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Marc Chan
University of Melbourne and Australian National University

Cain Polidano
Melbourne Institute, Australian National University and ARC Centre

Ha Vu
Deakin University and Australian National University

Roger Wilkins
Melbourne Institute, Australian National University and IZA

Andrew Carter
Australian National University and Australian Taxation Office

Hang To
Australian National University and Australian Taxation Office

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

How Effective are Matching Schemes in Enticing Low-income Earners to Save More for Retirement? Evidence from a National Scheme*

Concerns over the adequacy of low and middle-income earner contributions to retirement plans have led governments to introduce targeted matching schemes. In this study, we examine the effects of a simple and generous Australian scheme using administrative tax-filer data, exploiting longitudinal changes in eligibility and match rates. We find small increases in the proportion who contribute and bunching at the eligible maximum, but lower average contributions because the matching payment displaces contributions of high contributors. Contributions through unmatched channels are also crowded out. These findings highlight the difficulties of targeting matching schemes and question the merits of simplifying them.

JEL Classification: I3, J14, H55

Keywords: private pension, matching schemes, retirement income, aging population

Corresponding author:
Cain Polidano
Melbourne Institute of Applied Economic and Social Research
University of Melbourne
111 Barry Street
Melbourne VIC 3010
Australia

E-mail: cainp@unimelb.edu.au

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1. Introduction

Faced with fiscal pressures from an aging population, many countries are resetting the 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 contributions of middle- and low-income earners to fund a comfortable standard of living in retirement. The progressive nature of most taxation systems means that this group is not incentivised to contribute to tax-favoured schemes to the same extent as high-income earners. For this reason, governments such as Australia, Austria, Chile, Czech Republic, Germany, Hungary, Mexico, New Zealand, Turkey and the United States have incorporated matching schemes for middle- and low-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 to private pensions. A co-contribution can be a flat payment (such as the German Riester scheme) or made at a certain percentage of the private contribution (such as New Zealand's KiwiSaver).

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 consumption to private pension contributions (substitution effect). On the other hand, increases in retirement income from the matching payment can 'crowd out' personal contributions in favour of current consumption (retirement income effect). The relative strength of these effects depends on contributions in the absence of the scheme. For example, for those who would not have contributed in the scheme's absence, eligibility may encourage participation, while for high contributors, the scheme may represent a retirement income windfall that reduces contributions. These effects suggest different impacts across the distribution of contributions, with uncertain impacts on the average contributions.

In this study, we test the theoretical predictions of a simple matching scheme model, by estimating the impacts of a generous and simple Australian Government scheme. Under the scheme, known as the Superannuation Co-contribution Scheme, the government offers to match personal after-tax contributions up to a maximum of $1,000 per year at a given rate, which since its inception (2003-04) has varied over time — 100% (2003-04 and 2009-10 to

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

2011-12); 150% (2004-05 to 2008-09) and 50% (2012/13 on). For example, at a matching rate of 100%, a low-income earner can expect for every dollar they voluntarily contribute to superannuation up to a maximum of $1,000, the government will also (co-)contribute a dollar.[2] This maximum eligible contribution is only available for people whose total income is less than a certain threshold, beyond which it is gradually phased-out at a flat rate. This contrasts with other schemes, such as the U.S. Saver's Credit, where matching rates and eligibility differ dramatically on either side of income thresholds that induce income manipulation and bunching at the thresholds (Ramnath 2013), which complicates identification.

Impacts of the co-contribution scheme are estimated using data from the ATO Longitudinal Information File (ALife), a 10% random sample of the Australian population of longitudinally linked tax and superannuation records since 1990-91, exploiting plausibly exogenous variation in eligibility and match rates over time. Impacts are estimated on the extensive and intensive margins and across contribution increments to uncover the distributional effects. To test whether increased contributions induced by the scheme crowd out unmatched contributions to retirement savings, we also examine impacts on employment-based contributions that are made through 'salary sacrifice' (pre-tax contributions that reduce taxable income). The use of administrative data allows us to examine responses throughout the population, including by level of permanent income (following an approach in Heim and Lurie 2014), gender and partner status, age, superannuation balances and use of a tax agent.

We make two important contributions to the literature. First, this study utilises a unique national policy experiment to test theoretical predictions of matching scheme effects that are unencumbered by design complexity or external validity concerns associated with small-scale field experiments. Current evidence on the impacts of matching schemes in raising contributions to retirement plans is limited to evaluations of two schemes, the German Riester (Corneo *et al.* 2009 and 2010) and the U.S. Saver's Credit (Duflo *et al.* 2007; Ramnath 2013; Heim and Lurie 2014). At best, these studies find small effects, but broader conclusions on the effectiveness of retirement income matching schemes are limited by the design complexity of these two schemes that can complicate incentives and limit responses. (See Section 2 for an overview and Duflo *et al.* (2007) for a detailed discussion of how institutional settings have blunted the response to Saver's Credit.) Underlining this conclusion from the literature, a field

[2] Besides meeting income threshold requirements, at least 10% of gross income must be related to employment. The Co-contribution Scheme is also only eligible to Australian citizens and permanent residents.

experiment of a co-contribution scheme by Duflo *et al.* (2006), akin to the scheme examined in this study, elicited much stronger responses. However, conclusions from the Duflo *et al.* (2006) experiment must be tempered because it was a 'once-only' payment, the study didn't examine crowding out of unmatched contributions to employment-based plans (such as 401(k))[3] and the sample was highly selective.[4]

Second, we test a battery of theoretical predictions of a simple matching scheme model, some of which have been overlooked by the literature. Specifically, we estimate how sensitive substitution, income, and bunching effects are across different matching rates by estimating impacts below, above, and at the maximum eligible contribution amount. Reductions in contributions above the eligible maximum can be interpreted as being a result of retirement income effects because of the absence of substitution effects in this range. Estimates of these parameters can help inform match rate choice. We are also the first to test for symmetry in impacts, that is, impacts of comparable magnitude, but of opposite sign, associated with the loss and gain of eligibility. Evidence that the effects of eligibility are asymmetric, that is, the effects of the scheme are stronger when people become eligible would suggest the possibility of 'early targeting' of incentives to encourage greater savings over a life-course.

Our results, while consistent with theory, cast doubt on the prospect that generous and simple co-contributions schemes can raise the retirement income of low- and middle-income earners. We find that the co-contribution scheme is associated with small increases (1-3 percentage point increases) in the proportion who voluntarily contribute to superannuation and increases in bunching at the maximum eligible contribution, depending on the match rate. Further, we find evidence that the scheme crowds out, to varying degrees, *unmatched* employment-based contributions and reduces the average size of after-tax contributions because of negative retirement income effects among high contributors. We find stronger responses on contribution rates among those with high permanent income, but who are eligible because of transitory low

[3] Participants in Duflo *et al*. (2006) would have had opportunities to substitute between retirement accounts given that their Adjusted Gross Income was $43,000, a level that has around 50% coverage of employment plans (Koenig and Harvey 2005).

[4] Participant average income was $43,000, which is around the 2006 national average. If we assume that clients of H&R Block Tax consultants are more likely than average to have a tax liability, then their contributions to the field experiment would have also received the Saver's Credit, which would have boosted their tax refund (or reduced their tax liability) and helped avoid the need to forego consumption to pay for (X-IRA) contributions in the experiment.

income, among secondary income earners (partnered women) and among people who are close to retirement age. Our results are symmetric, with gain and loss in treatment intensity producing similar responses. Together with low responses of those aged under 40, this result casts doubt on the prospect of age-based schemes to establish positive retirement savings habits from a young age that may be phased out at older ages. We find no evidence that the small response is due to a lack of information, with survey data suggesting an 80% awareness among tax filers and no higher response among the eligible who use agents to file their tax returns and who therefore may have better information about the scheme.

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), our empirical approach (Section 5), description of the data (Section 6), estimation results (Section 7) and concluding comments (Section 8).

2. Existing evidence on the efficacy of private pension matching schemes

The literature to date is limited to the evaluations of two matching schemes: the Saver's Credit and Riester schemes. The most studied scheme is the Saver's Credit Scheme introduced in the United States in the 2001-02 tax year. The Saver's Credit is a non-refundable tax credit for the first $US2,000 of contributions, with match rates of 11%, 25% or 100% depending on income relative to certain thresholds. The income-dependence of the match rate creates strong incentives for income manipulation and bunching at the thresholds.[5] Because it is non-refundable tax credit, it is only available to those with a tax liability.

Duflo *et al.* (2007) and Ramnath (2013) both compare responses of people on either side of the income thresholds who face different match rates. Duflo *et al.* (2007) makes this comparison between those who are eligible for Saver's Credit and ineligible due to their tax liability (difference-in-differences) using an H&R Block tax returns client database. The study estimates responses of around a 1 percentage point increase in contribution rates associated with differences between the 25% and 100% matching rates and small increases in average contributions, both unconditional and conditional on making contributions. Ramnath (2013), in contrast, uses IRS tax returns data for the period 2002 to 2006 and a regression discontinuity

[5] Private pensions include Individual Retirement Arrangements (IRA), 401(k), 403(b), or Savings Incentive Match Plan for Employees (SIMPLE) IRA and Simplified Employee Pensions (SEP).

design approach, exploiting differences in the match rate on either side of the threshold, but with intervals around the estimates of program effect to account for potential bias associated with bunching. This study finds no significant difference in contribution behaviour associated with differences in matching rates on either side of the income thresholds, despite the strong evidence for bunching, suggesting that people respond by manipulating their income, but do not take advantage of the credit.

Heim and Lurie (2014) also estimate impacts of the Saver's Credit scheme in a study that also focusses on contributions to private pensions by level of permanent and transitory income. The authors apply difference-in-differences estimation to data from two years: 2001-02 (the year before the scheme's introduction) and 2005-06. Their sample is defined by those eligible for the Saver's Credit in 2005-06 and treatment status is defined by tax liability in 2001-02, where those without a tax liability do not stand to gain from the tax credit. Their results are more positive than those estimated for Duflo *et al.* (2007) and Ramnath (2013), with the scheme associated with an estimated 2.8 percentage point increase in contribution rates and, conditional upon contributing, $317 increase in average contributions associated with the program's introduction.

The Riester is a voluntary state-sponsored savings incentive scheme introduced in 2002 that involves a government co-contribution base payment to certified private pension plans of up to EUR175 per person per year (singles).[6] Families eligible for the base payment also receive up to EUR300 per child (EUR185 per child for those born before 2008). To be eligible, an individual must first enrol in a certified Riester pension plan and make a minimum contribution of EUR60 per year. However, to receive the full co-contribution payment, individuals must contribute (inclusive of the co-contribution payment) at least 4% of their previous year's personal income. For contributions less than 4%, the government co-contribution is paid on pro rata basis. Contributions to the Riester plans, including the co-contribution payments, are also tax deductible up to a maximum of EUR2,100 per year. These design features mean that the match rate depends intrinsically on income and number of children, which makes it difficult to understand the magnitude of the co-contribution benefit (Börsch-Supan *et al.* 2012). At the extremes, the overall match rate is 90% for a person in a relationship with two children who

[6] All compulsorily insured workers in the German public age pension scheme are eligible for Riester.

earns less than EUR10,000 and whose partner doesn't work, and 35% for a single person with no children who earns EUR35,000 (Corneo *et al.* 2009).[7]

Corneo *et al.* 2010 examine the impacts of Riester using data from the Socio-Economic Panel (SOEP) and SAVE, a survey specifically designed to measure savings. For SOEP, the question on savings is about the amount of money left over at the end of the month for large purchases, emergencies and building wealth, while for SAVE it is money saved over the previous year, including for Riester. Because there are no income thresholds for eligibility, the authors could not construct control groups that are unaffected by Riester. Instead, the authors compare savings patterns among groups that face different co-contribution matching rates because of their income or number of children, controlling for selection into the Riester scheme using propensity score matching. They find no significant increase in the probability that households report saving for retirement (extensive margin) or in the household savings to income ratio (intensive margin). The authors tentatively conclude that the zero net effect of Riester on total savings, despite around 40% of eligible households enrolling in Reister (Coppola and Gasche 2011) represents savings displaced from other sources and/or a strong retirement income effect among people who are already saving for retirement or program complexity.

