemes (Duflo *et al.* 2006, Corneo *et al.* 2010, Ramnath 2013, Heim and Lurie 2014) have found modest responses, but with limited insight as to why. These studies have only examined overall effects, without exploring the relative importance of substitution and negative income effects. At least in terms of the Saver's Credit scheme, design complexity has been identified as a possible reason (Duflo *et al.* 2007).

In this study, we present a series of results that together suggest liquidity constraints and negative income effects, and not design complexity, are likely to be responsible for the modest responses of low and middle-income earners to targeted retirement matching schemes. First, despite the Superannuation Co-contribution Scheme including simple design features, as recommended by Duflo *et al.* (2007), and more generous match rates than previously examined, we find that the magnitude of extensive margin responses are similar to those from other national studies (1-3 percentage point increases). We find no evidence that the modest responses are due to a lack of understanding or awareness of the scheme, indicated by the positive relationship between the magnitude of responses and match rates and similar responses among people who did and did not lodge through a tax agent, respectively. The latter is also corroborated by two independent surveys (McNair Ingenuity Research 2008 and Australian National Audit Office 2010) that found around 80% public awareness of the scheme.

Second, we present the first estimates of impacts across the contribution distribution. We find that income effects are not negligible in size, as implicitly assumed in previous studies. Eligibility to the matching scheme is associated with reduced contributions above the eligible maximum ($1,000), a range where only income effects apply. This leads to a $35 reduction in the average contribution, which is 16% of the average personal contribution ($215) among the eligible. Results from sub-group analysis show stronger income effects (in absolute terms, and relative to extensive margin responses) amongst those likely to have lower 'discretionary' income — those with low permanent income and among non-partnered individuals. Combined with the evidence that strong negative income effects are *not* associated with increased holdings of liquid assets, this suggests that low and middle-income earners use their retirement-income windfall from the matching scheme to increase current consumption. We also find that the income effects generated by the scheme reduce *unmatched* contributions from employer-based sources, which broadens findings from previous (untargeted) matching studies (Benjamin 2003; Chernozhukov and Hansen 2004; Chetty *et al.* 2014, Messacar 2018).

Although we highlight the importance of income effects in Australia, internationally, their importance is likely to depend on pre-existing contribution levels. Prior to the rollout of the scheme in Australia, 14.5% of tax filers were already making voluntary personal contributions, and 7.2% contributed more than the eligible maximum of $1,000. While it is difficult to measure pre-existing contribution rates in other settings to put our results into context, there are two key reasons for high pre-existing personal contributions that are not unique to Australia. First, like pensions in Germany and Scandinavian countries, superannuation has almost universal coverage, which may make low and middle-income earners more likely to voluntarily contribute to private pensions. Second, low and middle-income earners may favour voluntary personal contributions over employer-based contributions. Voluntary personal contributions are made through payments from a personal bank account without requiring an employer-employee agreement to make automated deductions. This added flexibility, along with an aversion of low and middle-income earners to 'locking-in' contributions, means that we may observe high initial personal contributions despite concessional treatment of employer-based contributions.

Our study is also the first to show stronger responses to decreases in the matching entitlement compared to increases, which are related to differences in the magnitude of income effects. Specifically, we show that for those already contributing more than the eligible maximum, increases in the entitlement trigger strong reductions in contributions, most likely to fuel immediate consumption. However, losses in the matching entitlement elicit only weak increases in contributions. This asymmetric behaviour is consistent with mental accounting (Shefrin and Thaler 1988), where people categorise increases in the entitlement as a 'current income bonus' that can be consumed straight away, but that the loss of the bonus is treated as external to consumption-savings decisions. The implication is that once high contributors reduce their contributions, it becomes more difficult to increase them, possibly because it requires foregoing current consumption. This behaviour diminishes the prospect that early targeting of matching schemes can establish persistent savings behaviours over a working-life.

For countries with existing national matching programs, this study raises questions about the efficacy of these programs and about the merits of expanding them. For example, at the time of writing, US policy makers were considering reforms to the Saver's Credit scheme that would expand income thresholds to make more taxpayers eligible and change the scheme to a government co-contribution scheme where payments are made directly to retirement accounts irrespective of tax liability.[26] While these reforms may simplify the Saver's Credit scheme and make it more accessible, based on the findings from this study, the impacts of such reforms on retirement incomes of low and middle-income earners may be negligible. To the extent that the objective of targeted matching schemes is to increase the retirement income of low and middle-income earners, our findings suggest that policies that directly target income in retirement years may be more effective in meeting this end, especially means-tested government top-up payments to retirement accounts. That said, such an approach may discourage savings among low and middle-income earners, although the scant empirical evidence suggests that this may not happen in practice (Sefton *et al.* 2008).

[26] The Retirement Security and Savings Act of 2019, introduced by Senators Portman and Cardin, would (as of December 2021) simplify the Saver's Credit to make it closer in spirit to the Superannuation Co-contribution scheme. Changes under the bill include: increasing the income limits applicable to the Saver's Credit; making the credit refundable; and requiring that, instead of being credited directly to the taxpayer, the credit would be paid to a retirement plan. See https://www.congress.gov/bill/116th-congress/senate-bill/ (see s.1431 – Retirement Security and Savings Act of 2019).

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Appendix A: Program promotion and awareness

A component of the ATO's responsibilities in administering the Co-contribution Scheme is to communicate with clients (including superannuation funds and superannuation members) to ensure that they are aware of relevant elements of the Scheme. For communication with member, this means ensuring they understand eligibility and entitlement provisions so that they can decide on whether to participate in the scheme on an informed basis.

