The Economic Incidence of Superannuation

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Abstract
This paper evaluates the economic incidence of superannuation by comparing workers who receive superannuation at the government guarantee rate to those who receive superannuation above the guarantee rate. We compare wage growth between these two groups during periods when the superannuation guarantee is constant. We also use a difference-in-difference approach to assess whether wage growth changes for workers at the government guarantee rate relative to those who are paid above the guarantee during periods when the guarantee rate is increasing. We use fixed-effects models to control for initial income levels and other individual characteristics. The results suggest that wage growth for workers who receive above the superannuation guarantee rate is consistently lower than wage growth for those who receive the superannuation guarantee. As a result, total compensation across the two groups of workers tends to converge over time suggesting that workers initially bear the majority of the incidence of superannuation and over time they bear the full incidence. Results from the difference-in-difference analysis provide similar results and suggest that between 71% to more than 100% of increases in the superannuation guarantee are offset by lower wage growth; workers bear most of the incidence of increases in the superannuation guarantee.

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Executive Summary

The superannuation guarantee was introduced to boost the private retirement savings of individuals. Since its introduction, the superannuation guarantee (SG) rate has increased over time and currently sits at 9.5 per cent of wages. The SG is legislated to rise to 10 per cent in 2021 and then increase, in steps, to 12 per cent by mid-2025. Pausing these increases is under active debate. In particular, current debates centre around the economic incidence of an increase in the SG. Do employers bear the cost of legislated increases to the superannuation guarantee rate by increasing their labour costs? Alternatively, is the disposable income (take-home pay) of employees reduced to account for the increased cost to employers of the increase in the SG? This research aims to contribute to a better understanding of these questions.

While employers are legally bound to pay the superannuation guarantee, some employers, like the public service and academia, choose to pay more. This research uses administrative tax data to exploit the differences in wages paid to employees who receive different amounts of superannuation in order to estimate where the burden (the economic incidence) of the SG lies. One approach will be to compare wage growth during periods where the SG does not change. If employers bear the burden of SG, then wage growth should be constant for the two groups: those paid at SG and those paid above the SG.

We also exploit changes in the SG to estimate the incidence of SG. In particular, employees who already receive more than the superannuation guarantee from their employers are unaffected by legislated increases to the SG ("above SG group"). As a result, their wage growth should not change when the SG changes. By contrast, workers employed by firms that only pay the SG are affected by increases ("at SG group"). If workers bear the burden of the increase, then wage growth should slow down for the "at SG group" when the SG increases, relative to the "above SG group". We thus estimate the economic incidence of increases in the SG by comparing differences in wage growth between the two groups in: (1) periods where the SG is constant to (2) when the SG is increased.

Formally, estimation of the economic incidence is achieved by applying a difference-in-difference approach. The results show that in periods when the SG was constant, wage growth in the "above SG group" is consistently lower than wage growth in "at SG group". In periods when the SG is increased, wage growth for "at SG group" slows down, consistent with the idea that workers bear (at least part of) the economic incidence of increases to the SG. Further calculations show that workers bear between 71% to more than 100% of the cost of increases to the superannuation guarantee through lower wage growth, depending on the time period considered.

Our research findings align with one (Coates et al. 2020) of the three existing Australian studies which measure the economic incidence of increases in superannuation. The two other studies, by Stanford (2019) and Taylor (2019), do not find that a trade-off exists between higher super and lower wages and in some instances present the case for a positive relationship between higher superannuation and wages. They rely on time series data to establish correlation between wage growth and changes in the superannuation guarantee. As we have seen with the current debates about pausing increases to the SG, it tends to be politically easy to raise the SG when wage growth is robust and convenient to pause changes to the SG when wage growth is slow. The correlations established in the macro-economic studies may well be picking up the political economy of when SG increases are politically feasible and when they are not, rather than a causal relationship of SG increases on wage growth.

We argue that our approach, using microdata at the individual level, is better suited to analysing the economic incidence of increases to superannuation because focusing on changes across groups of individuals (or firms), reduces the impact of confounding macroeconomic effects (because all individuals experience the same macroeconomic conditions at the same time). Our results are also consistent with economic theory and the international, empirical economic literature.

In conclusion, policymakers will need to balance their goal of boosting superannuation balances, through an increase in the superannuation guarantee, with the costs and benefits of doing so. The current settings of the Age Pension are such that an increased superannuation balance is not directly correlated with an increase in retirement living standards. An increase in the superannuation guarantee may, however, reduce future Age Pension expenditure. At the same time, as our results suggest workers bear the cost of increases in the superannuation guarantee through lower wage growth. Subsequently, the government will forgo the tax revenue from labour income taxed at individuals' marginal personal income tax rates, for greater superannuation contributions that are taxed concessionally. Lower wage growth also implies less disposable income available to workers and their families to consume today or to save through alternative means.

1. Introduction

Private retirement savings help to ensure adequate living standards for future generations of retirees. They can also help to alleviate budgetary pressure on governments facing increasing costs associated with an ageing population. Australia's legislatively mandated private pension system, established through the Superannuation Guarantee (SG), was introduced in the 1992 – 1993 financial year. Originally, companies had to contribute at least 3 per cent of an employee's ordinary time earnings to her superannuation account. Since then the rate gradually increased to 9.5 per cent. Legislation to gradually raise the SG to 12 per cent is undergoing consideration and active debate. In particular, current debates centre around the economic incidence of an increase in the SG. Do employers increase their labour costs in response to an increase in the superannuation guarantee rate? Alternatively, is the disposable income (take-home pay) of employees reduced to account for the increased cost of increases in the superannuation guarantee? These questions are important for the purposes of retirement incomes policy design for several reasons.

First, if workers bear the incidence of superannuation, they forego current consumption and save more for retirement. Foregone consumption has both costs and benefits. One potential benefit is increased savings for retirement. Greater retirement savings should improve the adequacy of an individual's living standards in retirement. However, in the presence of other policies, like the Age Pension, there is not a direct relationship between increased retirement savings and improved retirement living standards for all individuals. For example, for lower income individuals, an increase in private retirement savings, likely offsets the value of the Age Pension they would have otherwise received. By contrast, higher income individuals, ineligible for the Age Pension, are likely to increase their retirement savings. Subsequently, if workers bear the incidence of superannuation, there is a trade-off between higher consumption and reduced future expenditure on the Age Pension that policymakers must consider.

A second and related policy consideration relates to the broader budgetary implications of increases in the superannuation guarantee. If a worker bears the incidence, a greater share of her total remuneration will be concessionally taxed by the superannuation system, rather than through the personal income tax system. By contrast, if the employer bears the incidence, corporate income tax receipts are reduced, or the increased labour costs are passed on to consumers through higher prices. As a result, the magnitude of the budgetary impact of increases in the superannuation guarantee also depends on the incidence.[1]

The objective of this paper is to estimate the economic incidence of the superannuation guarantee. Prior to the introduction of the SG, many employers operated private retirement plans which contributed significantly larger percentages of their employees' wages in superannuation, compared to the superannuation guarantee. For example, universities contributed 17 per cent of employees' earnings to superannuation prior to the introduction of the SG and have continued to

[1]Some of the savings from reduced expenditure on the Age Pension offset the superannuation tax concessions. Cooper et al. (2013) however, suggests that the value of latter far exceeds the savings from expenditure on the former by 0.4 per cent of GDP per year.

do so to present day. Ross (2010) estimates that around 23% of employees benefit from employer contributions greater than the minimum superannuation guarantee. The historical legacy of private occupational superannuation plans results in a clear divide between employees who work for firms which pay the minimum SG and those which pay in excess.

While the remuneration of employees working for firms paying the minimum SG is affected by legislated increases to the SG, the latter group of employees is not. As a result, variation over time in employers' superannuation policies and changes in the legislated superannuation guarantee rate since its introduction provide significant variation over time and across individuals to identify the economic incidence of superannuation using deidentified tax data provided by the ATO in January 2020.

In order to assess the impact on wage growth of receiving different levels of superannuation, first a fixed effect model compares workers who receive employer superannuation contributions in excess of the superannuation guarantee to those who receive the superannuation guarantee; the results suggest that wage growth in the former group is consistently lower than wage growth in the latter group. As a result, total compensation across the two groups of workers tends to converge over time suggesting that suggests that workers initially bear the majority of the incidence of superannuation and over time they bear the full incidence (100%). The results provide descriptive evidence that workers who receive superannuation in excess of the superannuation guarantee, trade-off higher superannuation contributions for lower wage growth. In order to interpret these results as causal, workers in jobs which receive above the superannuation guarantee must be identical in all other respects to workers who receive the superannuation guarantee. This is probably not true—many workers who receive above the superannuation guarantee are government employees or in education. Workers may choose these occupations for other reasons, such as risk aversion, that may be related to lower wage growth. This lower wage growth may have nothing to do with superannuation.

To circumvent this problem, we also estimate a separate difference-in-differences model which asks whether workers at the superannuation guarantee receive lower wage growth than what would have been expected when the superannuation guarantee changes. This approach will still provide causal estimates even if workers who receive the superannuation guarantee are systematically different than those who receive superannuation above the guarantee. Using common trends in growth rates, we can control for these differences and use the differential growth rates to estimate a counter-factual for workers at the guarantee amount. The results also suggest that between 71% to more than 100% of the increase in superannuation guarantee is paid for by workers out of lower wage growth.

2. Background: Australia's superannuation system and the Superannuation Guarantee (SG)

The first Australian policies aimed at ensuring old-age welfare were enacted in the 1840s by individual employers. Over the course of the nineteenth and twentieth centuries, these employer schemes, including for the public sector, continued to expand and develop through defined benefit schemes. They encouraged long-service and loyalty to one firm and often excluded blue-collar workers (Millane 2019). Women were also excluded indirectly given the nature of their non-continuous employment patterns.

While a national scheme was considered, the failure of the Whitlam government to enact a national superannuation system during the early 1970s encouraged trade unions to promote occupational schemes. During the 1980s, an occupational superannuation scheme also "…spoke to a number of these elements of the economic reform agenda – reducing inflation, restraining wages and increasing Australia's savings, all through deferred wages (Millane 2019)." It was the historical legacy of occupational superannuation programs, their continued expansion, and changing economic circumstances, which shaped the design and adoption of a modern system - a national occupational scheme based on defined employer contributions - through the Superannuation Guarantee in 1992.

Table 1. Historical superannuation guarantee rates

Financial Year	Annual national payroll for the base year did not exceed $1,000,000	Annual national payroll for the base year exceeded $1,000,000
1992-1993	3	5
1993-1994	3	5
1994-1995	4	5
1995-1996	5	6
1996-1997	6	6
1997-1998	6	6
1998-1999	7	7
1999-2000	7	7
2000-2001	8	8
2001-2002	8	8
2002-2003	9	9
2003-2004	9	9
2004-2005	9	9
2005-2006	9	9
2006-2007	9	9
2007-2008	9	9
2008-2009	9	9
2009-2010	9	9
2010-2011	9	9
2011-2012	9	9
2012-2013	9	9
2013-2014	9.25	9.25

2014-2015	9.5	9.5
2015-2016	9.5	9.5
2016-2017	9.5	9.5
2017-2018	9.5	9.5
2018-2019	9.5	9.5
2019-2020	9.5	9.5

Sources: Superannuation Guarantee (Administration) Act 1992; ATO.

When the superannuation guarantee was introduced, it applied two different rates to employers depending on annual payroll. These rates were unified during the 1996 – 1997 financial year. Over time, the superannuation guarantee rate has increased from 3 per cent to 9.5 per cent. For example, in the 1992 – 1993 financial year, an employer with a payroll amounting to less than $1,000,000 was required to contribute 3 per cent of their employees' earnings to the employee's retirement income account. The historical rates are presented in Table 1. The introduction of the superannuation guarantee also broadened the coverage of employees in receipt of superannuation from about 79% of full-time workers and 44% of part-time workers in 1991 to 87% and 62%, respectively in 1995 (ABS 1995).

Given the occupational design of the superannuation system and the historical legacy of the occupational superannuation system, heterogeneity remains across employers with respect to the percentage of earnings paid into superannuation. It is also this heterogeneity which creates the variation required to identify the economic incidence of superannuation. For example, research from the Association of Superannuation Funds of Australia (Ross 2010) suggests that around 23% of employees benefited from employer contributions greater than the minimum superannuation guarantee in 2006. Employees receiving generous employer superannuation contributions are concentrated in finance, universities, building and construction, private education (particularly in Queensland), the brewing industry and government.