A simple randomised field experiment by Duflo *et al.* (2006) found much stronger contribution responses than estimated for the complex Saver's Credit and Riester schemes. The experiment involved randomised offers of a co-contributions of up to $US1,000 in X-IRA accounts, a type of private pension account, with variation in matching rate — 0%, 20% and 50%. The experiment was conducted at 60 H&R Block tax consultant offices in low- to middle-income neighbourhoods of St. Louis, where clients were randomly allocated to a control (no matching) and two treatment groups with different matching rates. Participants were invited by tax consultants to make 'one-off' contributions to H&R Block X-IRAs from their tax refunds, with contributions up to $US1,000 matched for the treatment groups. Matching payments were paid to the client's X-IRA accounts. Duflo *et al.* (2006) estimate 5 percentage point and 11 percentage point increases in contribution rates for 20% and 50% match rates respectively. They further find an increase in the average contribution of $335 in X-IRA accounts (conditional on contributing) under both matching rates.

[7] The means-testing of the flat government contribution favours low-income earners, while the tax deductibility of contributions favours higher-income earners, so the matching rates are lowest for middle-income earners.

There are good reasons to believe that results from the Duflo *et al.* (2006) experiment may not be fully generalisable and scalable. First, given that H&R Block clients in the participating offices may be more likely than average to have a tax liability, X-IRA contributions would have counted towards Saver's Credit, which would boost their tax return and reduced the need to forego consumption to pay for the scheme contributions. Thus, the large positive results in this study may be from interaction of the scheme with the Saver's Credit. Second, they left unanswered the possibility of reduced contributions to unmatched savings accounts, such as employment plans.[8] Related studies, although not focussed on low- and middle-income earners, have found that retirement account tax incentives, such as those associated with 401(k) retirement plans in the United States (Benjamin 2003; Chernozhukov and Hansen 2004) and Danish savings plans (Chetty *et al.* 2012) have induced strong inter-fund substitution effects. Finally, the experiment was a 'one-time-only' payment and there is a chance that people reacted strongly because they knew it was their only chance to take advantage of the scheme.

Related studies of employer matching schemes for 401(k) plans and public/private matching schemes for deposits to Individual Development Accounts (IDAs) provide mixed evidence, possibly because of issues of non-random selection into these programs (see Gelber 2011 for a review). Employer matching schemes are heterogenous and their availability and design are not orthogonal to both employer and employee characteristics, including unobserved tastes for retirement saving among employees. Even when these issues are overcome using within-worker changes in eligibility (see Gelber 2011), impacts on middle- and low-income earners is difficult to assess because these groups are under-represented in 401(k) plans. In the main, evidence on IDAs are 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. It is also not clear whether the savings behaviour induced by IDAs for attaining shorter-term goals are generalisable to retirement savings.

In summary, the literature to date has found no or very limited responses to the Saver's Credit and Riester schemes, but the complex design of these programs means that the results may be due to muddied incentives versus just a lack of response. These studies also do not measure

[8] Participants in Duflo *et al.* (2006) would have had opportunities to substitute between retirement accounts given that their Adjusted Gross Income was $43,000, a level that has around 50% coverage of employment plans (Koenig and Harvey 2005).

distributional effects, which can shed light on the strength of negative retirement income effects on contributions, and thus explain the estimated small/null responses. We address these issues in this study by examining distribution effects of a simple national scheme with a single match rate, analogous to the Duflo *et al.* (2006) experiment, but which is more generous (with a match rate of up to 150%), mass-scale and ongoing.

3. The Australian superannuation system

Unlike in countries where private pensions are voluntary, Australia's private pension system, known as superannuation, has almost universal coverage of employees. It was first introduced in the 19th century for select white collar workers, including public servants, but was made compulsory for almost all employees in April 1992. (See Nielson and Harris (2010) for a chronology of superannuation in Australia.) From 1992, employers were required to make contributions to their employees' superannuation accounts at a minimum rate of 3% of employee earnings (for ordinary hours of work). This minimum contribution rate has gradually increased over time to its current level of 9.5%.[9] Employer contributions are not counted as taxable income for 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%.

Employees can make voluntary contributions that are either concessional or after-tax up until age 75 or the age of retirement. Employee concessional contributions are made by requesting that their employer 'salary sacrifice' all or part of their pay into their superannuation account.[10] The self-employed can also make voluntary concessional contributions through a special provision that allows them to claim a tax-deduction on contributions. After-tax contributions are made either directly from employee pay packets or from individual bank accounts, which are not taxed upon entering the fund and, subject to eligibility, attract government co-contribution payments (discussed in detail below).

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[9] Employees are ineligible if they are paid less than $A450 in a calendar month; if they are aged under 18 and have worked no more than 30 hours a week or if they are self-employed. Employee earnings from ordinary hours of work include commissions, shift loadings and allowances, but not overtime payments.

[10] Total concessional contributions are subject to an annual cap that is not likely to be binding for low- and middle-income earners. A cap of $100,000 per year was introduced in 2007-08, which has been reduced over time to its current level of $25,000. Currently, contributions above the cap are taxed at the individual's marginal income tax rate.

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%.[11] Since 1 July 2007, benefits withdrawn from the fund in the retirement phase have been tax free, as have been returns accrued during this phase.

Superannuation Co-contribution Scheme

Given the progressive nature of the income tax system in Australia, low- and middle-income earners are not incentivised to contribute to tax-favoured superannuation to the same extent as high-income earners. To incentivise greater contributions and encourage self-funded retirement among this group, 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* (John Howard 2001). The first co-contribution payments to superannuation accounts were made in July 2004 for contributions made during the 2003-04 financial year.[12]

For those eligible for the scheme, every dollar of voluntary after-tax contributions is matched by a government co-contribution at a fixed rate, known as the matching rate (ϕ), up to a maximum eligible contribution ($\overline{pc}$) of \$1,000.[13] 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:

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

[11] Lump sum benefits under \$A135,590 were tax free.

[12] 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.

[13] The self-employed became eligible from 1 July 2007; however, the amount eligible for the scheme is net of deductible personal contributions that are available for self-employed.

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

In Table 1, we present the key parameters of the co-contribution program (ϕ, inc_L, inc_U) and the maximum payment when $inc \leq inc_L$, and the taper rate of maximum payment ($\tau_{\overline{pc}}$) between FY03-04 and FY16-17. Importantly, the taper rate is very low, less than 10c for every dollar over the lower income threshold, 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 5 we examine this issue further by plotting the distribution of income and proportion of contributors by income.

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 eligible maximum of $1,000. In the empirical section we outline a strategy for testing the extent to which people calculate and modify their contribution accordingly or persist at the salient maximum of $1,000. In practice, people whose income falls within the 'tapered zone' may find it difficult to figure out their maximum eligible contribution $\overline{pc}(inc)$, which may encourage them to contribute at the salient maximum of $1,000. While an online 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 the maximum eligible contribution.[14]

To be eligible for the co-contribution payment, middle- and low-income earners must meet a work requirement (10% of their taxable income must be from employment), their total income must be below the upper eligibility threshold, they must be Australian citizens or permanent residents, no more than 70 years of age at the end of the financial year and file a tax return.[15] Eligibility for co-contribution payments 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 Member Contribution Statements (MCS).[16] As a result, to be eligible, contributions must be made throughout the financial year and cannot be made from individual tax returns.

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 and 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).[17] Based on research from consulting studies (Association of Superannuation Funds of Australia 2008; 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 impacts on private pension contributions from a matching scheme for low- and middle-income earners is theoretically ambiguous, depending on competing income and substitution effects. To demonstrate these effects, we present a simple two-period graphical model where,

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

[15] From 1 July 2009, concessional employer 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.

[16] Member Contribution Statements are reported each financial year and 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.

[17] See https://www.ato.gov.au/Calculators-and-tools/Super-co-contribution-calculator/ for online calculator.

in the first period, people choose their 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 period 1 and 2 is expressed as:

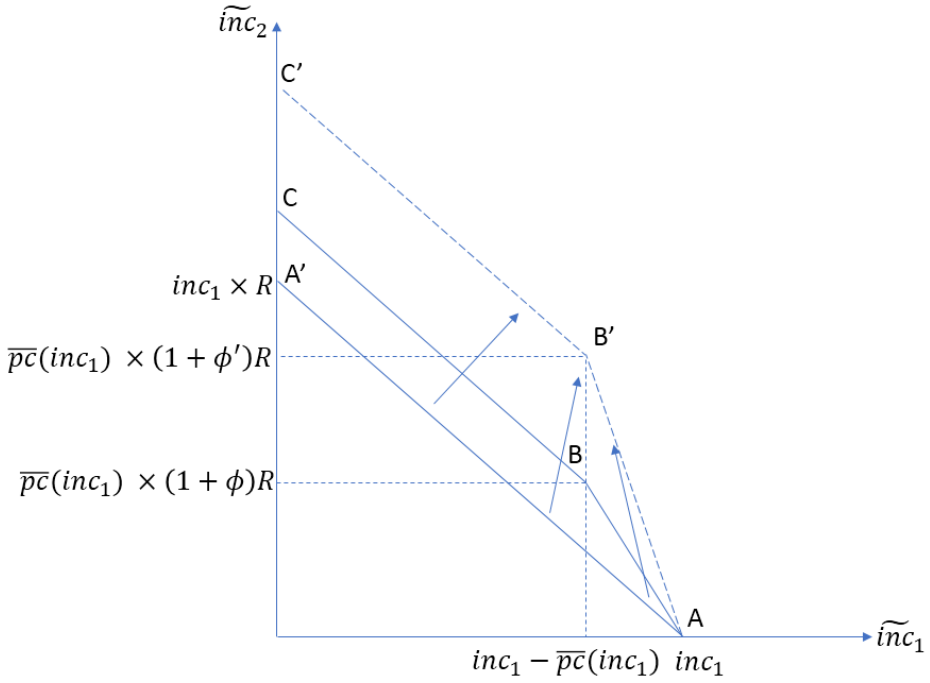
$$\widetilde{inc}_1 \coloneqq inc_1 - pc_1 \tag{2}$$

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

For simplicity, we have assumed away other savings behaviour and other sources of retirement income. 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 $\overline{pc}(inc_1)$.

In theory, people will choose pc_1 that maximizes their intertemporal utility subject to their intertemporal budget constraint, but the kink point will draw mass from either side. For those who would have contributed less than $\overline{pc}(inc_1)$ in the absence of the matching scheme, those to the right of B on the original budget constraint A'A, the matching scheme will reduce the cost of 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 encourages people to substitute $\widetilde{inc}_1$ for more future income $\widetilde{inc}_2$by increasing pc_1 (not beyond B), although the extent to which they will do this may be tempered by a negative income effect – a reduction in the appetite to save because of the increased future income from the matching payment. In contrast, people who would have contributed 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, will consider the match as nothing more than 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 congregate at B. 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 kink point B' at the same contribution level of $\overline{pc}(inc_1)$.

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



Assumed in this simple model is that increased private contributions to pensions increases savings at the expense of lower consumption, but in practice it is possible that such increases may instead 'crowd out' other forms of saving. Under the Australian Co-contribution Scheme, a prime candidate is the crowding-out of voluntary concessional contributions to private pensions that are paid through salary sacrifice.