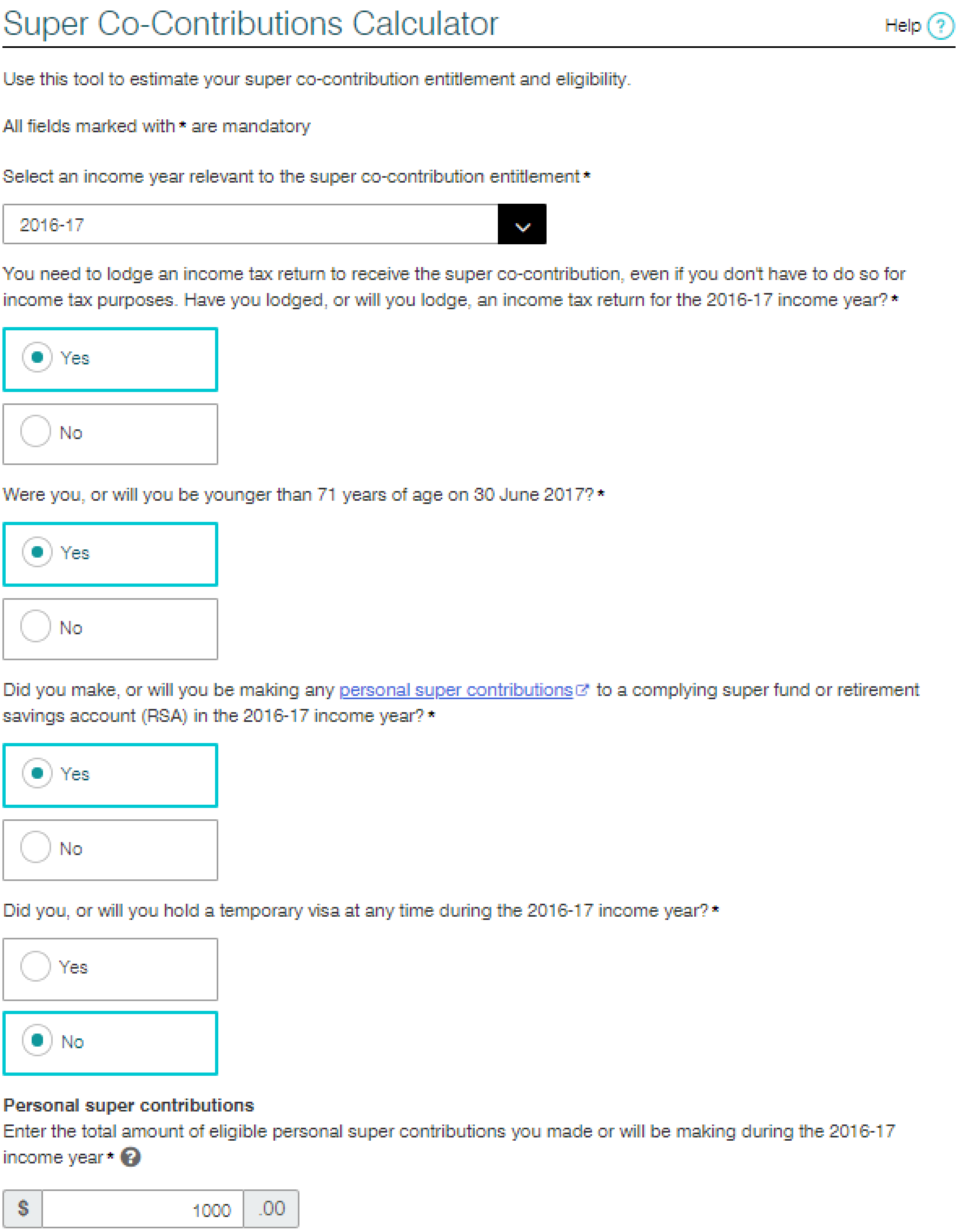
Table A.1: Major advertising campaigns of the Superannuation Co-contribution scheme

Approach	Date	Description
Initial co-contribution campaign	2004 & 2005	Mass media campaign, including television and radio, based on a piggy bank icon. There was also direct mailing of material explaining the co-contribution and a comprehensive public relations program including a website links program.
Better Super campaign	May 2007	Second and final mass media campaign to promote Super Simplification reforms, including the extension of the co-contribution to the self-employed.
Tax Office website	Ongoing	Detailed description of the Scheme, at <http://www.ato.gov.au/individuals/content.asp?doc=/Content/42616.htm>.
Super co-contribution – Saving for your Future brochure	2004 to 2009	Document outlining the main eligibility and entitlements provisions of the Scheme. Available in hard copy and online, utilised piggy bank icon, 12 pages long.
Other	Ongoing	Includes contributing articles to relevant media publications and having a Tax Office presence at superannuation events.

Source: Australian National Audit Office (2010).

Communication with superannuation members involves marketing campaigns to raise awareness of the scheme and major changes, which are summarised in Table A.1. Following the initial mass media campaign in 2004 and 2005, a consultant report commissioned by the ATO found 80% awareness of the scheme (on 1 July 2005) (Australian National Audit Office 2010). A subsequent nationally representative survey of 750 superannuants in September-October 2008 commissioned by the Association of Superannuation Funds of Australia found a 76% awareness of the scheme (McNair Ingenuity Research 2008).

Figure A.1: Screenshot of Superannuation Co-contribution online calculator



Super Co-Contributions Calculator

Help ?

Use this tool to estimate your super co-contribution entitlement and eligibility.

All fields marked with * are mandatory

Select an income year relevant to the super co-contribution entitlement *

2016-17

You need to lodge an income tax return to receive the super co-contribution, even if you don't have to do so for income tax purposes. Have you lodged, or will you lodge, an income tax return for the 2016-17 income year? *

- (•) Yes
- ( ) No

Were you, or will you be younger than 71 years of age on 30 June 2017? *

- (•) Yes
- ( ) No

Did you make, or will you be making any personal super contributions to a complying super fund or retirement savings account (RSA) in the 2016-17 income year? *

- (•) Yes
- ( ) No

Did you, or will you hold a temporary visa at any time during the 2016-17 income year? *

- ( ) Yes
- (•) No

Personal super contributions

Enter the total amount of eligible personal super contributions you made or will be making during the 2016-17 income year * ?

$ 1000 .00

Your estimated super co-contribution is: $367

Important information for the 2016-17 income year

Higher income threshold	$51,021.00
Lower income threshold	$36,021.00
Maximum super co-contribution	$500.00

The information you provided was used to estimate your super co-contribution entitlement

Eligible personal super contributions	$1,000.00
Income from employment	$40,000.00
Business income	$0.00
Business deductions	$0.00
Other income	$0.00
Reportable fringe benefits	$0.00
Reportable employer super contributions	$0.00

How did we calculate your super co-contribution amount?

We calculate your total income of $40,000 by adding your income from employment, business and other income to your reportable fringe benefits and reportable employer superannuation contributions (salary sacrifice) and then subtracting your allowable business deductions.

The formula for calculating your maximum co-contribution amount is the 'Maximum super co-contribution' for the year less the yearly 'reduction factor' multiplied by the difference between your total income and the 'Lower income threshold':

$500.00 - ($0.03333 * ($40,000 - $36,021.00))

The co-contribution you are entitled to is the lesser of:

- The 'Maximum super co-contribution' for the year of $500.00
- Your maximum co-contribution amount
- The amount of your 'Eligible personal super contributions' multiplied by 0.50

If your co-contribution entitlement is greater than $0 and less than $20 we will pay the minimum amount of $20

For more information refer to Super co-contribution.

Another key aspect of the ATO's co-contribution advertising campaign is the website co-contribution calculator (https://www.ato.gov.au/Calculators-and-tools/Super-co-contribution-calculator/). The online calculator estimates both peoples' eligibility and the government's co-contribution payment (see Figure A.1).

As well as promoting the scheme directly with members, the ATO actively engages with stakeholders to ensure the administration of the scheme is well understood, including through participation in superannuation consultative committees that include representatives from superannuation fund managers, accounting, legal and taxation industries, employer bodies and government agencies.

Appendix B: Matching schemes and the life cycle model

We construct a multi-period model to illustrate how a government matching scheme affects an individual's life cycle saving decisions. The model consists of a pre-retirement phase ($t = 1, \dots, T-1$) and a post-retirement phase ($t = T, \dots, T'$). In the pre-retirement phase, which is the focus of our model, the individual has a superannuation balance of A_t^S and a private asset (i.e., non-superannuation) balance of A_t^P at the beginning of each period. She receives a random draw of gross labor income y_t.[27] Based on the realization of y_t, she chooses her consumption c_t and *two* kinds of superannuation contributions. The first is personal contribution pc_t, which is made from her disposable, after-tax income via, say, a bank transfer to her superannuation account. The second is concessional contribution cc_t, which is made by arranging with her employer to 'salary sacrifice' part of her pre-tax income into her superannuation account. Both kinds of superannuation contributions are accumulated toward A^S, which is not accessible until the retirement phase. However, her private asset A^P is accessible in all periods, only subject to the no-borrowing constraint $A_t^P \geq 0 \; \forall t$ in an imperfect credit market. Therefore, A^P can be used to smooth consumption by insuring against low-income shocks in the future.