3. Literature Review

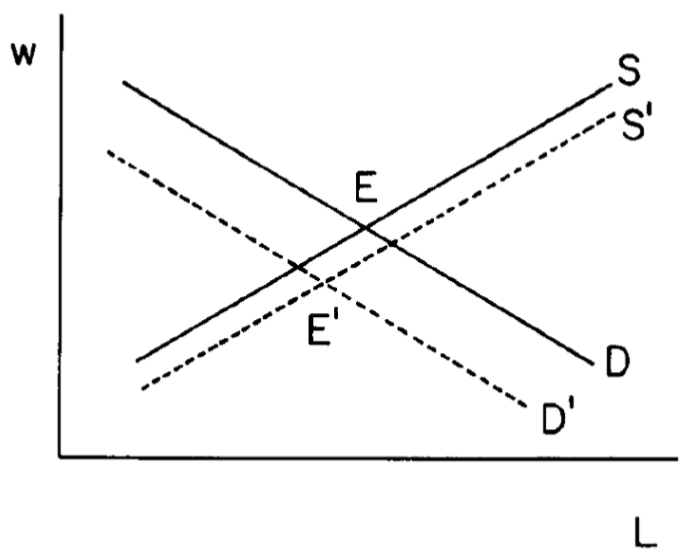
Mandatory social security contributions from employer to employee, such as those legislatively required by the Superannuation Guarantee (SG), are a type of 'mandated benefit'. Much of the research focusing on the economic incidence of social security contributions is part of a broader literature concerning mandated benefits. Other examples of mandated benefits include health insurance, maternity benefits, workers' compensation insurance and unemployment insurance. In theory, mandated benefits function similarly to public programs financed directly by benefit taxes. This insight has clear implications for the incidence of mandated benefits, which have largely been supported by empirical evidence. In Australia, there is a mostly separate but related body of literature and public discussion relating to the incidence of the SG. Theory implies that the incidence of the SG should mostly fall on employees, although there is limited empirical evidence of this, which this paper will help to address.

Theory

Traditionally, most economists have considered mandated benefits to be equivalent to a tax on labour. Some economists, such as Friedman (1965), believed that the incidence of the "tax" falls on employees, whereas many other economists have remained undecided on the matter (Jaszi 1958, Groves 1965). Early empirical literature (Brittain 1971, Feldstein 1972) was similarly equivocal.

The key insight of Summers (1989) is that mandated benefits are not equivalent to a tax on labour, but are more like public programs financed by benefit taxes. In the standard neoclassical framework, the incidence of a tax depends on the elasticities of labour supply and demand – the side that is less responsive to price will bear the greater burden. If labour supply is perfectly elastic, the employer must bear the full burden, resulting in no change to wages, but reduced employment. Otherwise, the burden will be shared between employer and employee, with wages declining by some amount. However, in the case of mandated benefits, the incidence depends on the extent to which employees value the benefit, as well as on the elasticities, as depicted in Figure 1. To the extent that employees value the benefit, the reduced demand for workers induced by the increased labour costs may be partially or even fully offset by a downward shift in the supply of workers who value the benefit, with employees bearing the greater burden, resulting in reduced wages and limited disemployment effect.

Figure 1: The effects of mandated benefits (Summers 1989)



There are some additional caveats regarding the applicability of the above theory. The incidence of mandated benefits must depend on the degree of linkage between the "tax" and the benefit (Gruber 1997). If the tax and benefit are not linked, as in the case of a generic payroll tax on employment, levied on the employer, then there is no mandated benefit and the incidence of the tax depends on the elasticities of labour supply and demand. Summers (1989) also notes that, in the presence of wage rigidities such as minimum wages, mandated benefits may result in disemployment, as wages cannot fall to offset increased labour costs. If wages are sticky in the short run, there may be a delay in the effect of mandated benefits on wages, which would motivate extending empirical analysis beyond the short run where possible (Adam, Phillips & Roantree 2019).

Empirical studies

Several empirical studies were precipitated by Summers (1989), and have largely been in accordance with the theory. Gruber and Krueger (1991) study the incidence of increases in the cost of mandated employer-provided workers' compensation insurance in the US. They do this via a pooled time series model on survey data, estimating wage equations by industry and controlling for state and year fixed effects. In aggregate, the authors find that 86.5 per cent of the cost shifts to wages, with little disemployment effect. Gruber (1994) analyses the effects of mandated maternity benefits in the US and, using a difference-in-differences approach on survey data, finds that a large share of the cost is shifted to wages with only minor disemployment effect. In particular, young women's wages are shown to fall by up to 5 per cent with insignificant effect on employment, suggesting that the cost has been fully passed through to wages. Gruber notes the assumption of the mandated benefits theory that wages must be allowed to adjust freely to reflect employee valuation of the benefit, which may be of particular concern in the case of such a "group-specific" (that is, applicable to a particular demographic group) policy. Here, the group-specific effect on wages is clearly observed.

Recent empirical studies have mostly reinforced earlier findings, using updated methodologies and data. As outlined by Bosch, van Ewijk, Micevska Scharf and Muns (2019), there is a methodological distinction between studies that analyse distributions around payroll tax thresholds to estimate incidence (for which cross-sectional data is sufficient), and studies that use panel data to examine incidence by exploiting tax variation over time and across individuals. As a recent example of the former approach, Prada, Rucci and Urzúa (2015) use an administrative employer-employee dataset and regression discontinuity design model to investigate the effect of mandated employer-provided childcare on the wages of women hired in large firms in Chile. They find evidence of a large pass-through, with the monthly starting wages of women hired in a firm with 20 or more female workers being between 9 and 20 per cent below those of women by the same firm when no requirement of providing childcare was imposed. In the panel data framework, Goda, Farid and Bhattacharya (2016) estimate the incidence of the dependent care mandate of the 2010 Affordable Care Act in the US, which requires that employer-based insurance plans cover healthcare expenditures for employees with children 25 years old or younger. Using a difference-in-differences approach on survey data, they find that employees (irrespective of whether they have dependent children) experience an annual wage reduction of 3.5 per cent of earnings. In this instance, the cost of the mandated benefit is not exclusively borne by the group that receives it.

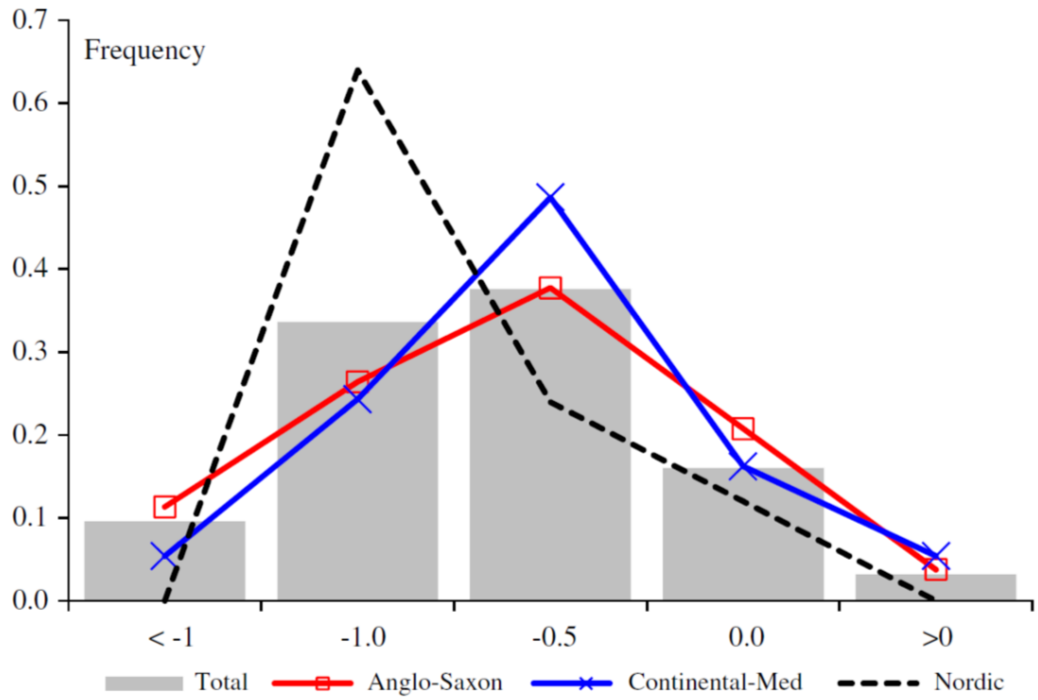
There have been some studies which appear to challenge the economic theory. Saez, Matsaganis and Tsakloglou (2012) use a regression discontinuity design on administrative social security data in Greece and find evidence that the incidence of social security contributions is determined by their statutory incidence, with employers bearing the full burden of employer contributions in the long run. The scenario analysed is an increase in payroll tax which applies only to people who entered the labour market after a specific date. Theory predicts that the new workers should bear the full burden of the tax increase. The authors' preferred explanation for their finding is that wage rigidity due to pay fairness norms prevented this from occurring. However, they note that the persistence of their result into the long run is unexpected. Adam et al. (2019) reach an analogous finding using difference-in-differences analysis on panel data from the UK. Their preferred explanation is wage stickiness due to adjustment frictions.

Findings which seem to go against theory are supported and perhaps better explained by Bozio, Breda and Grenet (2019). Using a difference-in-differences approach to analyse several historical reforms from administrative data in France, they find that the degree of perceived tax-benefit linkage has a significant impact on incidence, and that in the absence of tax-benefit linkage, statutory incidence also matters significantly. Both Saez et al. (2012) and Adam et al. (2019) consider social security contributions in their respective contexts to be pure taxes, due to a lack of tax-benefit linkage. Without tax-benefit linkage, social security is not a mandated benefit and the incidence of the tax depends only on the elasticities of labour supply and demand. Thus, it may be that, rather than being evidence against the economic theory, these and similar studies refer to contexts where the assumptions of the theory do not hold.

Of particular relevance to Australian superannuation are studies within the mandated benefits literature which focus on the incidence of social security contributions, including those previously cited, particularly in a Bismarckian social security system (that is, a non-redistributive system with a high degree of tax-benefit linkage). Social security contributions are also often classed as payroll taxes. There have been several such studies, although the responsiveness of earnings to payroll taxation has been relatively understudied when compared to the high volume of literature on the response of taxable income to income taxation. This is surprising given the importance of payroll taxation for revenue. Payroll taxes are on average equal to 22.6 per cent of labour costs, whereas income taxes are on average at 13.4 per cent of labour costs across OECD countries (Bosch et al. 2019).

Melguizo and González-Páramo (2013) conduct a meta-analysis of 52 empirical studies on the incidence of social security contributions. They find that, on average, employees bear 70 per cent of the tax burden in non-Nordic economies and 88 per cent of the burden in Nordic economies, in the long run. The amount of shifting to wages is much lower in the short run, with employees on average bearing 39 per cent of the burden. Figure 2 depicts the distribution of incidence estimates across studies, and also gives an indication of the level of dissent in the literature.

Figure 2: Distribution of elasticity of net wages to taxation across 52 studies on the incidence of social security contributions (Melguizo & González-Páramo 2013)



The Superannuation Guarantee in Australia

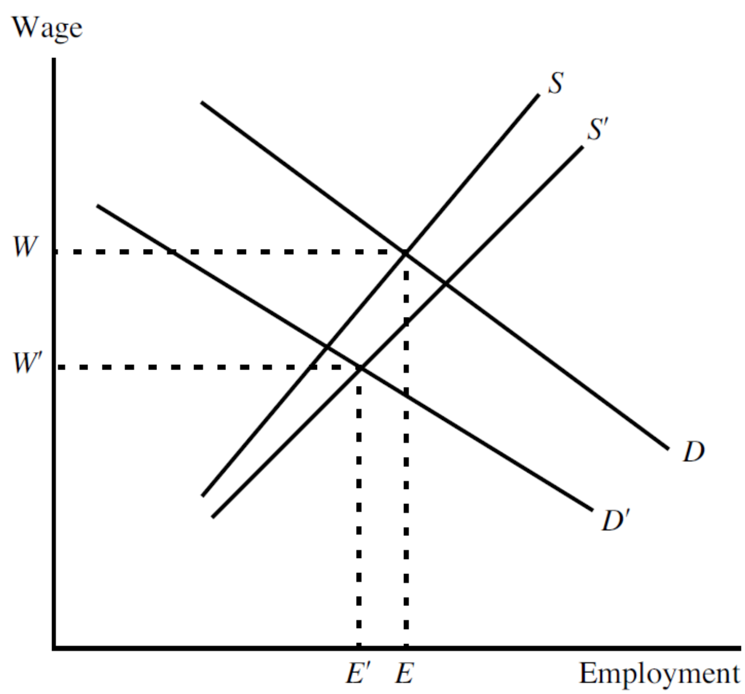
In Australia, empirical research on the incidence of the SG has been limited, although in recent years this has been a topic of politically charged debate, as further legislated SG increases become imminent. Most existing studies have the flaw that they are based on analysis of macroeconomic aggregates, which are heavily subject to macroeconomic conditions in general. It is easy to raise superannuation guarantee rates when wage growth is strong. Increases are less likely when wage growth is weak. This will lead to a positive correlation between increases to the SG and wage growth, although the causality is the opposite of what researchers are positing.

In theory, employees should bear most of the burden of the SG in the form of lower wages, with a comparatively lower reduction in employment. Freebairn (2004) implies this by suggesting that employees value the SG but not to the full extent, as it provides a less flexible form of savings than wages, and also may reduce their eventual age pension eligibility due to the interaction between superannuation and the pension means test. The effect is depicted in Figure 3.

The Grattan Institute supports the theoretical view that the incidence of the SG mostly falls on employees (Coates 2019). Coates, Mackey and Cowgill (2020) estimate the effect of the SG on wages using administrative microdata from the Attorney-General's Department's Workplace Agreements Dataset, which contains information on wage increases and conditions for all public and private federal Enterprise Bargaining Agreements certified from October 1991 to 2018. They find that around 80 per cent of the cost of SG increases is borne by employees. While this dataset only accounts for around a third of all employees, the authors theorise that effects should be no different for employees whose employment is not subject to a collective agreement – that is, employees whose pay is set by awards, state agreements or individual arrangements. This is because: the Fair Work Commission has publicly acknowledged the suppression of award wages due to SG increases; extrapolating public sector evidence from federal industrial relations data gives the same result; and pay under individual arrangements is most responsive to overall economic conditions, indicating an even larger pass-through to wages from the SG.