That aside, the main conclusions from the theoretical model are that there are likely to be different responses depending on the relative strengths of income and substitution effects, and the income effects hinge on the distribution of after-tax contributions in the absence of the scheme. If the percentage of people who would have contributed more than the maximum eligible contribution in the absence of the matching scheme is relatively high, the income effects can be significant and potentially dominate the substitution effects.

5. Data

Analysis presented in this paper is based on data from the ATO's Longitudinal Information File (ALife), which is a 10 percent random sample of all registered tax filers (since 1980) as at

30 June 2016.[18] Tax record and superannuation information for the sample is added each year from 1990-91 via their unique tax file number. Superannuation account information for those with zero balances is retained in ALife, as is superannuation information for people who do not lodge a tax return.[19] For each annual release of ALife following the initial 2016 sample, 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, including contributions and balances. Contribution information in ALife includes separate records for concessional and after-tax contributions, with only the latter eligible for the co-contribution payment.[20] A limitation of the data is that compulsory minimum employer contributions cannot be separated from voluntarily made salary sacrifice contributions prior to 2009-10. Thus, for the purposes 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.[21]

To examine the impacts of the superannuation co-contribution scheme, we define a sample of analysis that comprises the entire ALife data from 1999-2000 to 2016-17, for individuals with at least one tax return lodged during this period. 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

[18] The original 2016 release of ALife was compiled in early October in 2018, by which time tax returns had been finalised for almost all people required to lodge a tax return for the 2015-16 financial year. Similarly, an update of ALife that incorporated tax data for the 2016-17 financial year was compiled in October 2019.

[19] Generally, it is compulsory for those with taxable income above the tax-free threshold lodge a tax return in Australia. Many who earn less than the tax-free threshold also lodge a return to claim-back tax that has been withheld by their employer. 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.

[20] When referring to after-tax contributions, we mean after-tax contributions that are potentially eligible for matching — net of personal deductible contributions.

[21] See https://www.ato.gov.au/Forms/Super-member-contribution-statement-for-2012-13-and-later-financial-years/ (accessible as at 8 December 2020).

and older. Those who are in the top 10% of the income distribution every year are also removed because they are unlikely to be impacted by the scheme. We also remove people whose taxable income is below the tax-free threshold and would therefore have to volunteer to lodge to be eligible for a co-contribution payment, as well as selected individual-year outliers, defined as those with total voluntary after-tax superannuation contributions of more than $10,000 and those with negative incomes.

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 statistics before eligibility are for those who would have met eligibility criteria in 2004-05 had they existed in 2001-02 to 2002-03. Post-reform, based on criteria for eligibility, we estimate that a little over half of all observations in our sample were eligible for a co-contribution payment between 2004-05 and 2016-17, with around a quarter eligible for the maximum co-contribution matching payment. For low- and middle-income earners who are eligible for the scheme, after-tax contributions are clearly the main channel for making voluntary contributions to superannuation — 15.8%, compared to 5% making concessional contributions. This contrasts with the higher use of concessional contributions by high-income earners who are ineligible — 16.2% make after-tax contributions and 18.4% make concessional contributions.

The differences in the composition of contributions by income groups is consistent with the notion that, because of the progressive nature of income tax rates, the concessional treatment of contributions is much less attractive for low-income earners. After-tax contributions may also be preferable because they afford low- and middle-income earners greater flexibility to make contributions from income sources unrelated to employment. Interestingly, even before the scheme was introduced, voluntary after-tax contribution rates of low- and middle-income earners were high. As reported in Table 2, their rate of voluntary after-tax contributions was 14.9%, with an average contribution of $190.91. In terms of the average contribution among contributors, this equates to $1,281 per head, which is above the maximum eligible for the co-contribution payment.[22]

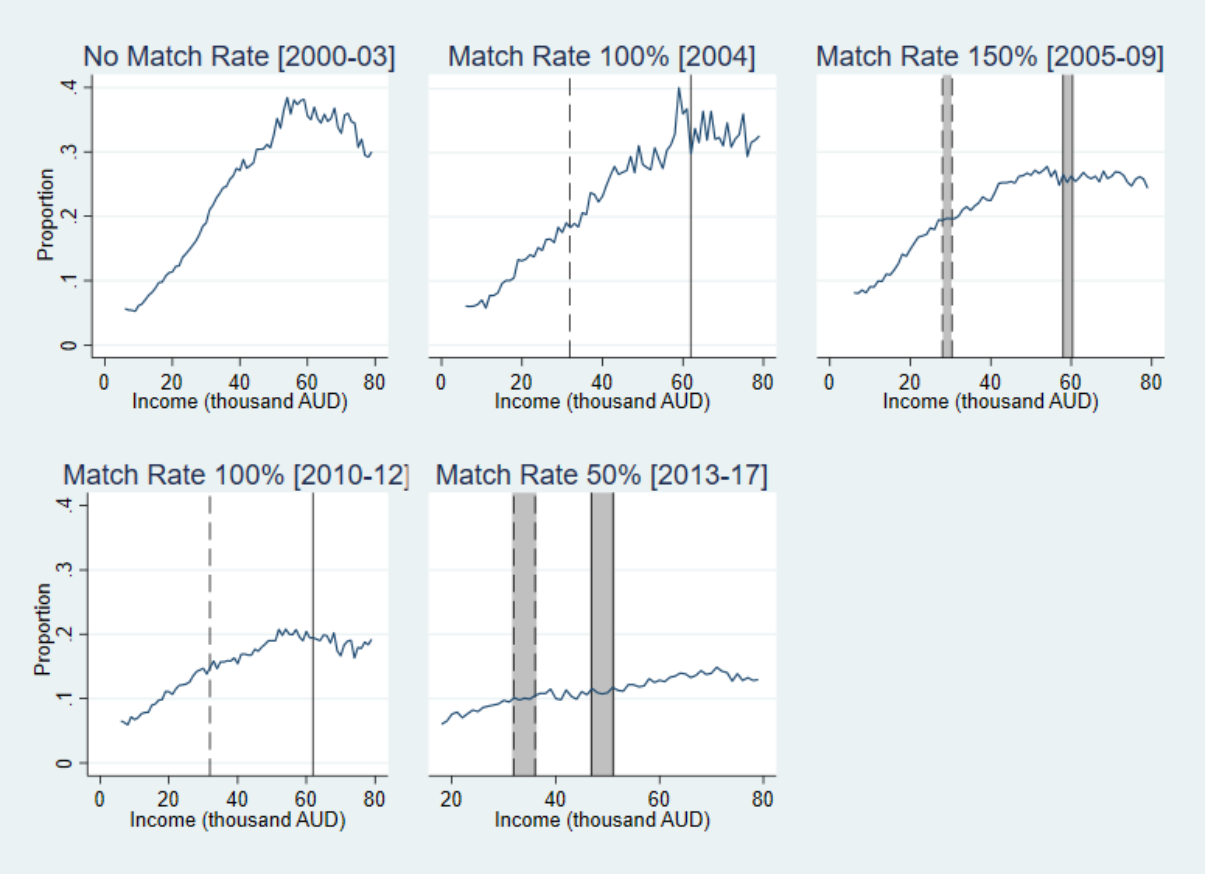
[22] Ratio of the average contribution across the entire sample and the contribution rate ($A190.91/0.149).

Table 2: Descriptive statistics for sample of analysis individual-year observations

	Pre-reform, 2000-01 to 2002-03		**Post-reform, 2004-05 to 2016-17**					
	'Eligible' in 2004-05		All observations		Eligible observations		Ineligible observations	
	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.
Co-contribution scheme eligibility	-	-	-	-	-	-	-	-
Proportion eligible for co-contribution matching payment	-	-	0.525	0.499	-	-	-	-
Proportion eligible for the maximum co-contribution matching payment	-	-	0.238	0.426	0.453	0.498	-	-
Contribution rates								
Proportion who make a voluntary after-tax contribution	0.149	0.356	0.160	0.367	0.158	0.365	0.162	0.369
Proportion who make voluntary concessional contributions[a]	n.a.	n.a.	0.124	0.330	0.050	0.217	0.184	0.388
Proportion who receive employer concessional contributions[b]	0.865	0.341	0.870	0.337	0.913	0.281	0.821	0.383
Contribution amounts ($A2017)[d]								
Voluntary after-tax contributions[c]	190.91	677.50	320.20	1,055.37	218.37	711.99	432.72	1,326.77
Co-contribution payments	-	-	55.35	226.26	105.44	303.71	-	-
Voluntary concessional contributions[a]	n.a.	n.a.	1103.92	4,899.53	165.93	1,359.64	1,858.48	6,368.05
Total concessional contributions	1842.70	3,105.97	5,208.73	7,552.42	2,860.27	4,138.66	7,803.87	9,397.47
Total personal income ($A2017)	32,890.86	19,807.51	55,795.76	54,674.06	33,661.49	1,4102.40	80,255.02	702,35.97
Count	128,397		1,398,427		734,104		664,323	

Notes: [a]Data is only available from 2009-2010 or 1,398,427 individual-year observations for 2004-05 to 2016-17 for the overall sample — 734,104 eligible and 664,323 ineligible. [b]Employer contributions are only compulsory for employees who: are paid at least $A450 in a calendar month; are 18 or over and have worked more than 30 hours a week. Employer contributions are also not compulsory for the self-employed. [c]After-tax contribution eligible for the matching payment is net of deductible personal contributions. [d]Estimated for those who are eligible under criteria introduced in 2004-05.

Figure 2: Proportion who make voluntary after-tax contributions

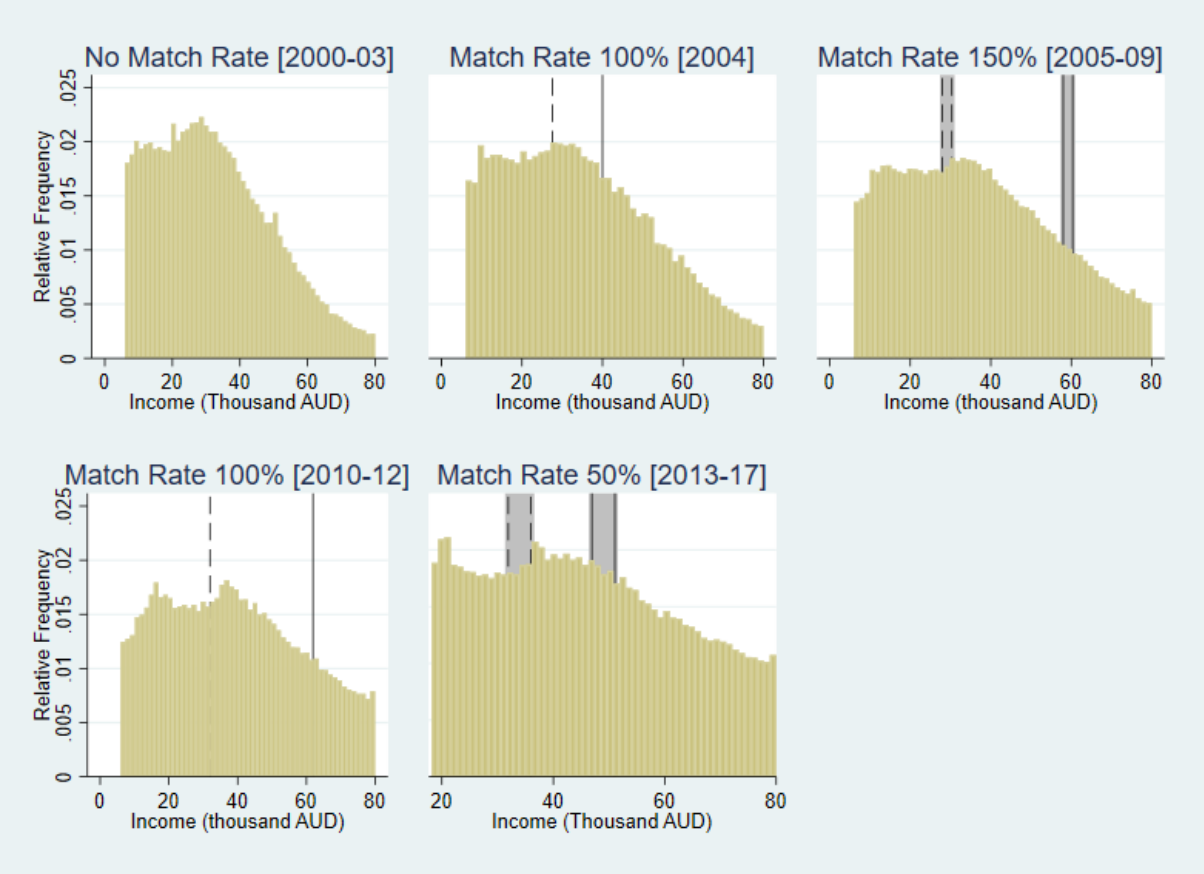


Notes: the broken vertical line represents the threshold for maximum matching payment and the unbroken line represents the threshold for eligibility. Data are pooled over multiple years where the same matching rate applied. Grey shading between the bars represents changes in the range of thresholds over the period.