A key aspect of the model is differences in the adjustment costs between concessional and personal contributions. In practice, there are considerable adjustments costs associated with concessional contributions. Typically, it requires individual employees to initiate, and potentially negotiate with their employer, changes to their default employment contract that establishes or adjusts a salary sacrifice arrangement. Salary sacrifice arrangements give employers authority to automatically siphon a fixed amount of pre-tax income into employee superannuation accounts. In contrast, the cost of adjusting personal contributions is trivial because it can be done independently of an employer through personal deposits directly into superannuation accounts.[28] Reflecting these differences, we capture the concessional adjustment concession costs through the parameter γ. Besides the above contributions, the employer also makes a compulsory contribution (Superannuation Guarantee), which is

[27] We let y_t represent the total compensation inclusive of employer compulsory contributions. In addition, we abstract away from labor supply decisions in this theoretical model. While the government matching scheme may reduce labor supply theoretically, we expect it to play a limited role relative to those from typical transfer programs because the benefit taper rate is very low (see Section 3) and the benefit size is relatively small. We focus on saving decisions which is of first-order importance in this program.

[28] In addition, some individuals may not know the procedure of doing so due to information frictions.

assumed to be κy_t where $0 \leq \kappa < 1$; it can be viewed as a type of contribution that is infinitely costly to adjust by the individual.

Under a matching scheme, personal contributions pc_t are matched by the government at rate ϕ up to the maximum eligible personal contribution $\overline{pc}$.[29] Personal contributions beyond $\overline{pc}$ are not eligible for matching. The individual's concessional contributions cc_t and employer's compulsory contributions κy_t are taxed at a concessional rate τ_s where the tax is deducted from A_t^S.[30] Her labor income net of these contributions, given by $(1-\kappa)y_t - cc_t$, is taxed at the constant tax rate τ $(\tau > \tau_s)$, as is her income from the private asset A_t^P. Reflecting the generosity of matching relative to tax concessions among low and middle-income earners, it is natural to consider $\phi > \tau - \tau_s$, although this is not needed for deriving our results below.

Assuming intertemporally separable utility and discount factor β, the individual's utility maximization problem in $t = 1, \dots, T-2$ can be written in Bellman equation form as follows:

$$V_t(A_t^S, A_t^P, cc_{t-1}; y_t) \coloneqq \max_{pc_t \geq 0;\, cc_t \geq 0;\, \widetilde{A_t^P} \geq 0} \quad u(c_t) - \gamma 1\{cc_t \neq cc_{t-1}\} + \beta E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t) \tag{C.1}$$

subject to the following constraints:

$$c_t + \widetilde{A_t^P} = (1-\tau)[(1-\kappa)y_t - cc_t] - pc_t + A_t^P \tag{C.2}$$

$$A_{t+1}^P = [1 + r_p(1-\tau)]\widetilde{A_t^P} \tag{C.3}$$

$$A_{t+1}^S = [1 + r_s(1-\tau_s)][A_t^S + [(1-\tau_s)(\kappa y_t + cc_t) + pc_t + \phi \min\{pc_t, \overline{pc}\}]] \tag{C.4}$$

The individual is subject to utility cost γ if she adjusts her concessional contribution. Hence the expected value function $E_t V_{t+1}(.)$ has three state variables, which consist of assets A_t^S, A_t^P and the concessional contribution last period, cc_{t-1}. The expectation $E_t V_{t+1}(.)$ integrates out y_{t+1}, which is unknown in period t. The constraints (C.2)–(C.4) are explained as follows:

- (C.2): Resources in period t, which consist of disposable labor income $\tilde{Y}_t \coloneqq (1-\tau)[(1-\kappa)y_t - cc_t] - pc_t$ and the opening balance of the private asset A_t^P, are allocated between consumption c_t and the end-of-period balance $\widetilde{A_t^P}$.

[29] For simplicity, we assume that $\overline{pc}$ is invariant to y_t within the range of y_t concerned. See footnote ??? and Section 3 for a discussion.

[30] See Chan, Morris, Polidano and Vu (2020) for a separate analysis on tax concessions in retirement contributions, focusing on the incentives among high-income individuals.

- (C.3): The opening balance of private asset next period, A_{t+1}^P, equals $\widetilde{A_t^P}$ rewarded by an after-tax return factor $R_p \coloneqq 1 + r_p(1-\tau)$.
- (C.4): The end-of-period superannuation balance is equal to the opening balance A_t^S plus personal and after-match contributions, the latter being a piecewise linear function $pc_t + \phi \min\{pc_t, \overline{pc}\}$. The opening balance next period, A_{t+1}^S, equals the end-of-period balance this period rewarded by after-tax return factor $R_s \coloneqq 1 + r_s(1-\tau_s)$. Note that investment returns within superannuation are taxed at the concessional rate τ_s.

We now discuss the retirement phase ($t = T, \ldots, T'$), which is an absorbing state in which the individual receives no labor income and decumulates her assets.[31] Because superannuation becomes liquid, there is no longer a fundamental difference between A^S and A^P. To simplify the model, we assume $R_s > R_p$, which implies the individual prefers to place all her assets in superannuation in the retirement phase. Hence, we can write the value function at the start of the retirement phase as $V_T(A_T^S) \coloneqq \max\limits_{c_T,\ldots,c_{T'}} \sum_{t=T}^{T'} \beta^{t-T} u(c_t)$.

This function condenses the post-retirement optimal utilities as a terminal value, from which the optimal decisions during the work phase ($t = 1, \ldots, T-1$) are solved backward recursively.[32] Due to the adjustment cost, the solution at t proceeds as follows. Denote $J_t = 1$ if the individual adjusts her concessional contribution ($cc_t \neq cc_{t-1}$), and $J_t = 0$ otherwise ($cc_t = cc_{t-1}$). Given $J_t = 1$, the first order conditions for the optimization problem in (C.1) – (C.4) are as follows:

$$\widetilde{A_t^P}: \qquad \frac{\partial u}{\partial c_t} = \beta R_p \frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^P} \tag{C.5}$$

pc_t:

$$\textbf{Case A1}: (pc_t^* = 0): \qquad \frac{\partial u}{\partial c_t} > \beta R_S (1+\phi) \frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S} \tag{C.6}$$

---

[31] We abstract away from the Australian Age Pension, a public pension for retired individuals. Although its payments do not depend on pre-retirement earnings, they depend on asset tests (including superannuation). Theoretically, because higher assets reduce pension payment, the terminal value function $V_T(A_T^S)$ will become more concave as a result. In practice, the asset taper rate is very modest and is unlikely to influence our empirical results.