Further, in a rebuttal to a recent study by Taylor (2019) of the McKell Institute taking the opposing view, Nolan, Mackey and Coates (2019) recreate Taylor's time series modelling, addressing their criticisms of it, and find evidence that increases in the SG do lead to a possibly substantial reduction in wages, as measured by Average Weekly Ordinary Time Earnings (AWOTE) – although with a wide 95 per cent confidence interval around this conclusion. In particular, the authors take issue with Taylor's wage growth measure, his assumptions about the timing of SG increases and the potentially delayed timing of wage responses, and the explanatory power of his model overall. They also support their finding by noting that the labour share of national income has fallen significantly since the introduction of mandatory superannuation.

Figure 3: Wage and employment effects of the SG, assuming superannuation is an imperfect substitute for wages (Freebairn 2004)



There are some further authors and commentators who disagree with the theoretical view. For example, Stanford (2019) of the Australia Institute investigates wage effects of the SG, via various regression models and inspection of cross-sectional aggregates. He finds insufficient evidence of any trade-off between wages and mandated employer superannuation contributions. His analysis is broadly similar to Taylor's (2019).

The approach to this paper differs from the pre-existing research conducted on the incidence of the superannuation guarantee. With the exception of the analysis conducted by Coates et al. (2020), the other two studies (Stanford 2019; Taylor 2019) only consider correlation between wage growth and change in the superannuation guarantee. They do not include a clear identification strategy to identify the causal impact of a change in the superannuation guarantee on wage growth. Second, this research is unique in relying upon microdata at the individual level. In general, the use of microdata is better suited to analysing the effect, compared to time series data, because by focusing on change across groups of individuals, who experience the same macroeconomic conditions, reduces the impact of confounding macroeconomic effects. In addition, the significantly larger sample size permitted by the administrative data increases the statistical precision of our results. Furthermore, fixed effects estimation allows us to control for differences, both observed and unobserved, between workers who receive different amounts of superannuation.

4. Data

The data for this analysis draw upon deidentified administrative data from the Australian Taxation Office (ATO). The data are limited to the adult working age population aged 25 to 60. Restricting the population to these ages eliminates young and older workers with more volatile earnings, thereby reducing cases of spurious wage growth in the sample. It also helps to eliminate part-time workers who are often students or those transitioning to retirement, which at least partially controls for our inability to observe hours in the data.

The data are also trimmed in several ways. Each trimming exercise applies more selective criteria. In a first sample, individuals are retained in the sample if they appear at least once in two consecutive years (waves) and have valid wage and superannuation data available. A second sample restricts the population of interest further to individuals who appear at least once in three consecutives waves. This reduces volatility in earnings, as we have discovered in other research using the tax data. A third sample uses the second sample and drops the first and last observation in an individual's working history, further reducing volatility by removing people who are transitioning into or out of the work force. A fourth sample uses the third sample and also drops a tiny number of observations that are flagged as the individual's last return or where the individual is deceased. The trimming exercises aim to render the population (and subsequent control and treatment groups) as comparable as possible. In addition, doing so allows for more precise estimation of the impact of changes over time and minimizes the impact that changes in the composition of the labour force exert on results. As the tax data present wages measured on an annual basis, this trimming also eliminates those who enter or leave the workforce partway through the year. These entrants and exiters may generate more measurement error than those who are consistently in the sample. While only our preferred estimates are presented in the empirical results section, the results from all of the different trimming exercises are provided in the appendix. All of the samples give approximately similar results.

Superannuation is paid based on an employee's ordinary time earnings (OTE). Ordinary time earnings (OTE) refer to the amount an employee earns for ordinary (as opposed to overtime) work. OTE includes over-award payments, commissions, shift loading, annual leave loading, bonuses, and allowances. While overtime is not included in the base calculation for OTE, if overtime amounts cannot be distinguished from OTE, they are included as part of the OTE. Under certain conditions, contractors are also eligible for superannuation, paid by their employer.

One limitation of the data is that while the value of an employee's employer superannuation contribution is measured in the data, the employee's OTE is not. As such, it is not possible to ascertain, with certainty, the percentage of an employee's wage that an employer pays in superannuation. To circumvent this challenge, two measures of wages are constructed and both measures are applied in combination with the employee's reported employer superannuation contributions to derive estimates of the approximate percentage of an employee's wage paid by the employer in superannuation.[2]

The first measure of wages used is the salary and wage variable in the tax data. The second measure of wages is more comprehensive since other forms of payment are also included as part of OTE. This second measure is the sum of salary and wages, allowances, net personal services income (PSI), and reportable fringe benefits. Our preferred estimates are those based on the salary and wage variable only and these are presented in the empirical results section. The results from the two different definitions of wages are provided in the appendix. Our substantive results are unaffected by which definition of remuneration we use.

In order to assess the impact on wage growth of receiving different levels of superannuation, employees earning the minimum, legislated superannuation guarantee need to be differentiated from those earning in excess of the minimum. However, there is potential for measurement error due to administrative reporting systems. Employers are required by law to make superannuation payments on a quarterly basis, at a minimum. For example, superannuation payments for OTE earned during the last quarter of a financial year (1 Apr. – 30 Jun.) must be made by 28 July, at the latest. As a result, since the administrative tax data are provided to researchers on an annual basis based on the financial year, in some cases there may be reporting error due to the timing of payments which under or overstate the amount of superannuation an employee received, relative to their wages.

To account for this measurement error and test the robustness of results, two definitions are applied to define those who receive the minimum superannuation guarantee and those who receive more than the superannuation guarantee: a broad definition and a narrow definition. These definitions are presented in Table 2. The narrow definition for workers who received more than the superannuation guarantee is based off of the distribution of enterprise agreements; very few enterprise agreements provide superannuation greater than 18%.

[2] In addition, employers are only required to make contributions up to the maximum super contribution base (MSCB). As a result, there is a risk that the treatment/control status of some workers with high earnings is misclassified. Fortunately, there are very few workers who are affected by the MSCB. As a result, their potential misclassification is unlikely to affect our results. Unfortunately, there is no way to precisely identify the workers who meet these conditions in the dataset to conduct robustness checks on their influence.

Table 2. Definitions applied to define the control and treatment groups

	Superannuation guarantee in effect	Workers receiving the superannuation guarantee	Workers receiving more than the superannuation guarantee
Broad definition			
2000 – 01 to 2001 - 02	8%	6.75 – 9.4%	12 – 25%
2003 – 04 to 2012 – 13	9%	7.6 – 10.6%	12 – 25%
2013 – 14	9.25%	7.8 – 10.9%	12 – 25%
2014 – 15 to 2016 – 17	9.5%	8.0 – 11.2%	12 – 25%
Narrow definition			
2000 – 01 to 2001 - 02	8%	7.5 – 8.5%	11 – 18%
2003 – 04 to 2012 – 13	9%	8.5 – 9.1%	11 – 18%
2013 – 14	9.25%	9.1 - 9.4%	11 – 18%
2014 – 15 to 2016 – 17	9.5%	9.3 – 9.9%	11 – 18%

These definitions help to minimize the impact of outliers and reduce measurement error. Individuals earning between the upper threshold of both definitions and 11 or 12% are excluded from the analysis in order to create a clear delineation between those who receive the minimum superannuation guarantee and those who receive more. Since salaries and wages are reported by employers to the ATO, fewer reporting errors are expected in this variable and other forms of remuneration. While our preferred estimates are presented in the empirical results section, the results from all of the different definitions of the control and treatment groups are provided in the appendix.

The numbers used in the narrow definition were chosen by looking at the distribution of calculated superannuation rates from the data. There is a sharp spike in the distribution at the SG level and the distribution is quite tight around the SG rate. For the above SG group, most people who receive 12 per cent are more are concentrated in the 12 to 15 per cent range, with a tail that rapidly drops off, but which is quite long. The choice of 18 per cent will ensure that we include university employees who receive 17 per cent superannuation.

5. Methodology and identification strategy

In order to evaluate the economic incidence of the superannuation guarantee, two time periods are considered. First, periods where the superannuation guarantee rate was constant are analysed. This occurred between 2002 – 2003 to 2012 – 13 when the superannuation guarantee rate was fixed at 9.0%. A second period occurred between 2014 – 15 to 2016 – 17 when the superannuation guarantee was fixed at 9.5%. Second, periods where the superannuation guarantee was increased are analysed. During the time period of analysis considered in this paper, the superannuation guarantee was increased three times: to 9% in 2002 – 03, to 9.25% in 2013 – 14, and 9.5% in 2014 – 15. The methods and results applied to both of these time periods (period of constant superannuation guarantee and a changing superannuation guarantee) are described and presented below

Periods of no change in the superannuation guarantee (2002 – 13 and 2014 – 17)

Periods of change where the superannuation guarantee was constant are important to consider in order to understand any differences between the two groups which appear in the absence of policy changes. Competitive labour markets have a market clearing wage. In simple terms, this means that if firms A and B offer an administrative assistant wages equal to $100,000 a year and firm C offers the same workers $50,000 a year, all of the administrative assistants will flock to firms A and B. In order to attract anyone to firm C, it will have to increase its wages to $100,000.

The superannuation guarantee operates similarly in a competitive labour market. If firm A offered $100,000 in *wages* and 17% *superannuation*, it would offer its workers $117,000 in total compensation. If firm B offered $100,000 in wages and 12% in superannuation, it would offer its workers $112,000 in total compensation. If firm C increased its wages to $100,000 and offered 9% superannuation, it would provide its workers $109,000 in total compensation. In this competitive labour market with three firms, all workers would flock to firm A, the firm with the highest compensation package.

How might firms B and C attract workers in these conditions? The first option would be for firms B and C to raise the amount of superannuation they offer to 17%. A second option would be for firms B and C to keep the amount of superannuation they offer, but raise workers' wages so that their total compensation package (wages + superannuation) equals $117,000. This would mean firm B would increase its wages to $104,464 and firm C to $107,339. A third option is to exploit changes over time, since many workers negotiate pay packages through enterprise agreements which last between 2 and 3 years (Coates, Mackey and Cowgill 2020).

This third option involves workers in firm A receiving higher total compensation levels initially, but lower *wage* growth over time. Workers in firms B and C would receive lower total compensation initially, but higher *wage* growth over time. This example is presented below in Table 3. For simplicity, the example excludes inflation. The table shows that while the total compensation of workers in firm A is higher in period 1 ($117,000), it is highest for workers in firm C by the end of period 3 ($122,472). This is because of the difference in wage growth negotiated for each firm in each enterprise agreement. Moreover, the total compensation received over the duration of the enterprise agreement is about similar for all three workers, suggesting that irrespective of the initial conditions, a market equilibrium will arise over time.

Table 3. A competitive labour market for firms paying different percentages of superannuation

Firm	**Time period**	**A (17% super)**	**B (12% super)**	**C (9% super)**
Wage	Period 1	$100,000	$100,000	$100,000
Total compensation	Period 1	$117,000	$112,000	$109,000
Enterprise agreement wage growth for period 2		1%	4%	7%
Wage	Period 2	$101,000	$104,000	$107,000

Total compensation	Period 2	$118,170	$116,480	$116,630
Enterprise agreement wage growth for period 3		1%	5%	8%
Wage	Period 3	$102,010	$109,200	$115,560
Total compensation	Period 3	$119,352	$122,304	$125,960
Total compensation over all three periods		$354,522	$350,784	$351,590
Wage	Period 4	Enterprise agreements (wage levels and wage growth) renegotiated		
Total compensation	Period 4			

This third hypothesis – lower wage growth for individuals who receive more than the superannuation guarantee – can be tested in the data by analysing the wage growth between the two groups of workers – those earning the superannuation guarantee and those earning more than the superannuation guarantee – over time. This hypothesis should apply in all periods, including those where the superannuation guarantee is constant.

To test this hypothesis, a difference-in-difference estimator is estimated using ordinary least squares (OLS) to compare differences in the wage growth of employees employed by firms which pay in excess of the superannuation guarantee to employees employed by firms which pay the superannuation guarantee. The model is applied to two consecutive financial years over two broader time spans where the superannuation guarantee was constant: 2003 – 04 to 2012 -13 and 2015 – 16 and 2016 – 17.

The model is presented in equation (2), which is the first difference of equation (1), where the dependent variable, represented by ln $(wage)_{it}$, is the natural log of the difference in the wage levels (wage growth) of individual i, between period *t* and *t-1*. D_{it} equals 0 for individuals who earn the superannuation guarantee (control group) and 1 for all individuals who earn in excess of the superannuation guarantee (treatment group). Note that we are treating being paid above the superannuation guarantee as the "treatment" here since this group is receiving a different treatment than that required by law. We will maintain this language below—we will refer to the "above SG group" as the "treatment group" and the "at SG group" as the control group even when the SG is changing and there is no change for the treatment/above SG group. This is just a linguistic convention and changes nothing in our impact estimates.