The minimal differences in after-tax contribution rates observed by eligibility status (Table 2) are not necessarily reflective of the possible 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 more finely show the relationship between income and the proportion making after-tax contributions for different match rates (that is, the relationship between income and the extensive margin). In each of the panels, we observe that the proportion contributing increases with income, although this relationship has weakened over time. In panels where a matching rate applies, 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/part eligibility.

Comparisons of contribution rates on either side of the eligibility thresholds should be treated with caution because people on either side can have very different propensities to contribute. Specifically, those who are below the threshold may be more likely to manipulate their income to gain or increase their eligibility, perhaps because they are more future orientated, which will also lead to higher contribution rates. While such manipulation has been found for the Saver's Credit scheme, where there are large differences in the matching rates on either side of income thresholds (Ramnath 2013), we find no evidence that this occurs for the co-contribution scheme, where no such sharp discontinuities exist (Figure 3). The only clear evidence of bunching appears to be at the top of the bottom tax bracket (at around $37,000).

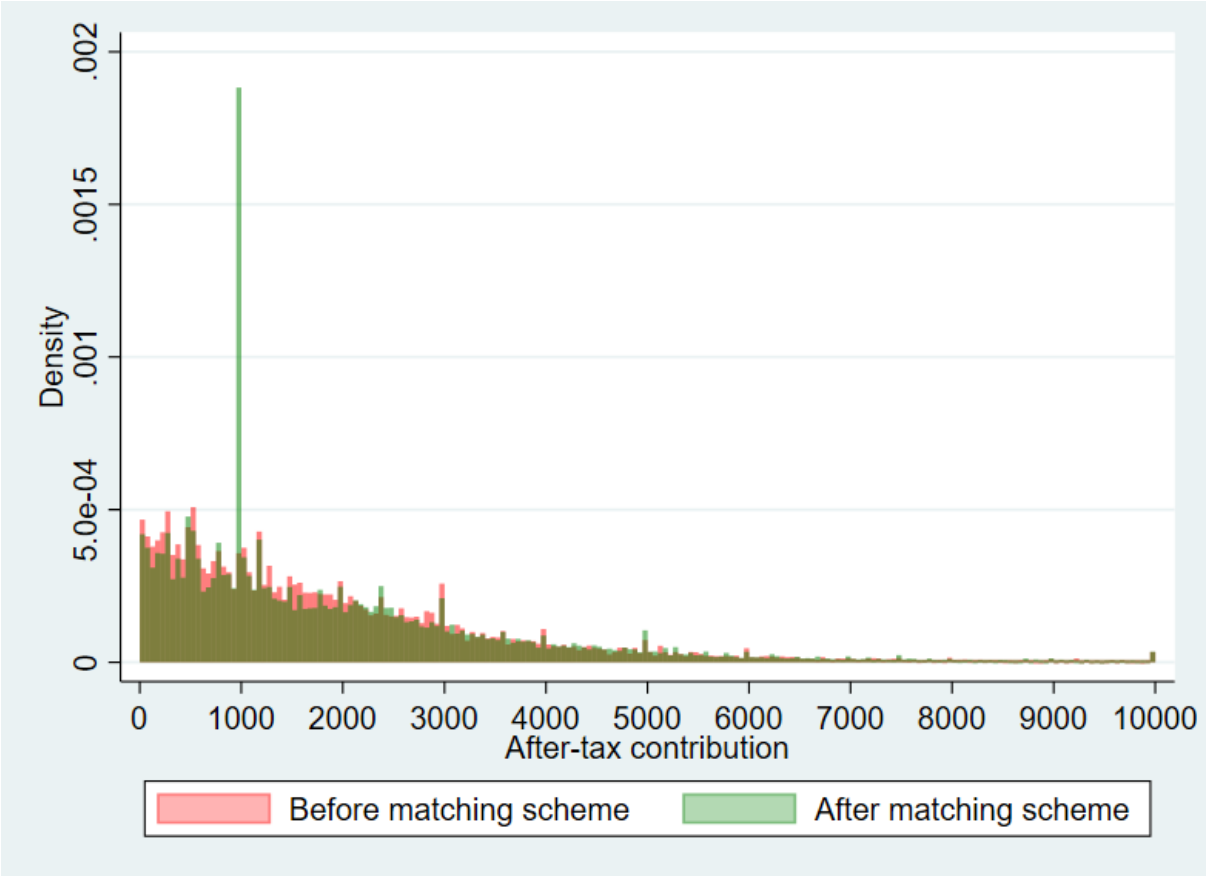
Figure 3: Relative frequency distributions of personal income



Notes: The broken vertical 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 applied. Grey shading between the bars represents changes in the range of thresholds over the period. For ease of presentation, the distribution is truncated below the tax free threshold ($6,000 for 2000-2012 and $18,200 for 2013-17) and above $80,000.

Data presented in Figure 3 is focussed on the extensive margin only, but predictions from the theoretical model presented in Section 4 suggests that matching schemes will have an impact on the distribution of contributions. The density of contributions above $1,000 will shift leftward towards $1,000, and we will have a higher mass at $1,000. Consistent with this prediction, in Figure 4 we show that the introduction of the scheme in 2004-05 appears to have induced bunching of after-tax contributions at the maximum eligible contribution of $1,000, drawing contributions both from above and below $1,000. The spike in contributions at $1,000 also points to the saliency of the maximum eligible contribution in determining the choice of contribution level.

Figure 4: Histogram of personal after-tax contributions before and after the matching scheme introduction



Notes: Those who do not make after-tax contributions are excluded. The period before the matching scheme is for the 2002-03 financial year and the period for after the matching scheme is for 2004-05. The data is truncated at an annual contribution amount of $10,000 (2017 prices).

6. Empirical approach

A key aim of this study is to test predictions of a theoretical model by estimating the effects of the co-contribution scheme on extensive and intensive margins and on the distribution of contributions. To meet this aim, we develop a base empirical model that exploits variation in eligibility and matching rates over time. We also estimate variants of this model to examine symmetry in effects associated with eligibility changes and heterogenous effects.

Base model

To estimate the effects of the co-contribution scheme, we aim to understand the nature of parameters in the following baseline model:

$$y_{it} = \alpha_{0.5}C_{0.5,it} + \alpha_{1.0}C_{1.0,it} + \alpha_{1.5}C_{1.5,it} + \beta_1 inc_{it} + \beta_2 inc_{it}^2 + x_{it}'\gamma + \mu_i + \delta_t + \epsilon_{it} \qquad (4)$$

where y_{it} is superannuation contribution measures (discussed below) of individual *i* in year *t*; $C_{0.5,it}$, $C_{1.0,it}$ and $C_{1.5,it}$ are the co-contribution treatment eligibility indicators for the three match rates, defined as:

$$C_{0.5,it} \coloneqq 1\{\phi_t = 0.5\}E_{it}$$

$$C_{1.0,it} \coloneqq 1\{\phi_t = 1.0\}E_{it}$$

$$C_{1.5,it} \coloneqq 1\{\phi_t = 1.5\}E_{it}$$

$$\text{where } E_{it} \coloneqq 1\{\overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) > 0\};$$

inc_{it} is gross income; x_{it}' is a vector of socio-economic characteristics, μ_i is the individual fixed effect, δ_t is the time fixed effect, and ϵ_{it} is an idiosyncratic shock. The key parameters of interest are $\alpha_{0.5}$, $\alpha_{1.0}$ and $\alpha_{1.5}$, which reflect the impact of the co-contribution scheme eligibility under alternative matching rates. The base model utilises variation in the most salient features of the scheme, eligibility and the matching rate. As part of robustness checks, we also present results in Section 7 from models that exploit variation in partial and full eligibility.

A key identifying assumption of the model is that people do not change their income to take advantage of the matching scheme, which is feasible given the program design (see Section 3) and the absence of any bunching around the eligibility thresholds (see Section 5). A related threat to identification is that the treatment status $C_{0.5,it}, C_{1.0,it}, C_{1.5,it}$ is inversely related to income, which may be correlated with unobservables, in particular μ_i. For example, individuals with high incomes may have a stronger preference to make contributions. In such a case,

$C_{0.5,it}, C_{1.0,it}, C_{1.5,it}$ are negatively correlated with μ_i. To deal with the potential endogeneity of treatment, we use a first-differenced estimator:

$$\Delta y_{it} = \alpha_{0.5}\Delta C_{0.5,it} + \alpha_{1.0}\Delta C_{1.0,it} + \alpha_{1.5}\Delta C_{1.5,it} + \beta_1 \Delta inc_{it} + \beta_2 \Delta inc_{it}^2 + x_{it}'\tilde{\gamma} + \tilde{\delta}_t + \tilde{\epsilon}_{it} \qquad (5)$$

where Δ is the first-difference operator for consecutive years e.g., $\Delta y_{it} \coloneqq y_{it} - y_{it-1}$, $\Delta C_{0.5,it} = C_{0.5,it} - C_{0.5,it-1}$; x_{it}' is a vector of (non-differenced) socio-economic characteristics and $\tilde{\gamma}$ captures the characteristic-specific time trend, $\tilde{\delta}_t \coloneqq \Delta\delta_t$ is the first-differenced year effect, and $\tilde{\epsilon}_{it} \coloneqq \Delta\epsilon_{it}$ is the first-differenced idiosyncratic shock.[23] This approach relies on the assumption that the first-differenced regressors are contemporaneously uncorrelated with the first-differenced error, e.g., $E\left(\Delta C_{0.5,it}\Delta\epsilon_{it}\right) = 0$.[24] We estimate this model using OLS with clustered standard errors. We also estimate an individual fixed-effects estimator, which relies on a strict exogeneity assumption, namely, that the regressors in any period are orthogonal to all past, present and future errors (e.g., $E\left(C_{0.5,it}\epsilon_{is}\right) = 0\ \forall t, s$). Results of this model are consistent with those of the first-differenced model (see Appendix B).