[32] When $t = T-1$, the Bellman equation is

$$V_{T-1}\left(A_{T-1}^S, A_{T-1}^P, cc_{T-2}; y_{T-1}\right) \coloneqq \max_{pc_{T-1}\geq 0;\, cc_{T-1}\geq 0; \widetilde{A_{T-1}^P}\geq 0} u(c_t) - \gamma 1\{cc_{T-1} \neq cc_{T-2}\} + \beta V_T(A_T^S)$$

where $\widetilde{A_{T-1}^P}^* = 0$, i.e., the private asset is shifted to superannuation or consumed.

Case A2: $(0 < pc_t^* < \overline{pc})$: $\frac{\partial u}{\partial c_t} = \beta R_S(1+\phi)\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S}$ (C.7)

Case A3: $(pc_t^* = \overline{pc})$: $\frac{\partial u}{\partial c_t} < \beta R_S(1+\phi)\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S}$ (C.8)

$$\frac{\partial u}{\partial c_t} > \beta R_S \frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S} \quad \text{(C.9)}$$

Case A4: $(pc_t^* > \overline{pc})$: $\frac{\partial u}{\partial c_t} = \beta R_S \frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S}$ (C.10)

cc_t:

Case B1: $(cc_t^* = 0)$: $\frac{\partial u}{\partial c_t} > \beta R_S \frac{1-\tau_S}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S} + \beta R_S \frac{1}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial cc_t}$ (C.11)

Case B2: $(cc_t^* > 0)$: $\frac{\partial u}{\partial c_t} = \beta R_S \frac{1-\tau_S}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S} + \beta R_S \frac{1}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial cc_t}$ (C.12)

Solving (C.5)–(C.12) yields the optimal choice conditional on $J_t = 1$, which is denoted by $(cc_{t;J_t=1}^*, pc_{t;J_t=1}^*, c_{t;J_t=1}^*)$. Given $J_t = 0$, we solve first-order conditions (C.5)–(C.10) and yield the optimal choice conditional on $J_t = 0$ as $(cc_{t-1}^*, pc_{t;J_t=0}^*, c_{t;J_t=0}^*)$. The solution ($cc_t^*$, pc_t^*, c_t^*) is then obtained by comparing the optimal value in (C.1) when setting the choice as $(cc_{t;J_t=1}^*, pc_{t;J_t=1}^*, c_{t;J_t=1}^*)$ against $(cc_{t-1}^*, pc_{t;J_t=0}^*, c_{t;J_t=0}^*)$. When $\gamma = 0$, the former yields a higher value than the latter. Yet when γ is sufficiently large, we have $(cc_t^*, pc_t^*, c_t^*) = (cc_{t-1}^*$, $pc_{t;J_t=0}^*, c_{t;J_t=0}^*)$ instead of $(cc_{t;J_t=1}^*, pc_{t;J_t=1}^*, c_{t;J_t=1}^*)$ as the solution, i.e., the individual does not adjust her concessional contribution.

We maintain the assumption that $u(.)$ is increasing and globally concave in c_t, $u(0) = -\infty$, $u'(0) = \infty$, and y_t follows a twice differentiable cumulative distribution function with continuous support over $\mathbb{R}_{\geq 0}$ and positive probability of $y_t = 0$. Overall, these conditions highlight trade-offs between consumption and multiple modes of saving through superannuation and the private asset (with optimal choices denoted by *):

FOC (C.5) equates the marginal utility of consumption with the marginal (expected) future value of wealth in the private asset. The equality implies that the individual holds positive private assets (i.e., $\widetilde{A_t^P}^* > 0$) to insure against income shocks.[33]

[33] Note that $\widetilde{A_t^P}^* = 0$ cannot be a solution as there is positive probability that $y_{t+1} = 0$ next period, in which case the utility equals negative infinity. It is optimal to have $\widetilde{A_t^P}^* > 0$ since $\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^P}|_{A_{t+1}^P=0} = \infty$.

- FOC (C.6)–(C.10) are the focus of our model, characterizing the trade-off between consumption and personal contributions, pc_t. This tradeoff depends on whether pc_t^* is zero (Case A1), between zero and $\overline{pc}$ (Case A2), at $\overline{pc}$ (Case A3), or above $\overline{pc}$ (Case A4). In Case A1, the expected marginal future value of increasing pc_t, $\beta R_S(1+\phi)\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S}$, is lower than the marginal utility of consumption $\frac{\partial u}{\partial c_t}$. In Case A2, both margins equalize to yield an interior solution. Case A3 represents the kink point $\overline{pc}$ where a further increase in pc_t is no longer matched. The individual would increase pc_t if $\overline{pc}$ was higher (3.8), and she would reduce pc_t if $\overline{pc}$ was lower (3.9). In Case A4, the margins in (3.9) equalize to yield a solution strictly above $\overline{pc}$.
- FOC (C.11)–(C.12) characterize the trade-off between consumption and concessional contributions, cc_t. Case B1 and B2 give the corner and interior solution, respectively. Increasing cc_t yields an expected future benefit of $\beta R_S \frac{1-\tau_S}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial A_{t+1}^S}$ where $\frac{1-\tau_S}{1-\tau}$ is the tax advantage. Importantly, it also entails an expected future disutility cost ($\beta R_S \frac{1}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial cc_t} < 0$) that arises because of the difficulty adjusting concessional contributions once they are made. In effect, low and middle-income earners become locked into future concessional contributions, which limits their ability to smooth consumption and insure against the adverse effects of negative income shocks.

Differences in adjustment costs between concessional contributions and personal contributions are important in explaining observed contribution behavior. To demonstrate, consider the alternative of no adjustment costs associated with concessional contributions ($\gamma = 0$). Under this scenario, people would no longer be locked into making future contributions and could instead adjust their contributions freely, meaning they would not suffer the disutility of foregone opportunities to insure against income shocks and smooth consumption ($\beta R_S \frac{1}{1-\tau}\frac{\partial E_t V_{t+1}(A_{t+1}^S, A_{t+1}^P, cc_t)}{\partial cc_t} = 0$). Under zero adjustment costs (from (C.6)–(C.12)), the relative magnitudes of pc_t^* and cc_t^* are determined purely by their relative payoff to making personal and concessional contributions, or $(1+\phi)$ and $\frac{1-\tau_S}{1-\tau}$ respectively. For low and middle-income earners, whose payoff to personal contributions is greater than for concessional contributions ($\frac{1-\tau_S}{1-\tau}$ <0), the prediction under zero adjustment costs is that personal contributions are prioritized over concessional contributions, but only up to the eligible maximum for matching ($pc_t = \overline{pc}$), after which concessional contributions are prioritised. However, in the presence of adjustment costs associated with concessional contributions, low and middle-income earners will tend to under-utilise concessional contributions and over-utilise personal contributions, in part, explaining the relatively high rate of low-to middle income earners making personal contributions above the $1,000 maximum eligible contribution (Table 2).

Comparative Statics

We focus on the effects of an increase in the match rate, ϕ. While the substitution effect will encourage personal contributions pc, the increased generosity of matches from the program will increase expected retirement income, which will reduce the marginal value of contributing to superannuation, i.e., $\frac{\partial E_t V_{t+1}(A^S_{t+1}, A^P_{t+1}, cc_t)}{\partial A^S_{t+1}}$ will become lower. This retirement income effect will counteract the substitution effect.