As shown in equation (2), fixed effects, represented by $\propto_i$ in equation (1), are eliminated by first differencing. Fixed effects capture observable and unobservable characteristics that are constant across individuals over time, like sex or ability. First differencing eliminates the impact that these characteristics could have on the results. T_{it} equals 0 in period *t-1* and 1 in period *t*. β_3 captures the difference in wage growth between the control and treatment groups.

$$wage_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 D_{it} + \beta_3 T_{it} D_{it} + \propto_i + \varepsilon_{it} \quad (1)$$

$$\Delta \ln(wage)_{it} = \beta_1 \Delta T_t + \beta_3 \Delta T_t D_i + \Delta \varepsilon_{it} \quad (2)$$

An alternative model also considered is a fixed effect model, with the fixed effects being applied to wage growth instead of wage levels (as in equation 1). This model is presented in equation (3) below, where η_{it} is the fixed effect for wage growth. Applying the fixed effects model to wage growth, instead of levels, implies that the unobservable differences drive differences in wage growth, instead of the wage levels, across individuals in the two groups. This model is presented over multiple time periods in equation three since only two periods is insufficient for the computation. δ_2 captures the difference in wage growth between the control and treatment groups.

$$\Delta \ln(wage)_{it} = \beta_1 \Delta T_t + \cdots + \beta_T \Delta T_t + \delta_2 \Delta T_t D_i + \cdots + \delta_T \Delta T_t D_i + \eta_i + \varepsilon_{it} \quad (3)$$

Periods of changes in the superannuation guarantee (2001 – 03, 2012 – 14 and 2014- 17)

The discussion of the results will show that δ_2 from equation (3) is consistently negative. In other words, during periods when the superannuation guarantee was constant, the wage growth of individuals working for firms that pay in excess of the superannuation guarantee is lower than workers employed by firms that only pay the superannuation guarantee. Increases to the superannuation represent exogenous shocks to a firm's labour costs. Firms may choose to absorb the costs, if they are in a position to do so. Alternatively, they may adjust the amount of wage growth they offer, to offset the increase in superannuation they are required to pay.

Table 4 reproduces the fictional simulation from Table 3 and adds two additional columns to illustrate these examples. In period 2, the government increases the superannuation guarantee from 9% to 11%. Since firm C is the only firm that paid the superannuation guarantee, it is the only firm directly impacted by the legislation. Firm C has two choices. Since it is in a competitive labour market, it can choose to absorb the costs temporarily until the expiry of the enterprise agreement, as it does in column 4 (total compensation over all three periods increases from column 3 to 4). This particularly might be the case if the superannuation guarantee increase was unexpected.

Alternatively, if the firm is forewarned about the increase in the superannuation guarantee, it can incorporate the increase in the superannuation guarantee into its agreement. Column 5 presents this case for firm D. Firm D is exactly the same as firm C, however, it is forewarned about the future increase in the superannuation guarantee. In firm D's first year, it pays the same starting wage as firm C and offers 9% superannuation. However, when the rise in the superannuation guarantee takes place (in period 2), firm D takes this into account and negotiates lower wage rises than firm C for periods 2 and 3. The lower wage increases allow firm D to keep its total compensation costs fixed (the total compensation value over all three periods is the same in column 3 and column 5).

Table 4. A competitive labour market for firms affected by an increase in the superannuation guarantee

Firm	**Time period**	**A (17% super)**	**B (12% super)**	**C (9% super)**	**C (11% super)**	**D (11% super)**
		(1)	(2)	(3)	(4)	(5)
Wage	Period 1	$100,000	$100,000	$100,000	$100,000	$100,000
Total compensation	Period 1	$117,000	$112,000	$109,000	$109,000	$109,000
Enterprise agreement wage growth for period 2		1%	4%	7%	7%	6%
Wage	Period 2	$101,000	$104,000	$107,000	$107,000	$106,000
Total compensation	Period 2	$118,170	$116,480	$116,630	$118,770	$117,660
Enterprise agreement wage growth for period 3		1%	5%	8%	8%	6.18%
Wage	Period 3	$102,010	$109,200	$115,560	$115,560	$112,550
Total compensation	Period 3	$119,352	$122,304	$125,960	$128,271	$124,930
Total compensation over all three periods		$354,522	$350,784	$351,590	$356,041	$351,590
Wage	Period 4	Enterprise agreements (wage levels and wage growth) renegotiated				
Total compensation						

Source: Authors' calculations.

Prior to the increase in the superannuation guarantee, firms paying in excess of the superannuation guarantee (firms A and B) paid, on average, 2.5% wage growth in period two. Prior to the increase in the superannuation guarantee, firms paying the superannuation guarantee (only firm C), paid 7% wage growth in period two. The difference between the two equalled 7 – 2.5 = 4.5%. This 4.5% is captured by β_3 coefficient in equation (2). However, after the change in the superannuation guarantee, the difference changed to 6 – 2.5=3.5%. The "normal" difference between the two groups (4.5%) minus the new difference between the two groups (3.5%) = 1%. The 1% represents the foregone wage growth (in period one) incurred by workers who are employed by firms that only pay the superannuation guarantee. Even though their total compensation remained the same, these workers receive 1% less wage growth than they would have received if the superannuation guarantee had remained constant.

The methodology applied in this paper to estimate the effect of an increase in the superannuation guarantee on wage growth is formalized below. The intuition for the results is, however, that explained above. The methodology aims to estimate a parameter that captures foregone wage growth incurred as a result of increases in the superannuation guarantee (the 1% calculated in the simplified simulation). If workers forego part of their wage growth, this provides evidence that workers bear the incidence of increases in the superannuation guarantee. Calculations of the magnitude of the incidence borne by workers are discussed further below.

Foregone wage growth is estimated by applying both OLS (equation 4) and a fixed effect models (equation 5), where $\widehat{\gamma_2}$ is the estimated difference in wage growth between the treatment and control groups during periods when the superannuation guarantee was increased.

$$\Delta \ln{(wage)_{it}} = \theta_2 + \gamma_2 Treat_i + \upsilon_{it} \quad (4)$$

$$\Delta \ln{(wage)_{it}} = \theta_2 \Delta T_t + \cdots + \theta_T \Delta T_t + \gamma_2 \Delta T_t Treat_i + \cdots + \gamma_T \Delta T_t Treat_i + \mu_i + \upsilon_{it} \quad (5)$$

In order to compute a true estimate of $\widehat{\gamma_2}$, it needs to be compared to the wage growth which would have occurred in the absence of the increase in the superannuation guarantee $\widehat{\beta_3}$ in equation 2, or $\widehat{\delta_2}$ in equation (3). Hence the true impact of foregone wage growth is captured by:

$$\Phi = \widehat{\gamma_2} - \widehat{\delta_2}$$

If $\widehat{\delta_2}$ is zero, then wage growth between the workers earning the superannuation guarantee and more than the superannuation guarantee was about the same during periods when the superannuation guarantee rate was constant. γ_2 would then provide the true impact of an increase in the superannuation guarantee. However, as previously mentioned, the empirical results (described below) suggest that $\widehat{\delta_2}$ is negative, implying that workers employed by firms that pay more than the superannuation guarantee have lower wage growth compared to their counterparts in firms that pay the superannuation guarantee. It is also expected that $\widehat{\gamma_2}$ will be negative (or close to zero) since during periods when the superannuation guarantee is increased, workers receiving more than the superannuation guarantee are expected to retain lower wage growth than those who only receive the superannuation guarantee.

If $\widehat{\gamma_2}$ and that $\widehat{\delta_2}$ are equal, then an increase in the superannuation guarantee will not have caused any difference in wage growth between the two groups. By contrast, if $\widehat{\gamma_2}$ is smaller than $\widehat{\delta_2}$, it implies that wage growth will have slowed for the group of workers receiving the superannuation guarantee, compared to periods when there was no change in the superannuation guarantee. In this scenario since $\widehat{\gamma_2} < \widehat{\delta_2}$ and both coefficients are negative, a negative minus a negative will result in a positive value of Φ. A positive value of Φ implies that workers bear at least some of the economic incidence of increases in the superannuation guarantee.

6. Empirical Results

Selection of our preferred sample

As described in the data section, several different samples, different definitions of wages, definitions of the control and treatment groups, and role of outliers were trailed to guide the selection of our preferred specification. Our preferred specification (shown in Table 5), estimated from our preferred sample selection, applies the smallest sample size (the fourth trimming exercise), the narrowest definition of wages, the narrowest definition of the control and treatment group and excludes outliers.

This particular sample was selected for several reasons summarized here and described in more detail (with the accompanying results) in the appendix. First, using the broader definition of the control and treatment group, the four trimming exercises are applied separately using the narrowest and broadest definitions of wages. The results show that while trimming reduces the sample size slightly, it does not change the magnitude of the coefficients very much (or at all in some instances), their sign, or significance. The same conclusion is found when the broader definition of wages is applied.

The exact same exercise was then applied using the narrower definition of the control and treatment groups. The results reach similar conclusions as those identified using the broader definition of the control and treatment groups with a few exceptions. First, results using the narrower definition of the control and treatment groups find a significant difference in wage growth between the two groups during the global financial crisis (the previous results showed no statistical difference for this time period). Second, there is some variation between the estimates that use the narrow definition of wages compared to the broader definition, however, neither definition generates consistently larger impact estimates than the other. Finally, the narrow definition of the control and treatment group generates slightly larger differences in wage growth compared to estimates from the broader definition. In summary, with small exceptions the results produce very similar results irrespective of the definitions of sample selection applied.

The impact of outliers was also considered and analysed for all of the sample selection tests applied above. Irrespective of the definition of the control and treatment group applied, outliers consistently proved to have a significant impact on the results. Removing outliers reduces the magnitude of the effects by about half. The standard errors are also smaller when the outliers are removed.

The impact of changes in the definition of employer superannuation contributions over time were also analysed. In particular, prior to the 2009-10 financial year, voluntary salary-sacrificed superannuation contributions (additional contributions made by the employer on the employee's behalf and at the employee's behest) were included as part of the ATO's definition of "total employer contributions". From the 2009 – 10 financial year, voluntary salary-sacrificed contributions were identified separately in the data. As a result, prior to 2009 – 10, in some cases, a worker could be misclassified as receiving more than the superannuation guarantee, when in fact she only received the superannuation guarantee (and also made additional voluntary superannuation contributions by salary sacrificing). To address this, impact estimates were estimated using both definitions of the employer's total superannuation contributions from the 2009 – 10 financial year. The difference in definition does not significantly influence the impact estimates.

The sensitivity of the results to the age range of the sample was also considered by further limiting the sample to individuals aged between 25 – 54. Individuals start to modify their employment patterns and superannuation behaviour (in terms of contributions and drawdowns) once they reach the preservation age. Restricting the age range reduces the impact of these behavioural changes. The results suggest that limiting the age range of the sample attenuates the magnitude of the impact estimates slightly.

Based on these findings, our preferred sample focuses on the smallest sample size, since trimming the sample appeared to have no impact on the results. The narrowest definitions of the control and treatment group and the definition of wages are also applied, since variation in these definitions very minimally impacted the results. Outliers are excluded since they significantly affect the magnitude of the results and removing them reduces the standard errors. The broader age range, 25 – 60, is also applied since it increases the sample size available and impacts the results only slightly. Finally, the more inclusive (and less precise) definition of total employer contributions is elected for our preferred sample for several reasons. First, by using the more restrictive definition, the analysis is limited from the 2009 – 10 financial year. Using the broader definition allows for an evaluation of the earlier change to the superannuation guarantee which occurred in 2002 – 03. Second, using the same definition of employer contributions across all periods allows for a direct comparison of the impact estimates over time. Third, employing the broader definition increases the sample size available. Moreover, as shown in the appendix, the results are not substantively affected by the choice of definition.

Periods of no change in the superannuation guarantee (2002 – 13 and 2014 – 17)

The results from our preferred sample selection are presented in Table 5 below. Column 1 presents the results from the OLS specification, whiles columns 2 and 3 present the results from the fixed effects model. As a robustness check, the third column drops the first and last years of the periods where the superannuation guarantee was constant.

Several conclusions can be drawn from Table 5. First, irrespective of the method or years included, all of the coefficients are negative and statistically significant at the one percent level (with one exception in column three in 2009-10). This implies that wage growth among employees working for firms that pay more than the superannuation guarantee (the treatment group), consistently have lower wage growth than employees employed by firms that only pay the superannuation guarantee. Second, in terms of the magnitude, the effects are larger (in absolute terms) when the fixed effects models are applied. For example, in 2003-04, the OLS results suggest that wage growth was 1.4% lower for workers receiving more than the superannuation guarantee, compared to 2.0% lower using the fixed effects model.

Third, the difference in the OLS and fixed effects models suggests that the fixed effects model is the more appropriate approach. In general, OLS models are preferred since, because of their larger sample sizes, they provide more precise estimates (there is less or no bias in the estimates).

However, since the fixed effects differ from the OLS results, it suggests that there are some unobservable characteristics that generate even lower wage growth for those individuals who work for firms that pay more than the superannuation guarantee. Since the fixed effects model controls for these unobservable characteristics, this is the preferred methodological approach. Finally, the results suggest that dropping the first and last years of the policy (column 2 compared to column 3) does not change the results very much.