Table 3: Possible within-individual variations in match rate and eligibility

Eligible in t-1	Eligible in t	Match rate		$(\Delta C_{0.5,it}, \Delta C_{1.0,it}, \Delta C_{1.5,it})$	Effect
		ϕ_{t-1}	ϕ_t		
N	N	-	-	(0,0,0)	0
N	Y	-	0.5	(1,0,0)	$+\alpha_{0.5}$
N	Y	-	1.0	(0,1,0)	$+\alpha_{1.0}$
N	Y	-	1.5	(0,0,1)	$+\alpha_{1.5}$
Y	N	0.5	-	(-1,0,0)	$-\alpha_{0.5}$
Y	N	1.0	-	(0,-1,0)	$-\alpha_{1.0}$
Y	N	1.5	-	(0,0,-1)	$-\alpha_{1.5}$
Y	Y	0.5	0.5	(0,0,0)	0
Y	Y	0.5	1.0	(-1,1,0)	$-\alpha_{0.5} + \alpha_{1.0}$
Y	Y	0.5	1.5	(-1,0,1)	$-\alpha_{0.5} + \alpha_{1.5}$
Y	Y	1.0	0.5	(1,-1,0)	$-\alpha_{1.0} + \alpha_{0.5}$
Y	Y	1.0	1.0	(0,0,0)	0
Y	Y	1.0	1.5	(0,-1,1)	$-\alpha_{1.0} + \alpha_{1.5}$
Y	Y	1.5	0.5	(1,0,-1)	$-\alpha_{1.5} + \alpha_{0.5}$
Y	Y	1.5	1.0	(0,1,-1)	$-\alpha_{1.5} + \alpha_{1.0}$
Y	Y	1.5	1.5	(0,0,0)	0

[23] $\boldsymbol{x_{it}}$ includes age at time of tax lodgement, age squared, gender, partnered status, partner income, whether a tax accountant is used and self-employment.

[24] We have $E(\Delta inc_{it}\Delta\epsilon_{it}) = E\left(\left(inc_{it} - \text{inc}_{\text{i,t}-1}\right)\left(\epsilon_{it} - \epsilon_{i,t-1}\right)\right) = E(inc_{it}\epsilon_{it}) + E\left(inc_{i,t-1}\epsilon_{i,t-1}\right) - E\left(inc_{i,t-1}\epsilon_{it}\right) - E\left(inc_{it}\epsilon_{i,t-1}\right) = 0$, which is 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. The first-differenced and fixed-effect model are the same when there are two periods only.

In the first-differenced model, the parameters $\alpha_{0.5}$, $\alpha_{1.0}$ and $\alpha_{1.5}$ are identified through 16 possible within-individual variations in matching rate and eligibility. These are listed in Table 3 along with the corresponding effects being identified, where we distinguish between those identified through gaining and loosing eligibility by + and – respectively. In the first-difference baseline model (Equation (5)), we assume symmetry in effects, that is effects from gaining eligibility are the same as loosing. We extend this approach in the auxiliary model in Section 6 to test symmetry of effects.

Table 4: Theoretical predictions tested with the base model

Predictions	Outcome of interest (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 theoretically 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 theoretically ambiguous	$1\{1000 < pc_{it} \leq \$3000\}$
6. Only income effect ($0 > \alpha_{0.5} > \alpha_{1.0} > \alpha_{1.5}$)	$1\{pc_{it} > \$3000\}$

We estimate a range of first-difference baseline models with different measures of y_{it} to test hypotheses generated from the theoretical model in Section 4 (Table 4). A key prediction is that, by subsidising contributions, matching schemes increase the proportion who do it, with impacts increasing with the matching rate (Prediction 1). Matching contributions up to an eligible maximum create a kink in the intertemporal budget constraint that entices bunching at \$1,000 and that the intensity will increase with the matching rate (Prediction 2). In terms of the intensive margin, the effect is ambiguous because of competing substitution and income effects (Prediction 3).

These competing effects are predicted to affect the distribution of contributions. The theoretical model predicts that individuals who initially don't 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 proportions who contribute among 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 will lower contributions among existing contributors in this range, it may also increase contributions from people who were previously high contributors (more than $3,000).

To more fully examine distributional effects predicted by the theoretical model, we test predictions in Table 5 by estimating the base models 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* that are consistent with distributional predictions of the theoretical model are presented in Table 5. [25]

Table 5: Theoretical predictions tested on distribution of 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 applies up to $1000 only.
∞	1	0	By definition

Symmetry of co-contribution eligibility

To the extent that becoming eligible induces people to change their contribution behaviour, this may establish saving patterns that persist even if they become ineligible at a later point. This would suggest asymmetry in policy effects. Such asymmetric responses would mean that even short-term eligibility may have long-run impacts in retirement income.

[25] 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).

To test this, we estimate first-difference models where we separate the effects of gaining and losing treatment intensity:

$$\Delta y_{it} = \alpha^{+}\Delta C_{it} 1\{\Delta C_{it} > 0\} + \alpha^{-}\Delta C_{it} 1\{\Delta C_{it} < 0\} + \beta_1 \Delta inc_{it} + \beta_2 \Delta inc_{it}^2 + x_{it}'\tilde{\gamma} + \tilde{\delta}_t + \tilde{\epsilon}_{it} \quad (6)$$

where $C_{it} = \phi_t E_{it}$ denotes treatment intensity, which equals 0 when the individual is ineligible and is increasing in the matching rate when eligible. The parameter α^{+} reflects the effect of increasing the treatment intensity (by becoming eligible and/or subject to a match rate increase when eligible), and α^{-} reflects the effect of reducing the treatment intensity (by becoming ineligible and/or subject to a match rate decrease when eligible).

Heterogenous effects

A key feature of our study is the use of national administrative data that enables us to examine differences in responses to the scheme within the population, which can help inform potential barriers to participation and help shed light on equity implications. To do this, we estimate fully interacted models, but using a more parsimonious specification than those described above to limit the number of estimated coefficients:

$$\Delta y_{it} = \sum_{g=1}^{G} 1\{\mathrm{w_i} = \mathrm{g}\} \left(\alpha_g \Delta C_{it} + \beta_{1g} \Delta inc_{it} + \beta_{2g} \Delta inc_{it}^2 + \tilde{x}_{it}'\tilde{\gamma}_g\right) + \tilde{\delta}_t + \tilde{\epsilon}_{it} \quad (7)$$

where $w_i \in \{1, \ldots, G\}$ is a categorical variable of individual *i*'s sub-group membership measured at base year and the other terms have been previously defined. By interacting the sub-group indicators with the regressors (which excludes age if age is used to form sub-groups, etc.), the parameters α_g measure group-specific effects associated with first-difference changes in treatment intensity (as defined for Equation (6)).

The sub-groups that we include in the analysis include combinations of gender and partner status, age, previous period superannuation balances, after-tax contribution patterns prior to introduction of the scheme, whether a tax consultant is used and permanent income. Following Heim and Lurie (2014), permanent income is the predicted value, including individual fixed effect, from a Mincer-style log income regression model of total personal income and individual characteristics using fixed-effects estimation. To enable flexibility of scheme responses, we group individual predicted values each year into quantiles.

7. Results

The main aim of this paper is to test theoretical predictions about how matching schemes affect the rate of contributions (Prediction 1), bunching at the intertemporal kink-point (Prediction 2); the amount contributed (Hypothesis 3) and the distribution of contributions above and below the kink-point (Predictions 4-6). In Table 6 below, we present key estimated results from the base model (Equation 5) that address these hypotheses (see Appendix C for full results).

Our results are consistent with the predictions of the theoretical model. On the extensive margin, we estimate that eligibility for the co-contribution matching scheme is associated with 0.6 percentage point, 0.9 percentage point and 2.7 percentage point increases in the rate of personal contributions of low- and middle-income earners for 50%, 100% and 150% match rates, respectively. These results suggest that over the matching ranges examined, the matching rate has a positive impact on personal contributions (Prediction 1). These responses are small and comparable to those found for the Saver's Credit (Duflo *et al*. 2007; Ramnath 2013;Heim and Lurie 2014). 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 responses above and below $1,000. For contributions up to $1,000, the matching scheme is associated with significant increases in the contribution rate (Prediction 4). In contrast, there is a fall in the rate of high contributions — above $3,000 (Prediction 6). For those who contribute more than the maximum eligible, the matching scheme represents a retirement income windfall that reduces their impetus to forego current consumption to afford personal contributions. For contributions between $1,001 and $3,000, where predictions are theoretically ambiguous (Prediction 5), results are positive suggesting that movement into this bracket from above $3,000 is greater than movement out of this bracket towards $1,000.

Table 6: Estimated relationship between after-tax contributions and co-contribution eligibility

	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)	Personal after-tax contribution ($) (Prediction 3)	Personal after-tax plus gov. co-contribution ($)
$\alpha_{0.5}$	0.0062***	0.0023***	0.012***	0.0011	-0.0066***	-24.0***	-7.14**
	(6.39)	(5.49)	(12.40)	(1.49)	(-13.32)	(-9.59)	(-2.76)
$\alpha_{1.0}$	0.0093***	0.0084***	0.016***	0.0024***	-0.0091***	-24.6***	40.0***
	(10.44)	(20.12)	(18.88)	(3.52)	(-19.06)	(-10.71)	(16.07)
$\alpha_{1.5}$	0.027***	0.014***	0.027***	0.0097***	-0.0098***	-6.49*	125.8***
	(25.27)	(25.66)	(26.33)	(11.51)	(-16.46)	(-2.29)	(39.87)
N	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622

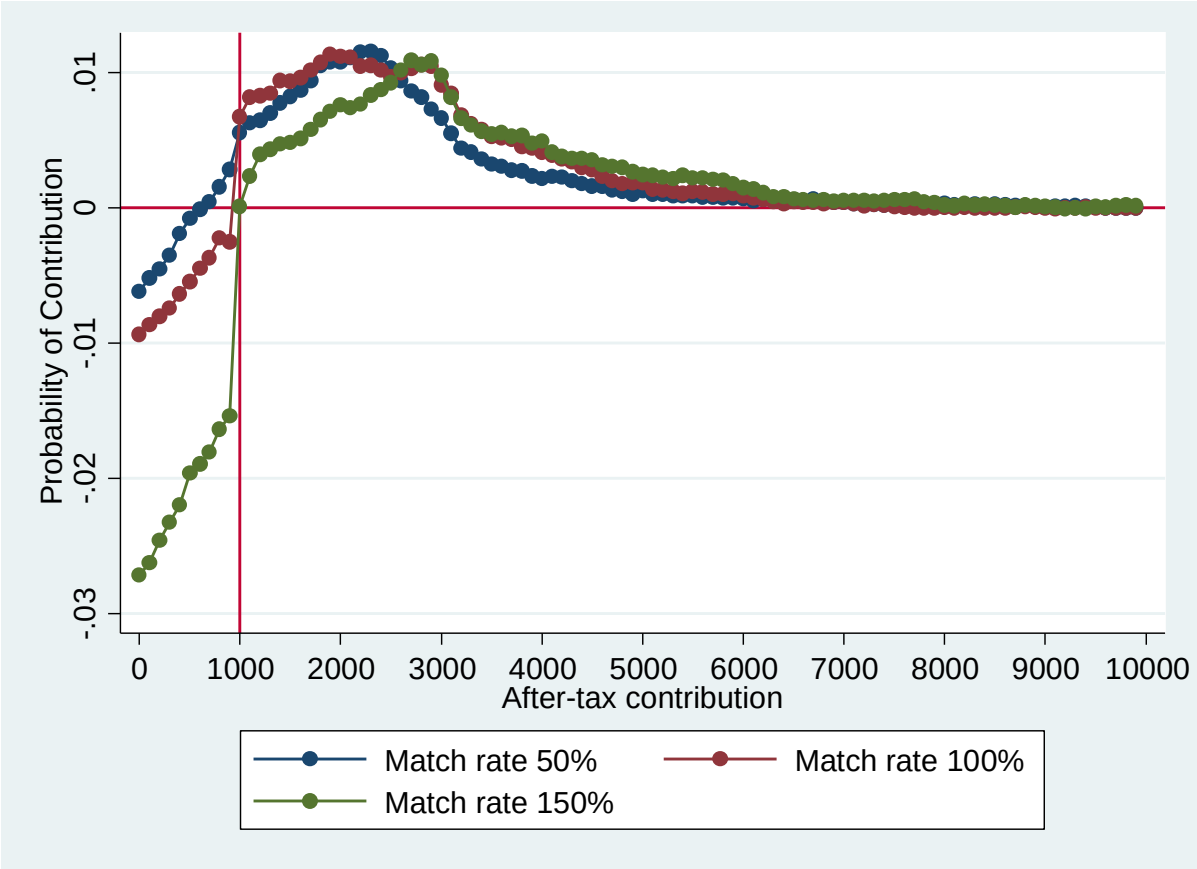
Notes: Estimated results from Equation (5). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7: Estimated relationship between making voluntary concessional (unmatched) contributions and co-contribution eligibility