Table B.1 summarizes the model's predictions, which depend on the individual's initial level of personal contribution and whether there are retirement income effects. Panel A assumes away retirement income effects. The cells in regular font are similar to the price subsidy analysis in Chetty et al. (2014), while the cells in boldface are new.[34] Among individuals who contribute less than $\overline{pc}$ initially, the policy increases personal contributions and crowds out other forms of saving and consumption. Among individuals who contribute at least $\overline{pc}$ initially, there are no effects.

Panel B incorporates the retirement income effects. Among individuals who contribute less than $\overline{pc}$ initially, the policy generates a weaker positive effect on personal contributions (even at the extensive margin) due to the retirement income effect (see FOC C.6-C.7). We still expect crowding out of other forms of saving and, to a smaller extent, consumption.

Among individuals who contribute at least $\overline{pc}$ initially, the retirement income effect will reduce personal contributions (or no change if she is at kink point $\overline{pc}$). Interestingly, the retirement income effect will also reduce concessional contributions. This is because both

[34] Chetty et al. (2014) consider a two-period consumption-saving model with voluntary contribution and government compulsory contribution. Their model examines two policies: (1) a price subsidy to contribution, and (2) increased compulsory contribution. They only consider a simple price subsidy without a kink point. Also, unlike their model, we distinguish between two types of voluntary contributions (pc and cc). They consider active savers as well as passive savers who keep the voluntary contribution fixed. The latter is akin to setting $\gamma = \infty$ in our model, i.e., individuals keep cc fixed.

personal and concessional contributions accumulate the same type of wealth (A^S; see FOC C.11-C.12). These reduced contributions will be reallocated to more liquid forms of savings and/or consumption.

Table B.1: Predicted response to an increase in match rate ϕ

Initial level of personal contribution	Predicted response on: Personal contribution (pc)	Concessional contribution (cc)	Non-superannuation saving ($\widetilde{A^P} - A^P$)	Consumption (c)
	Panel A: no retirement income effect			
0	Positive	**Negative**	Negative	Negative
$\in (0, \overline{pc})$	Positive	**Negative**	Negative	Negative
$\overline{pc}$	**No effect**	**No effect**	**No effect**	**No effect**
$> \overline{pc}$	**No effect**	**No effect**	**No effect**	**No effect**
	Panel B: with retirement income effect			
0	**Weaker positive**	**Negative**	**Negative**	**Weaker negative**
$\in (0, \overline{pc})$	**Weaker positive**	**Negative**	**Negative**	**Weaker negative**
$\overline{pc}$	**No effect**	**Negative**	**Sum positive**	
$> \overline{pc}$	**Negative**	**Negative**	**Sum positive**	

On a final note, we expect the retirement income effect to be stronger among low/mid-income individuals. This is a typical feature in precautionary consumption-saving models, where these individuals tend to "under consume" due to credit constraints. Intuitively, higher retirement income will make them shift their resources to "higher priority use" such as consumption or building liquid wealth.

Appendix C: Additional results

Modelling full and partial eligibility separately

The base model considers a binary eligibility status ($E_{it} \coloneqq 1\{\overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) > 0\}$), but for those whose income is in the tapered range, the maximum eligible personal contribution is less than \$1,000 (partial eligibility). To examine differences in responses to full and partial eligibility, we extend the base model as follows. We denote full eligibility by $E_{it}^{f} \coloneqq 1\{\overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) = 1000\}$ and partial eligibility by $E_{it}^{p} \coloneqq 1\{0 < \overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) < 1000\}$. We can then define $3 \times 2 = 6$ different entitlements in the same spirit as the base model — $C_{\phi,it}^{p}$ and $C_{\phi,it}^{f}$ for short, where $\phi = \{0.5,1.0,1.5\}$, $C_{\phi,it}^{p} = 1\{\phi_t = \phi\}E_{it}^{p}$ and $C_{\phi,it}^{f} = 1\{\phi_t = \phi\}E_{it}^{f}$. The extended model is:

$$\begin{aligned}\Delta y_{it} = \textstyle\sum_{\phi=0.5}^{1.5} \widetilde{\alpha_{\phi}^{p}} \Delta C_{\phi,it}^{p} + \sum_{\phi=0.5}^{1.5} \widetilde{\alpha_{\phi}^{f}} \Delta C_{\phi,it}^{f} + \sum_{\phi=0.5}^{1.5} \widetilde{\widetilde{\alpha_{\phi}^{p}}} \Delta C_{\phi,it-1}^{p} + \\ \textstyle\sum_{\phi=0.5}^{1.5} \widetilde{\widetilde{\alpha_{\phi}^{f}}} \Delta C_{\phi,it-1}^{f} + \sum_{m=1}^{3} \tilde{\beta}_m \Delta(inc_{it}^{m}) + \sum_{m=1}^{3} \tilde{\tilde{\beta}}_m \Delta(inc_{it-1}^{m}) + x_{it}'\gamma + \delta_t + \epsilon_{it}\end{aligned} \tag{C.13}$$

The model becomes more complicated to interpret, as there are 49 possible within-individual variations in eligibility and match rates.

In Table C.1 below, we present results for the total impacts of co-contribution eligibility in current and previous period ($\alpha_{\phi}^{p} = \widetilde{\alpha_{\phi}^{p}} + \widetilde{\widetilde{\alpha_{\phi}^{p}}}, \alpha_{\phi}^{f} = \widetilde{\alpha_{\phi}^{f}} + \widetilde{\widetilde{\alpha_{\phi}^{f}}}$). These results are consistent with the base model results — small positive impacts on the extensive margin, significant bunching at the eligible maximum of \$1000, and significant negative income effects above \$3,000 that lead to significant reductions in average contributions (intensive margin). Results from this model also demonstrate that individual responses are not highly sensitive to partial/full eligibility, which supports the use of the more parsimonious base model. Finally, results in Table C.1 highlight the importance of the salient maximum eligible contribution — partial co-contribution eligibility still elicits bunching of contributions at \$1000.

Table C.1: Estimation results that distinguish between partial and full co-contribution eligibility