Table 5. Differences in wage growth between the control and treatment group during periods when the superannuation guarantee was constant

Year	(1)	(2)	(3)
2003-2004	−0.014*** (0.0015)	−0.020*** (0.0022)	
2004-2005	−0.031*** (0.0015)	−0.032*** (0.0020)	−0.032*** (0.0023)
2005-2006	−0.0098*** (0.0014)	−0.011*** (0.0020)	−0.010*** (0.0022)
2006-2007	−0.011*** (0.0014)	−0.013*** (0.0019)	−0.011*** (0.0022)
2007-2008	−0.0027*** (0.0014)	−0.010*** (0.0019)	−0.0078*** (0.0022)
2008-2009	−0.013*** (0.0012)	−0.018*** (0.0018)	−0.016*** (0.0021)
2009-2010	−0.00015 (0.0010)	−0.0049*** (0.0017)	−0.0020 (0.0020)
2010-2011	−0.010*** (0.0010)	−0.017*** (0.0017)	−0.013*** (0.0020)
2011-2012	−0.014*** (0.0010)	−0.021*** (0.0017)	−0.015*** (0.0020)
2012-2013	−0.015*** (0.0010)	−0.022*** (0.0018)	
2015-2016	−0.0078*** (0.0010)	n/a	
2016-2017[a]	−0.012*** (0.0010)	n/a	
Average across all periods	-0.012	-0.017	-0.015

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
sample 4 (except for [a] where sample 5 is used); extreme values trimmed
Column 1: OLS regression on wage changes
Column 2: Fixed effects regression on wage changes
Column 3: Fixed effects regression on wage changes dropping first and last years of stable policy period
Sample sizes: See Table 7a below for sample sizes for column (1); 1,106,823 for column (2); 889,117 for column (3)

Note: Notes provided in the figure refer to table numbers that correspond to the appendix.

Periods when the superannuation guarantee increased (2001 – 02, 2013 – 14, 2014 - 15)

The results that evaluate the impact of increases in the superannuation guarantee on wage growth consider three time periods when the superannuation guarantee was increased: 2001 – 02, 2013 – 14, and 2014 – 15. Table 6 looks at the impact of the change on wage growth during the first change introduced in 2001 – 02 and Table 7 considers the impact of the smaller increases introduced in the latter two years. Both tables present the OLS results in column 1 and our preferred fixed effect estimates in column 2.

Both tables also present the results using a variety of empirical options for $\widehat{\delta_2}$ (wage growth in the absence of the increase in the superannuation guarantee). For example, the impact estimates in Table 6, sets $\widehat{\delta_2}$ equal to the average wage growth estimates for the two years preceding the increases in the superannuation guarantee. $\widehat{\delta_2}$ is also based on average wage growth estimates for the five and 10 years preceding the increase in the superannuation guarantee.

The impact estimates from Table 6 vary depending on the $\widehat{\delta_2}$ and model specification chosen. In this instance, our preference is the fixed effect model for the previous two years. The previous two years most closely approximate the prevailing economic conditions at the time the superannuation guarantee was increased. The result is significant at the 1% level and implies that workers employed by firms only paying the superannuation guarantee forwent 0.9% wage growth when the superannuation guarantee was introduced, compared to their counterparts who received more than the superannuation guarantee.

During this period the superannuation guarantee increased from 8% to 9%, a one percentage point increase and a 12.5% increase in the superannuation guarantee. Over the entire period considered in the analysis, the summary statistics show that wage growth averaged 4.7% for the group of workers employed by firms that only paid the superannuation guarantee. A 0.9% reduction in this growth equates to a 19% reduction in wages growth. These findings suggest that a 12.5% increase in the superannuation guarantee resulted in a 19% reduction in wage growth, providing compelling evidence that a trade-off between wages growth and superannuation exists.

The results from Table 6 provide evidence of a similar finding. Multiple estimates of $\widehat{\delta_2}$ are employed since two changes to the superannuation guarantee occurred in subsequent years. For this reason, our preferred estimates consider the combined impact for both increases made to the superannuation guarantee compared to wage growth two years prior to the changes and both two years prior and two years after. The impact estimate which estimates the impact of both years' increase, compared to two years prior to the reform, shows that workers employed by firms only paying the superannuation guarantee forwent 0.88% wage growth when the superannuation guarantee was increased by 0.5 percentage points. The impact estimate for two years before and after the increase is slightly smaller at 0.59%. These estimates amount to an 18.7 and 12.6 percent decrease in wage growth, alongside the cumulative 5.6% increase in the superannuation guarantee.

Table 6. Differences in wage growth between the control and treatment group when the superannuation guarantee increased to 9% in 2002 - 03

Year	(1)	(2)
2002-2003	-0.0094^{***}	-0.015^{***}
	(0.0016)	(0.0022)
2003-2004	-0.014^{***}	-0.016^{***}
	(0.0015)	(0.0020)
2004-2005	-0.031^{***}	-0.031^{***}
	(0.0014)	(0.0019)
2005-2006	-0.0098^{***}	-0.0091^{***}
	(0.0014)	(0.0018)
2006-2007	-0.011^{***}	-0.012^{***}
	(0.0013)	(0.0018)
2007-2008	-0.0027^{**}	-0.0091^{***}
	(0.0013)	(0.0018)
2008-2009	-0.013^{***}	-0.017^{***}
	(0.0012)	(0.0017)
2009-2010	0.00015	-0.0038^{**}
	(0.0011)	(0.0017)
2010-2011	-0.010^{***}	-0.016^{***}
	(0.0011)	(0.0017)
2011-2012	-0.014^{***}	-0.020^{***}
	(0.0011)	(0.0017)
2012-2013	-0.015^{***}	-0.021^{***}
	(0.00078)	(0.0017)
Impact Estimate (previous 2 years)	0.013^{***}	0.0091^{***}
	(0.0019)	(0.0021)
Impact Estimate (previous 5 years)	0.0043^{**}	0.0012
	(0.0017)	(0.0020)
Impact Estimate (previous 10 years)	0.0027	0.0011
	(0.0017)	(0.0020)
N	1,187,256	1,187,256

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth

Table 7. Differences in wage growth between the control and treatment group when the superannuation guarantee increased to 9.25% in 2013-14 and 9.5% in 2014-15

Year	(1)	(2)
2011-2012	-0.014^{***} (0.0010)	-0.016^{***} (0.0023)
2012-2013	-0.016^{***} (0.0010)	-0.017^{***} (0.0023)
2013-2014	-0.0092^{***} (0.0011)	-0.0010^{***} (0.0023)
2014-2015	-0.0081^{***} (0.0010)	-0.0067^{***} (0.0023)
2015-2016	-0.0081^{***} (0.0010)	-0.0091^{***} (0.0023)
2016-2017	-0.012^{***} (0.0010)	-0.014^{***} (0.0023)
Impact Estimate (2014 compared to previous 2 years)	0.0056^{***} (0.0013)	0.0071^{***} (0.0014)
Impact Estimate (2014 compared to final 2 years)	0.00080 (0.0013)	0.0013 (0.0015)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0032^{***} (0.0012)	0.0042^{***} (0.0013)
Impact Estimate (2015 compared to previous 2 years)	0.0068^{***} (0.0013)	0.010^{***} (0.0015)
Impact Estimate (2015 compared to final 2 years)	0.0020 (0.0013)	0.0046^{***} (0.0014)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0044^{***} (0.0012)	0.0075^{***} (0.0013)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0062^{***} (0.0010)	0.0088^{***} (0.0012)
Impact Estimate (2014 & 2015 compared to final 2 years)	0.0014 (0.0010)	0.0030^{**} (0.0012)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0038^{***} (0.00090)	0.0059^{***} (0.0010)
N	808,213	808,213

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

Pass-through calculations

Table 8 presents calculations for the degree of pass-through. It calculates the economic incidence of the increase in the superannuation guarantee from 8% to 9% between 2001 – 02 and 2002 – 03 using the example of a fictional worker (John) who earned $100,000 in 2001 – 02. The summary statistics for our preferred sample revealed that the average wage growth for workers who earned the superannuation guarantee amounted to 4.7%. The "counterfactual scenario (estimated)" shows the amount of wages, superannuation and total compensation that John would have received in the absence of the increase in the superannuation guarantee.

The "actual scenario (observed)" rows show the trends revealed by our preferred impact estimate provided in Table 6. Following the increase in the superannuation guarantee, wage growth slowed for employees employed by firms which only paid the superannuation guarantee by 0.91%. Subsequently, in 2002 – 03, John's wages only increased by 3.79% (4.7 - .91). The amount of superannuation also increased because of the increase in the superannuation guarantee.

The two final rows in Table 8 show alternate scenarios in the event that workers or employers bear the entire incidence of the increase in the superannuation guarantee. For example, if employers entirely bore the cost of the increase in the superannuation guarantee, wage growth would have remained steady at 4.7%. The superannuation guarantee would have increased alongside the value of the employer's superannuation contributions (because of the increased wage growth). By contrast, if workers bore the entire cost of the increase, employers' total compensation costs would have remained fixed and wages would have declined. This can be observed from column (d), where the total compensation cost, if workers bore the entire cost, is $113,076. This value is the exact same value presented for the "counterfactual scenario (estimated)" for 2002 – 03. While the total compensation costs are the same in these two rows however, the wage and superannuation costs differ.

The next section of the table shows the relative percentage increase in each of the components as a result of the increase in the superannuation guarantee. For example, if employers bore the entire incidence, wages would increase by 4.7%, while superannuation would increase by 17.8%, and the total compensation costs would rise by 5.7%. The same percentages are presented for the data as observed, based on our impact estimates ("Actual") and for a fictional case if workers bore the entire incidence. Since the "Actual" estimates lie in between the two extremes where workers or employers bear the entire incidence, the results suggest that the incidence is shared between the two groups. How much do workers bear? The final part of Table 8 shows that workers bear 94.3% of the costs of the increase in superannuation through lower wages. The results from this example show that the costs of an increase in superannuation were mostly paid for through reduced wage growth. Employers assumed a very small portion of the costs.

It is important to note however, that the confidence interval surrounding our impact estimate is quite large. This has significant implications for the pass-through. If the impact estimate falls at the lower bound of the confidence interval (.0091 - .0021) the pass-through is 71.1%. If it is at the upper bound of the confidence interval the pass-through rises to more than 100%.

The results for the change made in 2013 -14 are presented in Table 9. These results, alongside those from the remaining impact estimates from the increase to superannuation made in 2014 -15, place pass-through estimates at more than 100%. More than 100% pass-through is generated by the combination of two factors: a low percentage increase in the superannuation guarantee (as was the case when it increases from 9.0 to 9.25 and 9.50) and a relatively large impact estimate (foregone wage growth). The confidence interval for the 2013 – 14 impact estimates also places the pass-through at greater than 100%.

As shown in Table 9, if wage growth had remained at 4.7% and the superannuation guarantee at 9.0%, the worker would have received $114,123 in total compensation. However, because of the high impact estimate (.0071), wage growth slowed to 3.99%. The slower wage growth combined with the relatively small increase in the superannuation guarantee implied that total worker compensation only increased to $113,609. In other words, workers are $514 worse off than they would have been in the absence of the increase in the superannuation guarantee. Full pass-through (100%) to workers implies that while workers' wages decrease, they are no worse off in terms of total compensation than they would have been in the absence of a change to the superannuation guarantee. However, as this example shows, workers are worse off, which explains why the pass-through exceeds 100%.

Limitations of results

There are some limitations of our research which should be considered. First, the impact estimates could be overestimated if individuals are not randomly assigned to the control and treatment group. In particular, employers who pay more than the superannuation guarantee are overrepresented in education and the public service. Individuals who choose to go into these industries may do so because of the particular nature of the work and/or because of the relatively stable and secure employment and benefits they offer. If this selection effect occurs, and individuals are willing to forego some wage growth in exchange for the lower risk, then the impact estimate of foregone wage growth will be overestimated.

A second consideration relates to the confidence interval surrounding our impact estimates. The large sample size and methodology applied ensure that our impact estimates are precise. However small percentages in wage growth generate large cumulative effects that result in a wide confidence interval. Since the confidence interval is far from zero, it gives us certainty that an increase in the superannuation guarantee is passed through to workers. However, the confidence interval provides a wide range of possibilities for the magnitude of the pass-through.

Another consideration is the sample selection applied. As described in the data section, the sample is limited to individuals who either receive the superannuation guarantee or receive more than the superannuation guarantee in consecutive years. Individuals who transition from the control or treatment groups are excluded from the analysis. This could influence the results.