	Voluntary concessional contributions	Combinations of voluntary concessional and personal contributions			
		No voluntary concessional or after-tax contributions	Voluntary concessional only	After-tax contribution only	Voluntary concessional and after-tax contributions
$\alpha_{0.5}$	-0.011***	0.0031*	-0.0097***	0.0083***	-0.0017**
	(-10.87)	(2.45)	(-9.84)	(8.74)	(-2.96)
$\alpha_{1.0}$	-0.0079***	-0.0073***	-0.0064***	0.015***	-0.0015
	(-6.20)	(-4.80)	(-5.38)	(12.75)	(-1.85)
$\alpha_{1.5}$	-	-	-	-	-
N	649,400	649,400	649,400	649,400	649,400

Notes: Estimated results from Equation (5). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. Results for a match rate of 150% cannot be estimated because data for salary sacrifice is only available only from 2010. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 5: Estimated distributions impacts of the superannuation co-contribution scheme



Note: This represents $\alpha^{c}_{0.5}, \alpha^{c}_{1.0}, \alpha^{c}_{1.5}$ from the estimation of Equation 5 where $y_{it} = 1\{0 \leq pc_{it} \leq c\}$ and c=0, \$100, \$200, ..., \$10000.

Overall, the fall in the rate of high contributions means that the scheme is associated with a reduction in average contributions (intensive margin). The estimated impacts on average personal contributions (intensive margins) depend on the matching rate, which is also consistent with the ambiguous prediction (Prediction 3) of the theoretical model. While the substitution effects continue to strengthen with the matching rate, income effects appear to level off at matching rate above 100%, which means the fall in average contributions is lower at 150% match rate. 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%.[26] 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-

[26] Contributions to X-IRA accounts are inclusive of the match rate because the Saver's Credit is a tax credit. Because the study compares contributions of people facing different match rates either side of income thresholds, these are relative to 25% and 11% respectively.

contribution payments, which are larger than reported in Duflo *et al.* (2007) for a comparable match rate of 100%.

The reduction in average contributions associated with the co-contribution scheme demonstrates the importance of unintended effects of matching schemes on the existing contributors for whom the scheme is nothing more than a windfall. Further support for the distributional predictions of the theoretical model are presented in Figure 5. This figure shows estimated values for $\alpha_{0.5}^{c}, \alpha_{1.0}^{c}, \alpha_{1.5}^{c}$, which are base model estimates of the scheme's effect on the proportion of individuals contributing between \$0 and \$c. We present $\alpha_{0.5}^{c}, \alpha_{1.0}^{c}, \alpha_{1.5}^{c}$ for c=0,100,200...,10000. The estimates reflect the effects of the scheme on the CDF of contributions. Consistent with the predictions in Table 5, we observe negative coefficients for c below \$1,000, suggesting reductions in the proportion of low contributors due to the substitution effect.[27] For c at or above \$1,000, we observe positive coefficients, suggesting reductions in the proportion of high contributors due to the income effect. Interestingly, for c=1,000..., 2,500, $\alpha_{1.5}^{c}$ is less positive than $\alpha_{0.5}^{c}$ and $\alpha_{1.0}^{c}$. In combination with the strongly negative $\alpha_{1.5}^{c}$ coefficient for c below \$1,000, which indicates a strong substitution effect, this suggests that at the 150% match rate the scheme may have generated substitution effects that apply beyond \$1,000 ('overshooting' beyond the eligible maximum).

Not only are the responses to the scheme small, but the net effect on retirement income is further reduced when we consider the displacement of voluntary *concessional* contributions. Results presented in Table 7 are based on data from 2009-10 to 2016-17, allowing us to estimate the effects for the matching rates of 50% and 100%. The results show that eligibility of the matching scheme is associated with estimated 1.1 and 0.8 percentage point reductions in the proportion of people who make voluntary concessional contributions for match rates of 50% and 100%, respectively.[28] It should be noted that these reductions could come from 'new' and 'windfall' contributors. For the many eligible people who would have made voluntary after-tax contributions in the absence of the scheme, the resulting income windfall reduces the

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

[28] Data on salary sacrifice, one of the two key elements of voluntary concessional contributions, is only available after 2008-09.

need to make voluntary concessional contributions.

Based on estimates from Equation (6) presented in Table 8, we conclude that there is no strong evidence of an asymmetry in the relationship between the extensive margin and matching scheme treatment intensity. On average, increases in the treatment intensity relative to no change (increases in the match rate for those eligible or becoming eligible for those ineligible) are associated with a 1.3 percentage point increase in the rate of after-tax contributions, while decreases in intensity relative to no change are associated with 1.4 percentage point reductions in the rate of after-tax contributions. That said, we do find there is some evidence of asymmetry on the distributional effects. We find evidence of weaker bunching at the eligible maximum and weaker income effects above $3,000 in response to decreases in treatment intensity (rather than increases). These effects suggest greater persistence or 'stickiness' in contributions in response to decreases in treatment intensity rather than increases. When the treatment intensity falls, past receipt of co-contribution payments may have made people feel wealthier, so that they do not feel the need to increase personal contributions to the same extent. For the intensive margin, this translates to a reduction in average contributions when the intensity increases and no change when it decreases.

Table 8: Estimated relationship between after-tax contributions and symmetry of co-contribution eligibility

	Contributions within defined ranges					Continuous measures
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1000\}$	$1\{\$0 < pc_{it} \leq \$1000\}$	$1\{\$0 < pc_{it} \leq \$3000\}$	$1\{pc_{it} > \$3000\}$	Personal after-tax contribution ($)
α^+	0.013***	0.012***	0.020***	0.0026***	-0.0095***	-31.6***
	(13.19)	(27.39)	(21.64)	(3.45)	(-17.57)	(-11.67)
α^-	0.014***	0.0055***	0.015***	0.0055***	-0.0061***	-2.33
	(17.86)	(14.54)	(19.03)	(9.04)	(14.19)	(1.14)
N	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622

Notes: Estimated results from Equation (6). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7.1. Alternative specification

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, after-tax contributions less than $1,000 are eligible for a matching payment. As discussed in Section 6, we do not discriminate between full and part eligibility because we assume that those in the tapered region are unlikely to

calculate exactly their maximum eligible contribution amount, but instead rely on salient features of the scheme. To examine differences in responses to full and partial eligibility, we extend the base model to distinguish between "full" and "part" eligibility. Specifically, we denote full eligibility by $E_{it}^{f} \coloneqq 1\{\overline{pc}(inc_{it}, inc_{Lt}, inc_{Ut}) = 1000\}$ and part 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 treatment statuses in the same spirit as the baseline model ($C_{0.5,it}^{p}$, $C_{0.5,it}^{f}$, $C_{1.0,it}^{p}$, $C_{1.0,it}^{f}$, $C_{1.5,it}^{p}$, $C_{1.5,it}^{f}$, where $C_{0.5,it}^{p} \coloneqq 1\{\phi_t = 0.5\}E_{it}^{p}$, etc.). The extended model is:

$$\begin{aligned}\Delta y_{it} = {} & \alpha_{0.5}^{p}\Delta C_{0.5,it}^{p} + \alpha_{0.5}^{f}\Delta C_{0.5,it}^{f} + \alpha_{1.0}^{p}\Delta C_{1.0,it}^{p} + \alpha_{1.0}^{f}\Delta C_{1.0,it}^{f} + \alpha_{1.5}^{p}\Delta C_{1.5,it}^{p} \\ & + \alpha_{1.5}^{f}\Delta C_{1.5,it}^{f} + \beta_1\Delta inc_{it} + \beta_2\Delta inc_{it}^{2} + x_{it}'\tilde{\gamma} + \tilde{\delta}_t + \tilde{\epsilon}_{it}\end{aligned} \tag{8}$$

The model becomes more complicated to interpret, as there are 49 possible within-individual variations in eligibility and match rates. Generally, the results from Equation (8) are consistent with those from the base model (Equation 5). To save space, we present results from Equation (8) that are of most interest—namely, bunching at the eligible maximum of $1,000 (Table 9). Results suggest that part eligibility is significantly associated with bunching at $1,000, despite contributions less than $1,000 being eligible for the matching payment. This highlights the importance of salient maximum in influencing peoples' contribution decisions.

Table 9: Estimated relationship between after-tax contributions and co-contribution partial and full eligibility

	Base model result	Alternative model (Equation (8))	
		Part-eligibility	Full-eligibility
$\alpha_{0.5}$	0.0023***	0.0017*	0.0062***
	(5.49)	(2.16)	(4.87)
$\alpha_{1.0}$	0.0084***	0.0091***	0.023***
	(20.12)	(10.98)	(20.54)
$\alpha_{1.5}$	0.014***	0.0075***	0.026***
	(25.66)	(7.92)	(10.69)
N	1,416,622	1,416,622	1,416,622

Notes: Estimated results from Equation (8). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7.2. Heterogenous effects

A feature of the co-contribution scheme is that, because eligibility is slowly tapered with income, over half of all taxpayers are eligible for some co-contribution payment over the period of analysis. Understanding how responses vary within the low- and middle-income population can help shed light on possible reasons for the low average response to the scheme. In Table 8

we present heterogenous responses to the matching scheme estimated using Equation (7). As discussed above, identification of the matching scheme impacts is based on first-difference changes in the treatment intensity (eligibility and match rate combined).

Results from Table 10 suggest differences in the cost of foregoing consumption to save more for retirement is important in explaining differences in responses to the scheme. Specifically, we estimate stronger increases in contribution rates of partnered females (2.7 percentage points) and those whose permanent income is in the top quintile (3.6 percentage points). In contrast to the responses of those in the top permanent-income quintile, those in the bottom two permanent income quintiles hardly respond – 0.4 and 0.7 percentage point increases, respectively. Partnered females, because they are more likely to have experienced career interruptions compared to males and single females, are less likely to be the primary income-earner in a household. As a result, their income may be considered more discretionary than that of the primary income-earner. The increasing response with age reflects the decreasing liquidity cost associated with making contributions.

We find no evidence that the matching scheme helps people with low balances catch up. Instead, the response tends to increase with existing superannuation balance. For the approximately two-thirds of the population with low balances (less than $25,000), the increase in the rate of contributions associated with treatment is around 0.6 of a percentage point, compared to around 2.5 percentage points for those with balances greater than $100,000 (top 13%). Interestingly, those with higher existing balances also have stronger negative income effects, especially for contributions above $3,000.

Finally, our results do not suggest that the low response is due to information deficiencies. If a lack of information about the scheme explained the low response rates, then we might expect that those who file their tax through an agent should respond more strongly than those who file their own tax return. 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 prepare their tax returns without providing financial advice related to the co-contribution scheme.