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution ($)	Voluntary personal contribution plus gov. co-contribution ($)
Base model results							
$\alpha_{0.5}$	0.0115^{***}	0.00207^{**}	0.0139^{***}	0.0121^{***}	-0.0146^{***}	-34.38^{***}	-23.85^{***}
	(6.66)	(3.05)	(8.79)	(9.31)	(-15.77)	(-7.61)	(-5.13)
$\alpha_{1.0}$	0.0151^{***}	0.0129^{***}	0.0242^{***}	0.0121^{***}	-0.0212^{***}	-50.48^{***}	15.49^{**}
	(9.14)	(19.09)	(16.05)	(9.34)	(-21.65)	(-10.95)	(3.19)
$\alpha_{1.5}$	0.0349^{***}	0.0171^{***}	0.0330^{***}	0.0243^{***}	-0.0225^{***}	-19.99^{***}	113.0^{***}
	(19.14)	(21.57)	(19.65)	(15.98)	(-18.92)	(-3.80)	(20.27)
Model that distinguishes between partial and full eligibility							
$\alpha^p_{0.5}$	0.012^{***}	0.0035^{***}	0.014^{***}	0.010^{***}	-0.013^{***}	-32.0^{***}	-21.5^{***}
	(6.12)	(4.59)	(8.17)	(7.30)	(-13.82)	(-6.92)	(-4.46)
$\alpha^p_{1.0}$	0.018^{***}	0.011^{***}	0.023^{***}	0.015^{***}	-0.019^{***}	-38.4^{***}	25.9^{***}
	(10.46)	(15.92)	(14.06)	(10.93)	(-19.57)	(-8.27)	(5.23)
$\alpha^p_{1.5}$	0.038^{***}	0.015^{***}	0.031^{***}	0.027^{***}	-0.021^{***}	-8.15	120.4^{***}
	(20.64)	(17.85)	(18.24)	(17.88)	(-17.89)	(-1.61)	(22.06)
$\alpha^f_{0.5}$	0.0081^{***}	0.0071^{***}	0.024^{***}	0.0020	-0.018^{***}	-59.7^{***}	-39.2^{***}
	(3.74)	(7.70)	(11.68)	(1.25)	(-15.68)	(-10.38)	(-6.53)
$\alpha^f_{1.0}$	0.010^{***}	0.022^{***}	0.037^{***}	-0.0028	-0.024^{***}	-82.8^{***}	-3.12
	(4.99)	(21.18)	(18.94)	(-1.84)	(-22.42)	(-15.42)	(-0.53)
$\alpha^f_{1.5}$	0.029^{***}	0.030^{***}	0.050^{***}	0.0033	-0.025^{***}	-61.0^{***}	96.5^{***}
	(12.66)	(25.31)	(23.45)	(1.95)	(-20.45)	(-10.36)	(14.39)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839

Notes: Estimated results from Equation (6) and Equation (C.13), t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Results from separate sources of identification

In section 6.1, we discuss the possible threat to identification from our modelling assumptions. To test this, we split the sample into two subsamples (Table C.2): (1) years that involve a policy change (light-shaded years), plus pre-sample years (dark-shaded years); and (2) years with the program in place but without changes in policy (unshaded years). In the first subsample, identification is mainly from changes to policy, while in the second subsample, identification is mainly from consecutive-year changes in eligibility triggered by changes in personal income. Separate base models (equation (6)) are estimated using the two sub-samples. To increase the number of years for which we can identify results, the models are estimated without the lagged changes. The similarity of results using the two sub-samples and on an overall sample (Table C.3) suggests that results are not sensitive to the source of identification.

Table C.2: Sources of changes in co-contribution entitlement by year

Financial Year	Match rate (ϕ)	Upper income threshold (inc_{Ut})	Within-person changes in co-contribution entitlement $\Delta C_{it} = C_{it} - C_{it-1}$							Total count
			-1.5	-1	-0.5	0	+0.5	+1	+1.5	
2000-01	0	-	0	0	0	72,972	0	0	0	72,972
2001-02	0	-	0	0	0	74,592	0	0	0	74,592
2002-03	0	-	0	0	0	76,166	0	0	0	76,166
2003-04	1	40,000	0	0	0	34,664	0	44,016	0	78,680
2004-05	1.5	58,000	0	1,008	0	17,641	45,919	0	16,511	81,079
2005-06	1.5	58,000	5,384	0	0	75,417	0	0	2,417	83,218
2006-07	1.5	58,000	6,022	0	0	76,001	0	0	2,555	84,578
2007-08	1.5	58,980	5,965	0	0	78,119	0	0	3,073	87,157
2008-09	1.5	60,342	5,425	0	0	81,269	0	0	3,700	90,394
2009-10	1	61,920	5,515	0	58,029	24,084	0	3,547	0	91,175
2010-11	1	61,920	0	6,662	0	83,044	0	3,030	0	92,736
2011-12	1	61,920	0	6,713	0	83,922	0	3,298	0	93,933
2012-13	0.5	46,920	0	20,278	38,944	33,781	1,530	0	0	94,533
2013-14	0.5	48,516	0	0	5,999	83,390	5,322	0	0	94,711
2014-15	0.5	49,488	0	0	6,484	84,750	4,830	0	0	96,064
2015-16	0.5	50,450	0	0	7,172	85,355	4,772	0	0	97,299
2016-17	0.5	51,021	0	0	6,913	87,011	5,028	0	0	98,952
Total			28,311	34,661	123,541	1,152,178	67,401	53,891	28,256	1,488,239

Notes: Dark-shaded years are those in which there was no co-contribution program. Light-shaded years are those in which the policy settings changed.

Table C.3: Estimation results by source of identification (base model without lagged changes)

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \le \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \le \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution ($)	Voluntary personal plus gov. co-contribution ($)
Full sample: All sources of identification							
$\alpha_{0.5}$	0.0027*	0.00051	0.0082***	0.0016	-0.0071***	-26.5***	-17.9***
	(2.41)	(1.07)	(7.23)	(1.80)	(-12.00)	(-9.13)	(-6.03)
$\alpha_{1.0}$	0.0029**	0.0074***	0.013***	0.00078	-0.011***	-37.3***	19.5***
	(2.64)	(15.76)	(12.23)	(0.90)	(-17.50)	(-13.43)	(6.69)
$\alpha_{1.5}$	0.017***	0.012***	0.023***	0.0077***	-0.013***	-22.0***	97.4***
	(13.02)	(19.80)	(17.22)	(6.87)	(-16.11)	(-6.10)	(25.17)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839
Subsample 1: Identification mainly from changes in the policy settings							
$\alpha_{0.5}$	0.0034	0.000063	0.0076***	0.0040**	-0.0082***	-30.6***	-25.3***
	(1.79)	(0.07)	(3.89)	(2.76)	(-8.73)	(-6.82)	(-5.18)
$\alpha_{1.0}$	0.0035*	0.0086***	0.015***	0.000016	-0.012***	-44.2***	18.4***
	(2.53)	(14.91)	(11.16)	(0.02)	(-15.29)	(-12.51)	(4.95)
$\alpha_{1.5}$	0.023***	0.015***	0.028***	0.0100***	-0.015***	-24.5***	112.7***
	(12.68)	(21.49)	(16.56)	(6.82)	(-13.59)	(-4.89)	(21.40)
N	452,065	452,065	452,065	452,065	452,065	452,065	452,065
Subsample 2: Identification mainly from within-person changes in income							
$\alpha_{0.5}$	0.0017	0.0010	0.0085***	-0.00066	-0.0061***	-25.6***	-13.6***
	(1.26)	(1.92)	(6.31)	(-0.62)	(-8.43)	(-6.99)	(-3.68)
$\alpha_{1.0}$	0.010***	0.0054***	0.010***	0.011***	-0.012***	-8.20	44.3***
	(4.67)	(5.49)	(4.77)	(6.01)	(-7.97)	(-1.40)	(7.28)
$\alpha_{1.5}$	0.013***	0.010***	0.020***	0.0049**	-0.012***	-24.2***	80.7***
	(6.73)	(11.00)	(10.21)	(3.10)	(-10.46)	(-4.77)	(14.69)
N	835,774	835,774	835,774	835,774	835,774	835,774	835,774

Notes: Estimated results from Equation (6) without lagged variables. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Placebo test

Because eligibility of the scheme is determined by income, a threat to identification is that our results may be driven by different changes in contributions, which are resulted from changes in income, that are correlated with the changes in co-contribution policies. To test this, we impose placebo instead of real income eligibility thresholds to the data (Table C.4). These placebo thresholds mimic real eligibility thresholds in terms of changes and timing (from Table 1 in the main text) but are set at a higher level than the real values (starting from \$90,000 in 2003/04). Estimation is carried out on a sample of individuals with income exceeding \$70,000. (These individuals are ineligible for the real program.) For simplicity, we estimate the base model (equation 6) without the lagged variables.