Table 8. Pass-through estimates for the increase in the superannuation guarantee which occurred in 2001 - 02

	Wages	SG rate	Superannuation	Total compensation	Incidence
	(a)	(b)	(c)	(d)	(e)
Counterfactual scenario (estimated)					
2001 - 02	100,000	8.0%	8,000	108,000	n/a
2002 - 03	104,700	8.0%	8,376	113,076	n/a
Actual scenario (observed)					
2001 - 02	100,000	8.0%	8,000	108,000	n/a
2002 - 03	103,790	9.0%	9,341	113,131	n/a
Alternate counterfactual scenarios: if workers or employers bore the full cost of the SG increase from 8% to 9%:					
2002 - 03	104,700	9.0%	9,423	114,123	Employers
2002 - 03	103,739	9.0%	9,337	113,076	Workers

	Percent increase in:		
Incidence	**Wages**	**Superannuation**	**Total compensation**
	(a)	(b)	(c)
Employers	4.7	17.8	5.7
Actual	3.8	16.8	4.8
Workers	3.7	16.7	4.7

	Foregone costs or additional gains:			
Incidence	**Wages**	**Superannuation**	**Change in total compensation costs to employers**	**Share of costs borne by workers through lower wages**
	(a)	(b)	(c)	(d)
Employers	0	1,047	1,047	0.0%
Actual	-910	965	55	94.3%
Workers	-961	961	0	100.0%

Source: Authors' calculations

Table 9. Pass-through estimates for the increase in the superannuation guarantee which occurred in 2013 - 14

	Wages	SG rate	Superannuation	Total compensation	Incidence
	(a)	(b)	(c)	(d)	(e)
Counterfactual scenario (estimated)					
2012 - 13	100,000	9.0%	9,000	109,000	n/a
2013 - 14	104,700	9.0%	9,423	114,123	n/a
Actual scenario (observed)					
2012 - 13	100,000	9.0%	9,000	109,000	n/a
2013 - 14	103,990	9.25%	9,619	113,609	n/a
Alternate counterfactual scenarios: if workers or employers bore the full cost of the SG increase from 9% to 9.25%:					
2012 - 13	104,700	9.25%	9,685	114,385	Employers
2013 - 14	104,460	9.25%	9,663	114,123	Workers

Source: Authors' calculations

	Percent increase in:		
Incidence	**Wages**	**Superannuation**	**Total compensation**
	(a)	(b)	(c)
Employers	4.7	7.6	4.9
Actual	4.0	6.9	4.2
Workers	4.5	7.4	4.7

	Foregone costs or additional gains:			
Incidence	**Wages**	**Superannuation**	**Change in total compensation cost to employers**	**Share of costs borne by workers through lower wages**
	(a)	(b)	(c)	(d)
Employers	0	262	262	0.0%
Actual	-710	196	-514	>100%
Workers	-240	240	0	100.0%

Source: Authors' calculations

Heterogeneity across the income distribution

We explored whether the impacts were different in different parts of the income distribution by splitting the sample into individuals who were above median income and below median income, by year. The results are presented in the appendix and summarised here.

For individuals above median income, the results are quite similar to what is presented above. For those below median income, the results become very imprecisely estimated. They are not statistically different than what is presented above but the confidence intervals become very large. This is due to the large amount of movement in the tax data at the bottom part of the income distribution. While people above median are relatively stable in being present in the data, people below median move—either to a position above the median or out of the data. The requirement that individuals be in the "at SG" or "above SG" groups in consecutive periods combined with being in the same part of the income distribution in consecutive periods reduces the sample size for the below median group to about 10 per cent of the above median group.

Overall, however, there is no evidence that the effects differ by income.

7. Discussion and conclusions

This research shows that the cost (economic incidence) of increases to the superannuation guarantee largely lies with workers through lower wage growth. We use tax data to compare the wage growth of workers, employed by firms that pay *more* than the superannuation guarantee, to workers, employed by firms that *only* pay the superannuation guarantee. Wage growth between the two groups is compared during periods when the superannuation guarantee was constant and when the superannuation guarantee was increased.

During periods when the superannuation guarantee was constant, the results show that wage growth is consistently higher for employees who work in firms that only pay the superannuation guarantee. This finding is consistent a competitive labour market. For example, if firm A offered $100,000 in *wages* and 17% *superannuation*, it would offer its workers $117,000 in total compensation. If firm B offered $100,000 in wages and 12% in superannuation, it would offer its workers $112,000 in total compensation. If firm C increased its wages to $100,000 and offered 9% superannuation, it would provide its workers $109,000 in total compensation. In this competitive labour market with three firms, all workers would flock to firm A, the firm with the highest compensation package. The only way firm C can continue to exist in a competitive labour market is by offering higher *wage* growth to its workers over time to "catch-up" to the higher *total compensation* levels offered by other firms.

During periods when the superannuation guarantee increased, wage growth for workers, employed by firms that only paid the superannuation guarantee, slowed (but still remained higher than their counterparts receiving more than the superannuation guarantee). These results translate to workers bearing between 71% to more than 100% of the costs associated with legislated increases in the superannuation guarantee through lower wage growth.

Our findings differ from two of the three papers that measure the economic incidence of increases in the superannuation guarantee in Australia. Coates et al. (2020) find that workers bear about 80% of the costs. These results are similar to our findings. This is also the only other study which includes an identification strategy to identify the causal impact of a change in the superannuation guarantee on wage growth. By contrast, Stanford (2019) and Taylor (2019) do not find that a trade-off exists between higher super and lower wages and in some instances present the case for a positive relationship between higher superannuation and wages. They rely on time series data to establish correlation between wage growth and changes in the superannuation guarantee.

Our research approach also differs from all three studies because it relies on microdata (administrative tax data) at the individual level (Coates et al. 2020 use microdata at the firm level). In comparison to time series, the use of microdata is arguably better suited to analysing the economic incidence of increases to superannuation because focusing on changes across groups of individuals (or firms), reduces the impact of confounding macroeconomic effects (because all individuals experience the same macroeconomic conditions at the same time). In addition, the significantly larger sample size permitted by the administrative data increases the statistical precision of our results. Furthermore, our approach allows us to control for differences, both observed and unobserved, between workers who receive different amounts of superannuation

The findings from our research also align closely with economic theory. Superannuation is a mandated benefit. Economic theory predicts that the closer the link between payment for the benefit and receipt of the benefit, the more highly valued the benefit will be perceived, and the more workers will be willing to accept lower wages in exchange for the benefit. In other words, the closer the tax-benefit linkage, the greater the economic incidence will fall on workers. Since superannuation is a direct benefit to individuals, there is a very close link between payment for the benefit and receipt of the benefit. Our findings align with this theoretical prediction.

The results also correspond to other features of a competitive labour market. Empirically, Australian research finds that labour supply is on average, relatively inelastic. This means that workers do not respond (change their hours or quit their jobs) very much when wages change. If workers do not respond very much when wages change, then employers can more easily pass on increased labour costs, like an increase in the superannuation guarantee, to workers through lower wage growth. Consequently, the empirical observation that the Australian labour force is relatively inelastic aligns with the theoretical prediction and our empirical findings that workers will bear the costs of an increase in superannuation.

Finally, our research is consistent with the international empirical findings which consider the economic incidence of social security benefits with a close tax-benefit linkage. While the economic literature finds a range of estimates on the economic incidence of social security benefits, some of the most recent research shows that the range of estimates available in the literature can partly be explained by the variance in tax-benefit linkage. Workers bear less of the incidence of taxes and social security benefits when the degree of tax-benefit linkage is low. By contrast, they tend to bear most, all, or more than 100% of the incidence for taxes and benefits with high degrees of tax-benefit linkage (Bozio et al. 2019).

In conclusion, policymakers will need to balance their goal of boosting superannuation balances through an increase in the superannuation guarantee with the costs and benefits of doing so. The current settings of the Age Pension are such that an increased superannuation balance is not directly correlated with an increase in retirement living standards. An increase in the superannuation guarantee may, however, reduce future Age Pension expenditure. At the same time, as our results suggest, workers bear the cost of increases in the superannuation guarantee through lower wage growth. Subsequently, the government will forgo the tax revenue from labour income taxed at individuals' marginal personal income tax rates, for greater superannuation contributions that are taxed concessionally. Lower wage growth also implies less disposable income available to workers and their families to consume today or to save through alternative means.

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Appendix: Economic incidence of the superannuation guarantee

1 Models

1.1 No change periods

For 2002-2003 through 2012-2013 and again from 2014-15 through 2016-2017, the superannuation guarantee (SG) did not change. For these periods, we examine whether wage growth is different for those who are on the superannuation guarantee (control group) and those who receive superannuation above the guarantee (treatment group).

We have the following model for the natural log of wages (w) at time periods $t = 1 \ldots T$,

$$\begin{aligned} w_{it} =& \beta_1 + \beta_2 d2_t + \ldots + \beta_T dT_t \\ &+ \delta_1 Treat_i + \delta_2 d2_t \times Treat_i + \ldots + \delta_T dT_t \times Treat_i + \alpha_i + u_{it} \end{aligned} \tag{1}$$

The difference-in-difference estimator of the effect of treatment on wages between any two consecutive periods ($p-1$ and p) can be estimated as:

$$\begin{aligned} &E\left\{(\overline{w}_{Tp} - \overline{w}_{Cp}) - (\overline{w}_{T,p-1} - \overline{w}_{C,p-1})\right\} \\ =&((\beta_1 + \beta_p + \delta_1 + \delta_p) - (\beta_1 + \beta_p)) - ((\beta_1 + \beta_{p-1} + \delta_1) - (\beta_1 + \beta_{p-1})) \\ =&\delta_p \end{aligned} \tag{2}$$

Notice that we get the same estimate if we compare period p to the base period $t = 1$.

$$\begin{aligned} &E\left\{(\overline{w}_{Tp} - \overline{w}_{Cp}) - (\overline{w}_{T,1} - \overline{w}_{C,1})\right\} \\ =&((\beta_1 + \beta_p + \delta_1 + \delta_p) - (\beta_1 + \beta_p)) - ((\beta_1 + \delta_1) - \beta_1) \\ =&\delta_p \end{aligned} \tag{3}$$

δ_p is thus capturing the effect of treatment in year p and is not affected by the choice of base year.

If we estimate this model in first differences to eliminate the fixed effect, we have

$$\begin{aligned} \Delta w_{it} =& \beta_2 \Delta d2_t + \ldots + \beta_T \Delta dT_t \\ &+ \delta_2 \Delta d2_t \times Treat_i + \ldots + \delta_T \Delta dT_t \times Treat_i + u_{it} \end{aligned} \tag{4}$$

Notice that the differencing eliminates the fixed effect but also sweeps the constant and the treatment indicator out of the equation. Notice also that replacing the change in time dummies with the levels of the time dummies does not change the estimates of the period-specific treatment effects. We estimate equation (4) over the entire time period and also over each two-year sequence where the SG is unchanged. For the two year estimates (which we can generically call year 1 and year 2) the equation becomes simply

$$\begin{aligned} \Delta w_{it} =& \beta_2 \Delta d2_t + \delta_2 \Delta d2_t \times Treat_i + u_{it} \\ =& \beta_2 + \delta_2 Treat_i + u_{it} \end{aligned} \tag{5}$$

The last line follows since $\Delta d2_t = d2_2 - d2_1 = 1 - 0 = 1$. Equations (4) and (5) give identical estimates.

An alternative model would be that wage growth has a fixed effect (rather than the fixed effect being in the level equation (1)). This would provide

$$\begin{aligned} \Delta w_{it} =& \beta_2 \Delta d2_t + \ldots + \beta_T \Delta dT_t \\ & + \delta_2 \Delta d2_t \times Treat_i + \ldots + \delta_T \Delta dT_t \times Treat_i + \eta_i + u_{it} \end{aligned} \tag{6}$$

or, if there were only two time periods

$$\Delta w_{it} = \beta_2 + \delta_2 Treat_i + \eta_i + u_{it} \tag{7}$$

Note that this implies that in the level equation (1), α_i should be expressed as α_{it} and that $\eta_i = \alpha_{it} - \alpha_{i,t-1}$ for all time periods t. The time-varying α in equation (1) must be changing at a constant rate for each individual but that rate of change can vary across individuals. Also note that equation (7) can not be estimated with only two years of data as the model collapses when we try and take differences or estimate fixed effects. Equation (6) can be estimated over multiple time periods.

1.2 Periods of change

From 2001-2002 to 2002-2003, the SG increased from 8 per cent to 9 per cent. From 2012-2013 to 2013-2014, the SG increased from 9 per cent to 9.25 per cent. From 2013-2014, the SG increased from 9.25 per cent to 9.5 per cent.

can use the same methodology as above to compare treatment and control groups. Somewhat awkwardly, we define treatment as those people who are receiving above the SG and the control group as those who are receiving the SG, even though the SG is changing.

Using year-on-year differences, we can estimate models akin to equations (5) and (6):

$$\Delta w_{it} = \theta_2 + \gamma_2 Treat_i + v_{it} \tag{8}$$

or

$$\begin{aligned} \Delta w_{it} =& \theta_2 \Delta d2_t + \ldots + \theta_T \Delta dT_t \\ & + \gamma_2 \Delta d2_t \times Treat_i + \ldots + \gamma_T \Delta dT_t \times Treat_i + \varepsilon_i + v_{it} \end{aligned} \tag{9}$$

Again, equation (9) requires at least three time periods in order to be estimable.

1.3 Difference-in-difference-in-differences

Having determined that δ_2 is non-zero during times of no change, we need to account for this when we want to estimate the true treatment effect from equation (8) or (9). Below, we refer to the estimate as $\widehat{\delta_2}$

$\widehat{\gamma_2}$ is the estimated difference between the Treatment and Control groups in wage growth during the changing SG. In order to get an estimate of the treatment effect, we need to compare $\widehat{\gamma_2}$ with our estimate of what would have happened in the absence of any change to the SG $(\widehat{\delta_2})$. Our estimate of the impact of treatment will thus be:

$$\Phi = \widehat{\gamma_2} - \widehat{\delta_2} \tag{10}$$

If $\widehat{\delta_2}$ were zero, then $\widehat{\gamma_2}$ would give us the difference between treatment and control groups and $-\widehat{\gamma_2}$ would thus be the impact on the group for whom SG has increased. If $\widehat{\gamma_2}$ is close to zero and $\widehat{\delta_2}$ is negative, then this tells us that while the SG was increasing the two groups had similar wage growth but that during periods of no change, the control group had faster wage growth. In this case Φ would be positive and the impact on the control group of the increasing SG would be negative, that is $-\Phi$. If $\widehat{\delta_2}$ is negative but $\widehat{\gamma_2}$ is also negative and or larger absolute value, then the wage growth of the control group relative to the treatment group would have accelerated while the SG was increasing and Φ would be negative but the impact of the increasing SG on the control group $-\Phi$ would be positive.