Table 10: Estimated coefficients for personal after-tax contributions, select sub-groups

	Personal after-tax contribution within defined range			Continuous contribution measure		
Sub-group	$1\{pc_{it} > \$0\}$ (*a*)	$1\{pc_{it} = \$1000\}$ (*b*)	$1\{\$0 < pc_{it} \leq \$1000\}$ (*c*)	$1\{\$0 < pc_{it} \leq \$3000\}$ (*d*)	$1\{pc_{it} > \$3000\}$ (*e*)	Personal after-tax contribution ($) (*f*)
Partner and gender						
Partnered female	0.0272***	0.0173***	0.0292***	0.00813***	-0.0101***	-10.81***
	(21.67)	(23.85)	(23.51)	(8.48)	(-15.52)	(-3.45)
Partnered male	0.0122***	0.00889***	0.0150***	0.00417***	-0.00689***	-12.05***
	(11.27)	(16.96)	(14.43)	(4.94)	(-11.47)	(-4.10)
Single female	0.0105***	0.00537***	0.0169***	0.00253**	-0.00892***	-24.17***
	(8.95)	(9.50)	(14.37)	(2.86)	(-16.15)	(-9.76)
Single male	0.00631***	0.00289***	0.0103***	0.00235**	-0.00629***	-17.83***
	(6.32)	(6.93)	(10.59)	(3.13)	(-13.10)	(-8.04)
Individual permanent income						
Bottom quintile	0.00408***	0.00188***	0.0113***	0.000746	-0.00792***	-28.02***
	(3.99)	(4.40)	(11.09)	(1.00)	(-18.56)	(-15.69)
2nd quintile	0.00737***	0.00292***	0.0110***	0.00396***	-0.00754***	-19.28***
	(7.35)	(7.21)	(11.03)	(5.18)	(-15.49)	(-9.29)
3rd quintile	0.0129***	0.00698***	0.0172***	0.00423***	-0.00851***	-18.13***
	(10.77)	(12.67)	(14.53)	(4.56)	(-13.86)	(-6.86)
4th quintile	0.0184***	0.0125***	0.0211***	0.00530***	-0.00801***	-12.97***
	(13.27)	(17.14)	(15.63)	(4.79)	(-10.58)	(-3.56)
Top quintile	0.0358***	0.0266***	0.0345***	0.00895***	-0.00763***	8.205
	(18.21)	(21.34)	(18.30)	(6.18)	(-7.06)	(1.38)
Tax return lodged through a tax consultant						
Yes	0.0127***	0.00848***	0.0163***	0.00399***	-0.00764***	-16.15***
	(17.77)	(24.37)	(24.03)	(7.28)	(-19.97)	(-8.60)
No	0.0192***	0.0102***	0.0224***	0.00574***	-0.00888***	-13.30***
	(17.39)	(17.87)	(20.28)	(6.79)	(-16.08)	(-5.54)

Continued over page.

Table 10 cont.

Age						
Below 30	0.00424***	0.00157***	0.0104***	0.00176*	-0.00787***	-26.45***
	(4.58)	(4.17)	(11.33)	(2.56)	(-19.20)	(-15.77)
30-39	0.00908***	0.00417***	0.0133***	0.00406***	-0.00827***	-19.51***
	(9.02)	(9.85)	(13.40)	(5.28)	(-16.54)	(-9.06)
40-49	0.0146***	0.00856***	0.0183***	0.00370***	-0.00737***	-16.76***
	(12.00)	(14.75)	(15.21)	(3.88)	(-11.77)	(-5.93)
50-59	0.0233***	0.0172***	0.0240***	0.00792***	-0.00866***	-7.000
	(14.89)	(19.23)	(15.87)	(6.46)	(-9.98)	(-1.59)
60+	0.0399***	0.0291***	0.0395***	0.00724***	-0.00688***	15.49
	(15.04)	(16.68)	(15.59)	(3.83)	(-4.72)	(1.90)
Lagged superannuation balance[a]						
$S_{t-1} \leq \$25{,}000$	0.00559***	0.00317***	0.0133***	-0.00243*	-0.00531***	-21.25***
	(3.32)	(5.13)	(8.28)	(-2.05)	(-6.64)	(-5.50)
$\$25{,}001 < S_{t-1} \leq \$50{,}000$	0.0162***	0.00832***	0.0199***	0.00138	-0.00502***	-1.440
	(5.39)	(5.66)	(6.46)	(0.62)	(-3.60)	(-0.23)
$\$50{,}000 < S_{t-1} \leq \$100{,}000$	0.0221***	0.0121***	0.0247***	0.00914**	-0.0118***	-8.500
	(6.07)	(6.45)	(6.51)	(3.00)	(-6.23)	(-0.99)
$S_{t-1} > \$100{,}000$	0.0247***	0.0156***	0.0352***	0.0191***	-0.0296***	-76.64***
	(4.39)	(5.62)	(6.25)	(3.73)	(-7.09)	(-4.12)
Contributions prior to reform[b]						
Never contributed prior to 2004	0.0207***	-0.00116	0.0136***	0.000921	0.00616***	35.80***
	(13.28)	(-1.55)	(8.58)	(0.69)	(6.91)	(8.79)
Contributed at least $1,000 at least once prior to 2004	-0.0155***	0.00204*	0.00449*	-0.0107***	-0.00935***	-57.71***
	(-8.10)	(2.23)	(2.35)	(-5.91)	(-7.28)	(-10.18)
Contributed at least $3,000 at least once prior to 2004	-0.0106**	0.0106***	0.0118***	0.00551	-0.0280***	-117.0***
	(-2.88)	(5.32)	(3.49)	(1.71)	(-9.62)	(-8.56)
N	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622

Notes: Estimated results from Equation (7). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. [a] Estimated for matching rate of 50% only (N=450,103) because balances are only available in Alife from 2013. [b] Estimated from 2004 (*N*=1,162,866) with three difference models, each with a binary indicator for whether or not individuals are part of the group. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

8. Conclusions and discussion

Competing income and substitution effects mean that the theoretical impacts of matching schemes on the retirement plan contributions of low- and middle-income earners are ambiguous. Results presented in this study, while consistent with theory, cast doubt on the cost effectiveness of matching schemes in supporting the retirement incomes of low- and middle-income earners. We find small increases (1-3 percentage point increases) in the proportion who voluntarily contribute to superannuation in Australia in response to its co-contribution scheme. The small responses are found despite the scheme's simplicity, its high public awareness (around 80%) and its generous match rate of up to 150%. Further, we find evidence that the co-contribution scheme crowded out unmatched employment-based concessional contributions and reduced the average size of after-tax contributions. The latter is driven by negative retirement income effects among high contributors, which highlights the importance of examining impacts across the contribution distribution. Reductions in high contributions and bunching of contributions at the maximum are new findings that highlight the difficulty of targeting matching payments.

Our results also call into question the equity effects of matching schemes and their ability to deliver greater accumulated savings from contributions over a working life. Consistent with Heim and Lurie (2014), who examined responses to the Saver's Credit scheme, we find larger responses among people with higher levels of discretionary income (those with higher permanent income, as well as partnered females), which points to possible budgetary constraints on making contributions. For many low- and middle-income earners, they may prefer to spend their limited discretionary income on current consumption. This may be especially true when they have access to a public retirement pension. Whether tightening access to public pensions, such as by raising the minimum age of eligibility, changes this is a topic for future research. We also find new evidence of behaviours that limit the prospects for small responses to accumulate into large retirement income gains over a lifetime. First, we observe very low responses among people aged under 40; and second, we find no evidence for response asymmetry that would mean exposure to the scheme establishes lasting contribution patterns that persist beyond eligibility.

These findings help clarify the existing literature on the effectiveness of national matching schemes. Previous evaluations have focussed solely on the US Saver's Credit (Duflo *et al.* 2007, Ramnath 2013 and Heim and Lurie 2014) and the German Riester (Corneo *et al.* 2009 and 2010). These studies have found modest responses that can be attributed to program

complexity. Both the US Saver's Credit and the German Riester have rules that make it difficult for an individual to predict their eligibility and match rate in advance. For the Saver's Credit, the scheme is a non-refundable tax credit that varies with income, while the Riester is a co-contribution scheme where the match rate varies with individual circumstances, but eligibility is dependent on self-selection and minimum contributions that requires a mathematical formula to estimate. The more positive findings from the Duflo *et al.* (2006) field experiment (despite limitations discussed) ignited hope that more positive results could be found from simpler schemes with a single match rate and eligibility that was gradually phased out beyond an upper income threshold (Duflo *et al.* 2007). Estimated impacts in this study of the superannuation co-contribution scheme, which have these features, have dampened those hopes.

For countries with existing national matching programs, including Austria, Chile, Czech Republic, Hungary, Mexico, New Zealand, Turkey and the United States, this study raises questions about the efficacy of these programs. Our findings are particularly timely for policy makers in the United States, who are currently considering reforms before Congress to the Saver's Credit scheme. The reforms being considered propose to 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.[29] 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 small. That said, when considering the implications of our results, it is important to also consider that superannuation accounts, unlike in most other countries, are compulsory for all workers, and employers are required to contribute a minimum of 9.5% of earnings to the employee's account. Thus, it is possible that responses to matching schemes may be higher in countries with lower employer-scheme coverage. This seems unlikely, however, since we find that people with lower superannuation balances are less likely to take advantage of the scheme.

[29] At the time of writing, a bill (known as the Retirement Security and Savings Act of 2019, introduced by Senators Portman and Cardin) was under review by Congress to 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 file:///C:/Users/cainp/Downloads/Tax+Alert+2019-0924_Retirement+Security+and+Savings+Act.pdf.

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Appendix B: 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.

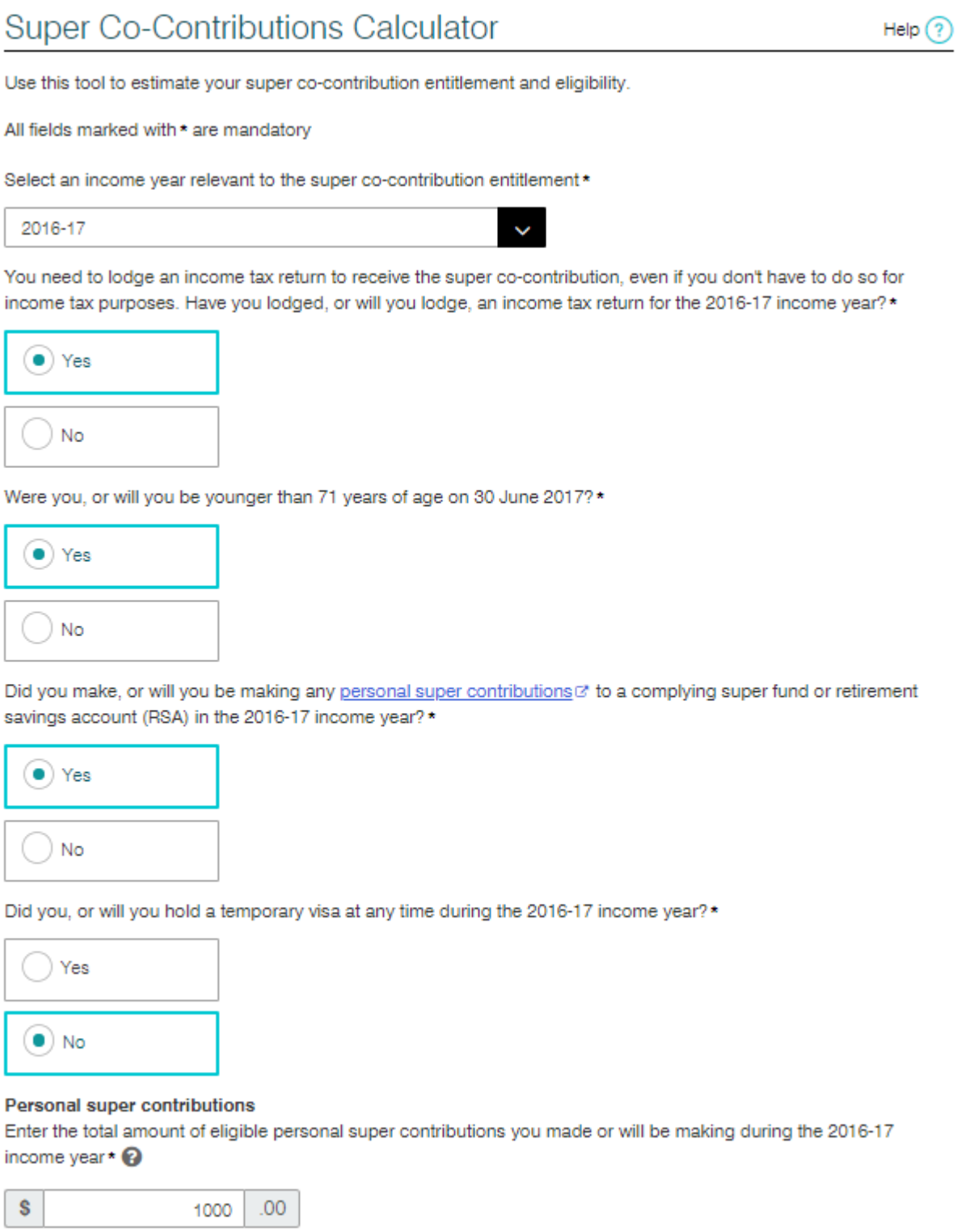
Table A.1: Major advertising campaigns of the Superannuation Co-contribution scheme