Table C.4: Superannuation co-contribution placebo 'eligibility' assignment

Financial year	Upper Income thresholds	Match Rate
2003-04	90,000	100%
2004-05	110,000	150%
2005-06	110,000	150%
2006-07	110,000	150%
2007-08	110,000	150%
2008-09	110,000	150%
2009-10	112,000	100%
2010-11	112,000	100%
2011-12	112,000	100%
2012-13	96,000	50%
2013-14	97,000	50%
2014-15	98,000	50%
2015-16	99,000	50%
2016-17	100,000	50%

The main coefficients of interest ($\alpha'_{0.5}$, $\alpha'_{1.0}$, $\alpha'_{1.5}$), which correspond to the effects of placebo eligibility thresholds and match rates (50%, 100%, 150%), are close to zero and mostly insignificant (Table C.5). This provides supportive evidence that results are not driven by divergent trends in contribution adjustments from different income groups. The exception is significant differences in the likelihood that people will contribute the eligible maximum (\$1,000), but the effects are economically insignificant.

Table C.5: Estimation results using placebo co-contribution eligibility

	Contributions within defined ranges					Continuous contribution measures
	$1\{pc_{it} >$ \$0\}	$1\{pc_{it}$ = \$1,000\}	1\{\$0 $< pc_{it}$ ≤ \$1,000\}	1\{\$1,000 $< pc_{it}$ ≤ \$3,000\}	$1\{pc_{it}$ > \$3,000\}	Voluntary personal contribution (\$)
*Base model with **real** eligibility thresholds*						
$\alpha_{0.5}$	0.0115***	0.00207**	0.0139***	0.0121***	-0.0146***	-34.38***
	(6.66)	(3.05)	(8.79)	(9.31)	(-15.77)	(-7.61)
$\alpha_{1.0}$	0.0151***	0.0129***	0.0242***	0.0121***	-0.0212***	-50.48***
	(9.14)	(19.09)	(16.05)	(9.34)	(-21.65)	(-10.95)
$\alpha_{1.5}$	0.0349***	0.0171***	0.0330***	0.0243***	-0.0225***	-19.99***
	(19.14)	(21.57)	(19.65)	(15.98)	(-18.92)	(-3.80)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839
*Base model with **placebo** eligibility thresholds*						
$\alpha'_{0.5}$	-0.00140	-0.0000804	0.00128	-0.00163	-0.00105	-12.19*
	(-0.86)	(-0.31)	(0.89)	(-1.33)	(-0.98)	(-2.18)
$\alpha'_{1.0}$	-0.00121	0.00136**	-0.00127	-0.00171	0.00177	5.476
	(-0.58)	(3.23)	(-0.72)	(-1.08)	(1.24)	(0.73)
$\alpha'_{1.5}$	0.00330	0.00160**	0.00319	-0.00249	0.00259	9.894
	(1.29)	(2.60)	(1.44)	(-1.24)	(1.40)	(1.00)
N	289,404	289,404	289404	289,404	289,404	289,404

Notes: In the model using placebo rules, eligibility thresholds and match rates are defined in Table C.4, the sample consists of individuals with income of at least \$70K, and the model is estimated without lagged variables. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Removing the lagged response to co-contribution entitlement

In the base model, responses to changes in matching entitlement may occur both in the same year that the entitlement changed and in following year. This allows for delays in responses that may come about because of inertia, or the time taken for people to realise their entitlement has changed. Significant lag effects in Table 6 suggests that there are delays in the response to changes in entitlement, and that this flexible model is preferable to one where lag effects are not captured. In Table C.6 below, we estimate a more parsimonious version of the base model without lagged entitlement changes and without lagged income shocks. Comparing results from the first and second panels in Table C.6, we conclude that excluding the lagged terms produces results that are qualitatively similar, but smaller in magnitude.

Table C.6: Estimation of the base model with and without lagged terms

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution ($)	Voluntary personal plus gov. co-contribution ($)
Base model							
$\alpha_{0.5}$	0.0115***	0.00207**	0.0139***	0.0121***	-0.0146***	-34.38***	-23.85***
	(6.66)	(3.05)	(8.79)	(9.31)	(-15.77)	(-7.61)	(-5.13)
$\alpha_{1.0}$	0.0151***	0.0129***	0.0242***	0.0121***	-0.0212***	-50.48***	15.49**
	(9.14)	(19.09)	(16.05)	(9.34)	(-21.65)	(-10.95)	(3.19)
$\alpha_{1.5}$	0.0349***	0.0171***	0.0330***	0.0243***	-0.0225***	-19.99***	113.0***
	(19.14)	(21.57)	(19.65)	(15.98)	(-18.92)	(-3.80)	(20.27)
Base model without lags							
$\alpha_{0.5}$	0.0027*	0.00051	0.0082***	0.0016	-0.0071***	-26.5***	-17.9***
	(2.41)	(1.07)	(7.23)	(1.80)	(-12.00)	(-9.13)	(-6.03)
$\alpha_{1.0}$	0.0029**	0.0074***	0.013***	0.00078	-0.011***	-37.3***	19.5***
	(2.64)	(15.76)	(12.23)	(0.90)	(-17.50)	(-13.43)	(6.69)
$\alpha_{1.5}$	0.017***	0.012***	0.023***	0.0077***	-0.013***	-22.0***	97.4***
	(13.02)	(19.80)	(17.22)	(6.87)	(-16.11)	(-6.10)	(25.17)
N	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839	1,287,839

Notes: Estimated results from Equation (6) with and without lagged variables. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Appendix D: Full base model results

Table D.1: Effect of co-contribution entitlement on voluntary personal contributions, full results