We can write down a simple model with three time periods ($t = 0, 1, 2$).

$$\begin{aligned} w_{it} = &\beta_1 + \beta_2 d1_t + \beta_3 d2_t \\ &+ \delta_1 Treat_i + \delta_2 d1_t \times Treat_i + \delta_3 d2_t \times Treat_i + \alpha_i + u_{it} \end{aligned} \tag{11}$$

Treatment happens between periods one and two. There is no treatment between periods zero and one. However, treatment and control groups might evolve differently over time–this is accounted for by the parameter δ_2. If common trends hold, then $\delta_2 = 0$. When we have more than one period pre-treatment, this also gives us a way to test for common trends.

The D-i-D-i-D estimator is one in which we want to subtract away any differential change between treatment and control groups prior to treatment to account for the absence of parallel trends. This approach assumes that the difference in growth rates is constant over time rather than the difference in levels.

Practically, we can do this by estimating two separate D-i-D models. We can estimate the D-i-D coefficient δ_2 from the two period version of equation (1) using only data from periods 1 and 2. Call this D_2. We can then estimate the same coefficient using only data from periods 0 and 1. Call this D_1.

To see how this relates to the model of equation (11), consider

$$
\begin{aligned}
\Phi =& D_2 - D_1 \\
=& ((\overline{w}_{T2} - \overline{w}_{C2}) - (\overline{w}_{T1} - \overline{w}_{C1})) - ((\overline{w}_{T1} - \overline{w}_{C1}) - (\overline{w}_{T0} - \overline{w}_{C0})) \\
=& (\beta_1 + \beta_3 + \delta_1 + \delta_3) - (\beta_1 + \beta_3) \\
& - (\beta_1 + \beta_2 + \delta_1 + \delta_2) - (\beta_1 + \beta_2) \\
& - (\beta_1 + \beta_2 + \delta_1 + \delta_2) - (\beta_1 + \beta_2) \\
& - (\beta_1 + \delta_1) - (\beta_1) \\
=& (\delta_1 + \delta_3) - (\delta_1 + \delta_2) - \delta_2 \\
=& \delta_3 - 2 * \delta_2
\end{aligned} \tag{12}
$$

So, rather than estimating two D-i-D models over two different sets of time periods, we can simply estimate equation (11) and use the expression from equation (12) to obtain an estimate of Φ, the impact of treatment.

2 Data and sample selection

We base estimation on individuals who are in the data for two consecutive time periods and who meet our other selection criteria for two consecutive time periods (see below). For example, to be included in the data as a member of the "at SG" (control) group for the year 2006-2007, the individual would have had to be in the data in both 2005-2006 and 2006-2007 and meet the definition of being in the control group for both of those years.

2.1 Treatment and control groups

The treatment group is defined as those who receive above the superannuation guarantee. We use a 'wide' definition and a 'narrow' definition:

- 12 - 25% superannuation (wide)
- 11 - 18% superannuation (narrow)

The control group is defined as those who receive the superannuation guarantee. We also use a 'wide' and a 'narrow' definition, but this now varies by year:

- 2000-2001 through 2001-2002
  - 6.75 - 9.4% superannuation (wide)
  - 7.5 - 8.5% superannuation (narrow)
- 2002-2003 through 2012-2013
  - 7.6 - 10.6% superannuation (wide)
  - 8.5 - 9.1% superannuation (narrow)
- 2013-2014
  - 7.8 - 10.9% superannuation (wide)

    - 9.1 - 9.4% superannuation (narrow)

- 2014-2015 through 2016-2017
    - 8 - 11.2% superannuation (wide)
    - 9.3 - 9.9% superannuation (narrow)

All of the above 'narrow' definitions were chosen after looking at kernel density estimates of the percentage of superannuation being received by individuals in the data.

2.2 Sample restrictions

We estimate all of the models using four different samples. Each sample is more restrictive than the preceeding one.

1. Sample 1
   All individuals who appear at least once in two consecutive waves and are in the treatment group in consecutive waves or in the control group in consecutive waves
2. Sample 2
   As sample 1, but only using individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer
3. Sample 3
   As sample 2, but dropping the first and last observation in any time spell
4. Sample 4
   As sample 3, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier
5. Sample 5
   As sample 2, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier

We use sample 5 in the 2014-2015 through 2016-2017 period in the models where superannuation does not change. If we drop the first and last observation in any spell, as in sample 4, we end up dropping all of 2016-2017 and then we can not estimate the model as we do not have three years of data.

2.3 Remuneration

The data do not contain the exact definition of income that is used for the purposes of calculating the superannuation guarantee. Thus, when we calculate the percentage of superannuation received, we use two different definitions of remuneration:

1. Salary and wages (narrow)
2. Salary and wages plus allowances plus net personal services income plus reportable fringe benefits

2.4 Trimming large and small observations

The data include some extremely large changes in wages in both the positive and negative directions. We drop changes in $\ln(wage)$ that are larger than one in absolute value. As can be seen from Table 1 below, this has a strong impact on the sample averages, particularly on the group who are above the superannuation guarantee.

2.5 Sample means

Table 1 shows the wage growth patterns for the different samples across all years of the data:

Table 1: Wage growth across all time periods

Sample	**Mean**	**Median**
Full sample		
"at SG" group	4.6%	2.7%
"above SG" group	0.6%	1.6%
Trimmed sample		
"at SG" group	4.7%	2.6%
"above SG" group	2.5%	2.1%
Other sample means at 2016-2017		
age	42	
female	.54	
married	.64	

'Trimmed sample' drops changes in log wage growth that are greater than 1 in absolute value
'Other sample means' calculated over the 133,733 from 2016-2107 using the most restrictive sample restrictions (sample 5 above) and trimming large wage changes

2.6 Main analysis sample

For the main analysis, we use:

1. Narrow definition of superannuation
2. Sample 4 (or sample 5); the most restrictive definition
3. Narrow definition of remuneration (only salary and wages)
4. Trim values of the natural log of wage growth that are greater than one in absolute value

As we show in the robustness section below, the only one of these decisions that has any material impact on the estimates is trimming the very large and very small values of wage growth. When we do not trim these values, we get unbelievably large impacts of the effect of superannuation on wages.

3 Results

3.1 No change periods

Table 2: Differences in wage growth between "above SG" and "at SG groups"

Year	(1)	(2)	(3)
2003-2004	-0.014^{***} (0.0015)	-0.020^{***} (0.0022)	
2004-2005	-0.031^{***} (0.0015)	-0.032^{***} (0.0020)	-0.032^{***} (0.0023)
2005-2006	-0.0098^{***} (0.0014)	-0.011^{***} (0.0020)	-0.010^{***} (0.0022)
2006-2007	-0.011^{***} (0.0014)	-0.013^{***} (0.0019)	-0.011^{***} (0.0022)
2007-2008	-0.0027^{***} (0.0014)	-0.010^{***} (0.0019)	-0.0078^{***} (0.0022)
2008-2009	-0.013^{***} (0.0012)	-0.018^{***} (0.0018)	-0.016^{***} (0.0021)
2009-2010	-0.00015 (0.0010)	-0.0049^{***} (0.0017)	-0.0020 (0.0020)
2010-2011	-0.010^{***} (0.0010)	-0.017^{***} (0.0017)	-0.013^{***} (0.0020)
2011-2012	-0.014^{***} (0.0010)	-0.021^{***} (0.0017)	-0.015^{***} (0.0020)
2012-2013	-0.015^{***} (0.0010)	-0.022^{***} (0.0018)	
2015-2016	-0.0078^{***} (0.0010)	n/a	
2016-2017[a]	-0.012^{***} (0.0010)	n/a	
Average across all periods	-0.012	-0.017	-0.015

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
sample 4 (except for [a] where sample 5 is used); extreme values trimmed
Column 1: OLS regression on wage changes
Column 2: Fixed effects regression on wage changes
Column 3: Fixed effects regression on wage changes dropping first and last years of stable policy period
Sample sizes: 1,365,167 for column (1); 1,106,823 for column (2); 889,117 for column (3)

We see consistently larger and statistically significant wage growth for the "at SG" group relative to the "above SG" group. This is consistent with the hypothesis that workers who receive higher superannuation pay a wage growth penalty.

The fact that the fixed effects regressions are different than the OLS regressions leads us to prefer the fixed effects regressions. If there were no fixed effects in wage growth, then these two sets of estimates should be the same. Note that the fixed effects estimates are slightly larger.

3.2 Periods of increasing superannuation guarantee

Table 3 presents the results from our D-i-D-i-D estimation of the change in the superannuation guarantee from 8% to 9% in 2001-2002 through 2002-2003. We compare 2001-2002 through 2002-2003 (where superannuation increased) to a period where the superannuation guarantee did not change. We provide three different impact estimates using three different time periods to establish the counter-factual. We compare the two years immediately following (2004-2005); five years (2004-2008) and ten years (2004-2013). A priori, we prefer the shorter time period as fewer confounding factors will be present.

Table 3: Impact of increasing SG
Difference-in-difference-in-difference estimation

Year	(1)	(2)
2002-2003	-0.0094^{***} (0.0016)	-0.015^{***} (0.0022)
2003-2004	-0.014^{***} (0.0015)	-0.016^{***} (0.0020)
2004-2005	-0.031^{***} (0.0014)	-0.031^{***} (0.0019)
2005-2006	-0.0098^{***} (0.0014)	-0.0091^{***} (0.0018)
2006-2007	-0.011^{***} (0.0013)	-0.012^{***} (0.0018)
2007-2008	-0.0027^{**} (0.0013)	-0.0091^{***} (0.0018)
2008-2009	-0.013^{***} (0.0012)	-0.017^{***} (0.0017)
2009-2010	0.00015 (0.0011)	-0.0038^{**} (0.0017)
2010-2011	-0.010^{***} (0.0011)	-0.016^{***} (0.0017)
2011-2012	-0.014^{***} (0.0011)	-0.020^{***} (0.0017)
2012-2013	-0.015^{***} (0.00078)	-0.021^{***} (0.0017)
Impact Estimate (previous 2 years)	0.013^{***} (0.0019)	0.0091^{***} (0.0021)
Impact Estimate (previous 5 years)	0.0043^{**} (0.0017)	0.0012 (0.0020)
Impact Estimate (previous 10 years)	0.0027 (0.0017)	0.0011 (0.0020)
N	1,187,256	1,187,256

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth

Table 4 presents the results from our D-i-D-i-D estimation of the change in the superannuation guarantee from 9% to 9.25% and then from 9.25% to 9.5% in 2012-2013 through 2014-2015. We compare each of the years where superannuation increased to the periods before and after the change change separately and together. We also compare the average of the two years to the years before and after the change separately and together.

Table 4: Impact of increasing SG
Difference-in-difference-in-difference estimation

Year	(1)	(2)
2011-2012	-0.014^{***} (0.0010)	-0.016^{***} (0.0023)
2012-2013	-0.016^{***} (0.0010)	-0.017^{***} (0.0023)
2013-2014	-0.0092^{***} (0.0011)	-0.0010^{***} (0.0023)
2014-2015	-0.0081^{***} (0.0010)	-0.0067^{***} (0.0023)
2015-2016	-0.0081^{***} (0.0010)	-0.0091^{***} (0.0023)
2016-2017	-0.012^{***} (0.0010)	-0.014^{***} (0.0023)
Impact Estimate (2014 compared to previous 2 years)	0.0056^{***} (0.0013)	0.0071^{***} (0.0014)
Impact Estimate (2014 compared to final 2 years)	0.00080 (0.0013)	0.0013 (0.0015)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0032^{***} (0.0012)	0.0042^{***} (0.0013)
Impact Estimate (2015 compared to previous 2 years)	0.0068^{***} (0.0013)	0.010^{***} (0.0015)
Impact Estimate (2015 compared to final 2 years)	0.0020 (0.0013)	0.0046^{***} (0.0014)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0044^{***} (0.0012)	0.0075^{***} (0.0013)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0062^{***} (0.0010)	0.0088^{***} (0.0012)
Impact Estimate (2014 & 2015 compared to final 2 years)	0.0014 (0.0010)	0.0030^{**} (0.0012)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0038^{***} (0.00090)	0.0059^{***} (0.0010)
N	808,213	808,213

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

The average impact effect from column (1) is 0.0038; the average from column (2) is 0.0058. These are close to the results comparing the average for the two change years to the two years prior to the change and the two years after the change. Thus, the last row of Table 4 are our preferred results. Again, the fixed effects results are a bit larger and ought to be preferred on theoretical grounds.

4 Robustness checks

4.1 Wide definition of superannuation receipt

Table 5 presents estimates of equation (5) for all of the years between 2003-2004 and 2016-2017 where the superannuation guarantee did not change. In Table 5, we calculate the percentage of superannuation received as the employer contributions divided by wages and salary received. For the period 2003-2004 through 2012-2013, we classify individuals as "above SG" as those whose employer contribution to wage ratio is between 12 and 25 per cent, inclusive. We classify those whose employer contribution to wage ratio is between 7.6 and 10 per cent, inclusive, as "at SG". For the years 2015-2016 through 2016-2017, we use the same definition for "above SG". We treat those receiving between 8 and 11.2 per cent, inclusive, as "at SG".