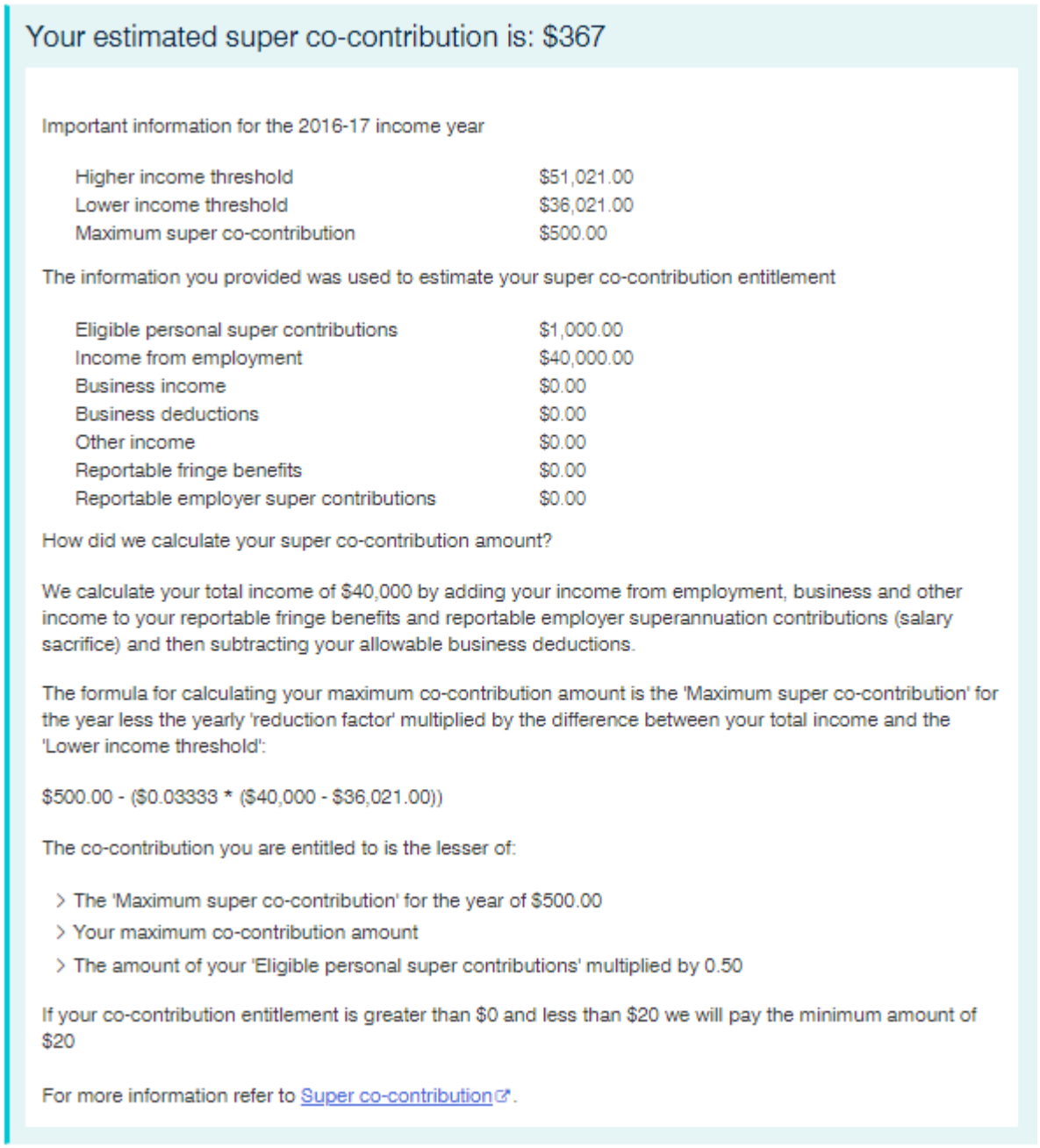
Approach	Date	Description
Initial co-contribution campaign	2004 & 2005	Mass media campaign, including television and radio, based on a piggy bank icon. There was also direct mailing of material explaining the co-contribution and a comprehensive public relations program including a website links program.
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). Subsequent surveys commissioned or undertaken by superannuation industry groups have found similarly high public awareness. A 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). Similarly, a study by the Australian Institute of Superannuation Trustees also found that 76 per cent of respondents were aware of the Scheme in April 2008 (Australian Institute of Superannuation Trustees 2008).

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





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: Fixed effects estimation

Table B.1: Estimated relationship between after-tax contributions and co-contribution eligibility

	Contributions within defined ranges					Continuous measure
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1{,}000\}$	$1\{\$0 < pc_{it} \leq \$1{,}000\}$	$1\{\$1{,}000 < pc_{it} \leq \$3{,}000\}$	$1\{pc_{it} > \$3{,}000\}$	Personal after-tax contribution ($)
$\alpha_{0.5}$	0.035***	0.0054***	0.018***	0.029***	-0.012***	0.97
	(24.00)	(10.64)	(16.87)	(27.43)	(-15.91)	(0.24)
$\alpha_{1.0}$	0.028***	0.014***	0.027***	0.016***	-0.014***	-12.7***
	(23.79)	(30.28)	(28.98)	(18.66)	(-21.13)	(-3.64)
$\alpha_{1.5}$	0.038***	0.024***	0.044***	0.018***	-0.025***	-33.1***
	(27.02)	(45.68)	(42.63)	(17.72)	(-28.10)	(-7.53)
N	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622	1,416,622

Notes: Estimated results from Equation (5). Model controls for year fixed effect, individuals' income ($A mill., deflated.), income squared, spouse's income, age, age squared, marital status and gender. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As discussed in Section 6, an alternative approach to our based first-difference model is to use a fixed-effects estimator, which relies on a strict exogeneity assumption, namely, that the regressors in any period are orthogonal to all past, present and future errors. However, as in many life-cycle models, the strict exogeneity assumption is strenuous because the regressors (e.g., income) are likely to be correlated with past shocks. For example, if a forward-looking individual anticipates his/her future income to go up, he/she may start increasing contributions now, leading to positive correlation between the current contribution shock and future income. Results from the fixed-effects model should be treated with caution.

Nevertheless, results from the fixed-effects model are generally consistent with those from the first-difference model and the theoretical predictions presented in Table 6. One exception is that there is an anomaly in the estimates for the match rate 50%, where we see the effects on the extensive margins exceed the effects on the probability of contributions up to $1000, which theoretically inconsistent, given that the effects on the latter capture the increase in new contributors as well as the increase in the 'windfall' contributors who now bunch at $1000. This analogy highlights the strength of first-difference model in controlling for time fixed effects, compared to fixed effects.

Appendix C: Other results

Table C.1: Estimated coefficients for personal after-tax contributions

Variables	Personal contribution within defined ranges, y_{it}^k					Continuous contribution measures	
	$1\{pc_{it} > \$0\}$	$1\{pc_{it} = \$1000\}$	$1.\{\$0 < pc_{it} \leq \$1000\}$	$1\{\$0 < pc_{it} \leq \$3000\}$	$1\{pc_{it} > \$3000\}$	Personal after-tax contribution	Personal after-tax plus matching contribution
Eligibility (50% match rate)	0.0062***	0.0023***	0.012***	0.0011	-0.0066***	-24.0***	0.0062***
	(6.39)	(5.49)	(12.40)	(1.49)	(-13.32)	(-9.59)	(6.39)
Eligibility (100% match rate)	0.0093***	0.0084***	0.016***	0.0024***	-0.0091***	-24.6***	0.0093***
	(10.44)	(20.12)	(18.88)	(3.52)	(-19.06)	(-10.71)	(10.44)
Eligibility (150% match rate)	0.027***	0.014***	0.027***	0.0097***	-0.0098***	-6.49*	0.027***
	(25.27)	(25.66)	(26.33)	(11.51)	(-16.46)	(-2.29)	(25.27)
Controls							
Total income ($A2017 mill.)	0.18***	-0.027***	0.0058	0.11***	0.064***	580.6***	0.18***
	(15.86)	(-8.98)	(0.73)	(14.54)	(9.30)	(13.83)	(15.86)
Total income squared	-0.029***	0.0045***	-0.00062	-0.018***	-0.010***	-93.3***	-0.029***
	(-8.62)	(7.09)	(-0.42)	(-7.92)	(-7.56)	(-9.04)	(-8.62)
Age at 30 June	-0.00024*	0.00014*	-0.00044***	-0.00032***	0.00052***	2.67***	-0.00024*
	(-2.13)	(2.32)	(-3.96)	(-3.87)	(8.90)	(8.48)	(-2.13)
Age squared	-0.0000020	-0.0000013	0.0000046***	0.00000098	-0.0000076***	-0.042***	-0.0000020
	(-1.45)	(-1.73)	(3.46)	(0.95)	(-10.32)	(-10.38)	(-1.45)
Partnered	0.00025	0.00054**	0.00049	-0.000015	-0.00022	0.34	0.00025
	(0.54)	(2.65)	(1.06)	(-0.04)	(-0.90)	(0.29)	(0.54)
Female	0.0055***	0.00052*	0.0018***	0.0030***	0.00071**	8.90***	0.0055***
	(12.45)	(2.49)	(4.05)	(8.93)	(3.14)	(7.84)	(12.45)
Partner's income ($A2017 mill.)	0.00040	-0.00058	0.00083	-0.00032	-0.000099	-0.31	0.00040
	(0.27)	(-0.77)	(0.55)	(-1.51)	(-0.35)	(-0.18)	(0.27)
Self-employed	0.0054***	0.00061	0.0033***	0.0025***	-0.00036	3.40	0.0054***
	(6.22)	(1.51)	(4.05)	(3.99)	(-0.83)	(1.43)	(6.22)
Use a tax accountant	-0.0026***	0.000087	-0.00080	-0.00086*	-0.00089***	-7.64***	-0.0026***
	(-5.28)	(0.37)	(-1.67)	(-2.32)	(-3.64)	(-6.56)	(-5.28)
Observations	1416622	1416622	1416622	1416622	1416622	1416622	1416622

Notes: All models are estimated with year fixed effects. *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.