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution ($)	Voluntary personal contribution plus gov. co-contribution ($)
$\alpha_{0.5}$	0.0115***	0.00207**	0.0139***	0.0121***	-0.0146***	-34.38***	-23.85***
	(6.66)	(3.05)	(8.79)	(9.31)	(-15.77)	(-7.61)	(-5.13)
$\alpha_{1.0}$	0.0151***	0.0129***	0.0242***	0.0121***	-0.0212***	-50.48***	15.49**
	(9.14)	(19.09)	(16.05)	(9.34)	(-21.65)	(-10.95)	(3.19)
$\alpha_{1.5}$	0.0349***	0.0171***	0.0330***	0.0243***	-0.0225***	-19.99***	113.0***
	(19.14)	(21.57)	(19.65)	(15.98)	(-18.92)	(-3.80)	(20.27)
Contemporaneous coefficients							
$\tilde{\alpha}_{0.5}$	0.0050***	0.00089	0.0096***	0.0041***	-0.0088***	-27.8***	-18.5***
	(4.39)	(1.91)	(8.71)	(4.67)	(-14.75)	(-9.51)	(-6.18)
$\tilde{\alpha}_{1.0}$	0.0064***	0.0089***	0.016***	0.0041***	-0.014***	-40.6***	18.7***
	(5.78)	(19.46)	(15.47)	(4.68)	(-21.31)	(-13.76)	(6.10)
$\tilde{\alpha}_{1.5}$	0.021***	0.013***	0.025***	0.011***	-0.015***	-21.5***	100.4***
	(15.92)	(22.14)	(19.42)	(10.08)	(-18.34)	(-6.00)	(26.20)
Lagged coefficients							
$\tilde{\tilde{\alpha}}_{0.5}$	0.0065***	0.0012**	0.0043***	0.0080***	-0.0058***	-6.54*	-5.36
	(5.56)	(2.58)	(3.89)	(9.25)	(-9.51)	(-2.19)	(-1.73)
$\tilde{\tilde{\alpha}}_{1.0}$	0.0087***	0.0040***	0.0080***	0.0080***	-0.0073***	-9.89***	-3.23
	(8.45)	(8.67)	(7.90)	(9.66)	(-12.32)	(-3.65)	(-1.10)
$\tilde{\tilde{\alpha}}_{1.5}$	0.014***	0.0039***	0.0080***	0.013***	-0.0073***	1.53	12.6***
	(11.32)	(6.94)	(6.70)	(12.83)	(-9.41)	(0.43)	(3.33)

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Table D.1 continued

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution (\$)	Voluntary personal contribution plus gov. co-contribution (\$)
$\Delta(inc_{it})$	0.29***	-0.078***	-0.084***	0.27***	0.10***	1024.8***	621.9***
	(14.35)	(-11.75)	(-5.31)	(17.11)	(8.30)	(14.39)	(9.15)
$\Delta(inc_{it}^2)$	-0.22***	0.065***	0.078***	-0.20***	-0.099***	-845.3***	-509.2***
	(-6.11)	(7.23)	(3.82)	(-7.07)	(-4.65)	(-5.97)	(-4.26)
$\Delta(inc_{it}^3)$	0.034***	-0.010***	-0.012**	0.030***	0.016***	131.1***	80.5***
	(4.39)	(-4.85)	(-3.13)	(4.70)	(3.74)	(4.25)	(3.40)
$\Delta(inc_{it-1})$	0.072***	-0.017**	0.026	0.049***	-0.0028	136.4*	205.2***
	(3.99)	(-2.62)	(1.68)	(3.82)	(-0.27)	(2.37)	(3.45)
$\Delta(inc_{it-1}^2)$	-0.073**	0.016**	-0.012	-0.035**	-0.027	-259.3**	-314.1***
	(-2.94)	(2.62)	(-0.60)	(-2.95)	(-1.83)	(-3.08)	(-3.66)
$\Delta(inc_{it-1}^3)$	0.014**	-0.0034**	0.00047	0.0073**	0.0066*	56.2**	60.6**
	(2.83)	(-2.74)	(0.14)	(3.10)	(2.15)	(2.95)	(3.19)
$\Delta(spousal\ inc_{it})$	4.1e-09	-4.9e-10	4.7e-09	-4.7e-10	-1.6e-10	0.0000025	0.0000034
	(1.56)	(-0.66)	(1.39)	(-0.35)	(-0.82)	(1.07)	(1.19)
$\Delta(spousal\ inc_{it-1})$	3.3e-09	-1.5e-10	6.7e-09*	-3.6e-09	1.3e-10	-0.0000011	0.00000099
	(1.37)	(-0.40)	(2.33)	(-1.93)	(0.79)	(-0.48)	(0.33)
$Age\ at\ 30\ June_{it}$	-0.00031***	0.000041	-0.00070***	-0.00023***	0.00062***	3.06***	3.40***
	(-3.98)	(1.17)	(-10.92)	(-4.29)	(14.82)	(12.65)	(13.15)
$Age\ at\ 30\ June_{it}^2$	-0.00000018	-0.00000010	0.0000083***	0.000000066	-0.0000086***	-0.044***	-0.049***
	(-0.19)	(-0.23)	(10.53)	(0.10)	(-16.17)	(-14.19)	(-14.81)

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Table D.1 continued

	Contributions within defined ranges					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Voluntary personal contribution (\$)	Voluntary personal contribution plus gov. co-contribution (\$)
$Married_{it}$	-0.00021	0.00048***	0.000029	-0.000028	-0.00021	-0.92	-0.51
	(-0.64)	(4.53)	(0.11)	(-0.12)	(-1.18)	(-0.95)	(-0.50)
$\Delta(Married_{it})$	0.0015	0.000060	0.00044	0.0011	-0.000048	2.24	2.99
	(1.43)	(0.16)	(0.44)	(1.40)	(-0.10)	(0.96)	(1.17)
$\Delta(Married_{it-1})$	0.0013	0.00072*	0.0012	0.00070	-0.00056	1.20	2.41
	(1.28)	(1.97)	(1.17)	(0.89)	(-1.08)	(0.50)	(0.92)
$Female_{it}$	0.0051***	0.00030***	0.0016***	0.0028***	0.00074***	7.80***	8.28***
	(20.75)	(3.43)	(8.28)	(15.90)	(5.62)	(10.33)	(10.49)
$Self\ employed_{it}$	0.0025**	0.00012	-0.00024	0.0022***	0.00052	5.80*	5.88*
	(2.85)	(0.33)	(-0.33)	(3.56)	(1.10)	(2.21)	(2.09)
$\Delta(Self\ employed_{it})$	0.0026	0.000029	0.0069***	-0.0018	-0.0025***	-11.8**	-13.4**
	(1.71)	(0.04)	(4.84)	(-1.72)	(-3.50)	(-3.07)	(-3.21)
$\Delta(Self\ employed_{it-1})$	-0.0013	-0.00065	0.0018	-0.0023*	-0.00081	-6.67	-6.81
	(-0.84)	(-1.04)	(1.26)	(-2.15)	(-1.19)	(-1.84)	(-1.71)
$Lodged\ tax\ through\ agent_{it}$	-0.0042***	-0.00039**	-0.0019***	-0.0014***	-0.00094***	-9.87***	-11.2***
	(-12.38)	(-3.06)	(-6.79)	(-5.84)	(-5.29)	(-9.88)	(-10.61)
$\Delta(Lodged\ tax\ through\ agent_{it})$	0.0040***	0.00027	0.0028***	0.0014*	-0.00020	6.33***	8.62***
	(4.99)	(0.82)	(3.49)	(2.39)	(-0.54)	(3.50)	(4.34)
$\Delta(Lodged\ tax\ through\ agent_{it-1})$	0.0022**	0.00013	0.00072	0.0018**	-0.00034	2.88	3.78*
	(2.87)	(0.41)	(0.95)	(3.18)	(-0.91)	(1.67)	(1.98)
N	1287839	1287839	1287839	1287839	1287839	1287839	1287839

Notes: Estimated results from Equation (6), t statistics in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001. All income is total personal income or total personal income of spouse reported in annual tax returns in Australian dollars (2020 terms).

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