Table 5: Difference in wage growth for individuals above the SG compared to individuals at the SG (Narrow definition of wage/salary compensation)

Year	(1)	(2)	(3)	(4)
2003-2004	-0.030^{***}	-0.030^{***}	-0.032^{***}	-0.032^{***}
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
2004-2005	-0.042^{***}	-0.042^{***}	-0.043^{***}	-0.043^{***}
	(0.0024)	(0.0024)	(0.0023)	(0.0023)
2005-2006	-0.028^{***}	-0.027^{***}	-0.029^{***}	-0.029^{***}
	(0.0023)	(0.0023)	(0.0022)	(0.0022)
2006-2007	-0.026^{***}	-0.026^{***}	-0.027^{***}	-0.027^{***}
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
2007-2008	-0.023^{***}	-0.023^{***}	-0.026^{***}	-0.025^{***}
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
2008-2009	-0.014^{***}	-0.014^{***}	-0.018^{***}	-0.018^{***}
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
2009-2010	-0.0012	-0.0012	-0.0043	-0.0043
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
2010-2011	-0.027^{***}	-0.027^{***}	-0.029^{***}	-0.030^{***}
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
2011-2012	-0.025^{***}	-0.024^{***}	-0.026^{***}	-0.026^{***}
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
2012-2013	-0.027^{***}	-0.027^{***}	-0.028^{***}	-0.028^{***}
	(0.0018)	(0.0017)	(0.0017)	(0.0017)
2015-2016	-0.030^{***}	-0.030^{***}	-0.031^{***}	-0.031^{***}
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
2016-2017[a]	-0.032^{***}	-0.025^{***}		-0.025^{***}
	(0.0016)	(0.0015)		(0.0015)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: All individuals who appear at least once in two consecutive waves
Column 2: Only individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer
Column 3: As column two, but dropping the first and last observation in any time spell
Column 4: As column three but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier
[a] For 2016-2017, column 4 is based upon the same sample as column two, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier. Because 2016-2017 is the last year of data, we can not estimate this model when we restrict the sample by dropping the last year.

Table 5a provides the sample sizes for the cells of Table 5.

Table 5a: Sample sizes for Table 5

Year	(1)	(2)	(3)	(4)
2003-2004	221,686	221,220	217,901	217,735
2004-2005	235,858	235,389	231,980	231,771
2005-2006	251,375	250,892	247,352	247,126
2006-2007	262,924	262,430	259,457	259,145
2007-2008	262,288	261,590	257,202	256,904
2008-2009	305,322	304,353	299,706	299,410
2009-2010	331,708	330,862	325,853	325,515
2010-2011	340,131	339,436	334,291	333,924
2011-2012	352,019	351,185	345,242	344,732
2012-2013	347,645	346,648	341,061	340,627
2015-2016	386,657	385,782	377,835	377,503
2016-2017	389,582	383,643		382,932

Table 6 presents estimates of equation (5) for all of the years between 2003-2004 and 2016-2017 where the superannuation guarantee did not change. The percentages that are used to classify individuals as "above SG" or "at SG" are the same as in Table 5, however, we use a broader measure of compensation that includes personal services income, allowances and reportable fringe benefits.

Table 6: Difference in wage growth for individuals above the SG compared to individuals at the SG (Broad definition of wage/salary compensation)

Year	(1)	(2)	(3)	(4)
2003-2004	-0.030^{***}	-0.030^{***}	-0.032^{***}	-0.032^{***}
	(0.0027)	(0.0027)	(0.0026)	(0.0026)
2004-2005	-0.040^{***}	-0.039^{***}	-0.039^{***}	-0.039^{***}
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
2005-2006	-0.028^{***}	-0.028^{***}	-0.029^{***}	-0.029^{***}
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
2006-2007	-0.024^{***}	-0.024^{***}	-0.024^{***}	-0.024^{***}
	(0.0025)	(0.0025)	(0.0024)	(0.0024)
2007-2008	-0.022^{***}	-0.021^{***}	-0.024^{***}	-0.024^{***}
	(0.0024)	(0.0024)	(0.0023)	(0.0023)
2008-2009	-0.013^{***}	-0.013^{***}	-0.016^{***}	-0.016^{***}
	(0.0020)	(0.0020)	(0.0020)	(0.0020)
2009-2010	-0.0019	-0.0019	-0.0011	-0.0011
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
2010-2011	-0.027^{***}	-0.027^{***}	-0.030^{***}	-0.030^{***}
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
2011-2012	-0.023^{***}	-0.023^{***}	-0.025^{***}	-0.025^{***}
	(0.0018)	(0.0018)	(0.0017)	(0.0017)
2012-2013	-0.027^{***}	-0.027^{***}	-0.028^{***}	-0.028^{***}
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
2015-2016	-0.031^{***}	-0.031^{***}	-0.032^{***}	-0.032^{***}
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
2016-2017[a]	-0.040^{***}	-0.033^{***}		-0.033^{***}
	(0.0017)	(0.0017)		(0.0017)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: All individuals who appear at least once in two consecutive waves

Column 2: Only individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer
Column 3: As column two, but dropping the first and last observation in any time spell
Column 4: As column three but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier
[a] For 2016-2017, column 4 is based upon the same sample as column two, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier. Because 2016-2017 is the last year of data, we can not estimate this model when we restrict the sample by dropping the last year.

Table 6a provides the sample sizes for the cells of Table 6.

Table 6a: Sample sizes for Table 6

Year	(1)	(2)	(3)	(4)
2003-2004	212,428	211,880	208,733	208,575
2004-2005	225,493	224,877	221,668	221,471
2005-2006	240,316	239,755	236,376	236,160
2006-2007	251,864	251,341	248,516	248,215
2007-2008	251,419	250,673	246,503	246,213
2008-2009	294,218	293,213	288,779	288,491
2009-2010	320,107	319,254	314,420	314,088
2010-2011	328,383	327,685	322,714	322,361
2011-2012	342,043	341,217	335,519	335,024
2012-2013	338,227	337,234	331,835	331,418
2015-2016	374,484	373,618	365,909	365,587
2016-2017	376,157	370,374		369,674

Lessons learned

What we learn from Tables 5 and 6 is:

- The sample selection doesn't matter in terms of the results
  The columns are all statistically equal
- There is a significant difference in wage growth between the two groups in all years except the GFC when no one got any wage growth
- If we estimate the above models by pooling all of the data and estimating one regression for all time periods, the results are the same.
- The results do not depend upon whether we use a 'narrow' or a 'wide' definition for compensation. The average difference in the two groups across all years (not weighting by year-specific sample sizes) is 0.0262 in Table 5 and 0.0260 in Table 6.

On that basis, we will only focus on results that use the narrow definition of wages/salary compensation and the smallest sample size from column (4) of the above tables.

4.2 Dealing with outliers

Table 7 examines the sensitivity of our results to outliers. This is potentially a concern because in the data that generate Tables 5 and 6 mean wage growth for the "above SG" group, across all years, is 0.6 per cent. The median wage growth is 1.6 percent. So there is substantial negative skewness for this group. For the "at SG" group, the mean is 4.6 per cent and the median is 2.7 per cent. So this group has a much longer right-hand tail in the distribution, the opposite of the "above SG" group.

The first two columns of Table 7 explore what happens when we trim the outliers from the data. We drop all individuals with wage changes above and below 100 per cent. The second two columns of Table 7 keep all the data but estimate the models using median regression rather than linear regression. This minimises the sum of absolute deviations (rather than the squared deviations) and thus minimises the effect of extreme observations.

In all the columns of Table 7 we use the most restrictive definition for the sample size–that used in column (4) of Tables 5 and 6. We only keep individual spells of three years or longer, we drop the first and last time that people appear in the data and we drop anyone flagged as deceased or where the tax return is flagged as the final return.

Table 7: Difference in wage growth for individuals above the SG compared to individuals at the SG; Two definitions of wage/salary compensation; Sensitivity to outliers

	Dropping outliers		Robust regression	
Year	(1)	(2)	(3)	(4)
2003-2004	-0.020^{***}	-0.019^{***}	-0.010^{***}	-0.010^{***}
	(0.0015)	(0.0016)	(0.00070)	(0.00074)
2004-2005	-0.027^{***}	-0.024^{***}	-0.014^{***}	-0.013^{***}
	(0.0014)	(0.0015)	(0.00079)	(0.00085)
2005-2006	-0.015^{***}	-0.016^{***}	-0.0065^{***}	-0.0078^{***}
	(0.0014)	(0.0015)	(0.00068)	(0.00074)
2006-2007	-0.016^{***}	-0.013^{***}	-0.0090^{***}	-0.0087^{***}
	(0.0013)	(0.0015)	(0.0007)	(0.00076)
2007-2008	-0.015^{***}	-0.015^{***}	-0.0084^{***}	-0.0095^{***}
	(0.0013)	(0.0014)	(0.00075)	(0.00082)
2008-2009	-0.0081^{***}	-0.0070^{***}	-0.00034	-0.00051
	(0.0011)	(0.0012)	(0.00056)	(0.00061)
2009-2010	-0.0031^{***}	-0.0037^{***}	-0.0083^{***}	-0.0081^{***}
	(0.0010)	(0.0011)	(0.00047)	(0.00051)
2010-2011	-0.018^{***}	-0.020^{***}	-0.0082^{***}	-0.0093^{***}
	(0.0010)	(0.0011)	(0.00055)	(0.00059)
2011-2012	-0.017^{***}	-0.016^{***}	-0.0052^{***}	-0.0048^{***}
	(0.0010)	(0.0010)	(0.00049)	(0.00052)
2012-2013	-0.015^{***}	-0.014^{***}	-0.0025^{***}	-0.0031^{***}
	(0.0010)	(0.0011)	(0.00047)	(0.00050)
2015-2016	-0.017^{***}	-0.019^{***}	-0.0063^{***}	-0.0084^{***}
	(0.0010)	(0.0010)	(0.00050)	(0.00055)
2016-2017[b]	-0.015^{***}	-0.023^{***}	-0.0091^{***}	-0.013^{***}
	(0.0010)	(0.0010)	(0.00044)	(0.00049)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Sample: Only individuals who appear at least once in three consecutive waves & only using

observations from spells that are three consecutive years or longer. We drop the first and last observation in any time spell. We drop any observations flagged as last return or where the individual is deceased in that financial year or earlier.
[b] Except 2016-2017 where we do not drop the last year.
Columns 1 & 3: Using narrow definition of compensation (only wages and salary).
Columns 2 & 4: Using broad definition of compensation. See description in text.

Table 7a provides the sample sizes for the cells of Table 7.

Table 7a: Sample sizes for Table 7

Year	(1)	(2)	(3)	(4)
2003-2004	211,110	202,288	217,735	208,575
2004-2005	224,853	214,921	231,771	221,471
2005-2006	239,881	229,269	247,126	236,160
2006-2007	251,276	240,748	259,145	248,215
2007-2008	248,984	238,704	256,904	246,213
2008-2009	290,445	279,923	299,410	288,491
2009-2010	316,559	305,532	325,515	314,088
2010-2011	324,674	313,391	333,924	322,361
2011-2012	335,979	326,493	344,732	335,024
2012-2013	331,870	322,889	340,627	331,418
2015-2016	367,645	355,966	377,503	365,587
2016-2017	374,327	361,279	382,932	369,674

Lessons learned

What we learn from Table 7 is:

- Impacts are generally smaller when we get rid of outliers or control for their influence through robust regression
- The average impacts in columns (1) through (4) are 0.016, 0.016, 0.0073 and 0.0080 respectively. These compare to impacts of 0.0262 and 0.026 from column (4) of Tables 5 and 6.
- Impacts when we trim outliers are about half of what we found when we didn't trim outliers
- Robust regression estimates are generally slightly smaller than the OLS on the trimmed data
- We now find a significant difference in wage growth between the two groups in all years including the GFC
- The standard errors get smaller when we trim the outliers

Notes about source files

- Tables 5 and 6: `superannuation_analyse2.log`
- Table 7, columns (1) and (2): `superannuation_analyse2a.log`
- Table 7, columns (3) and (4): `superannuation_analyse2b.log`

4.3 Narrow definitions of "at SG" and "above SG"

Table 8: Difference in wage growth for individuals above the SG compared to individuals at the SG (Narrow definition of wage/salary compensation)

Year	(1)	(2)	(3)	(4)
2003-2004	-0.029^{***}	-0.029^{***}	-0.030^{***}	-0.030^{***}
	(0.0028)	(0.0028)	(0.0028)	(0.0028)
2004-2005	-0.054^{***}	-0.053^{***}	-0.052^{***}	-0.052^{***}
	(0.0027)	(0.0027)	(0.0026)	(0.0026)
2005-2006	-0.033^{***}	-0.033^{***}	-0.032^{***}	-0.032^{***}
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
2006-2007	-0.025^{***}	-0.025^{***}	-0.024^{***}	-0.024^{***}
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
2007-2008	-0.018^{***}	-0.017^{***}	-0.017^{***}	-0.017^{***}
	(0.0025)	(0.0025)	(0.0024)	(0.0024)
2008-2009	-0.033^{***}	-0.032^{***}	-0.033^{***}	-0.033^{***}
	(0.0023)	(0.0022)	(0.0022)	(0.0022)
2009-2010	-0.012^{***}	-0.012^{***}	-0.012^{***}	-0.012^{***}
	(0.0020)	(0.0020)	(0.0019)	(0.0019)
2010-2011	-0.026^{***}	-0.026^{***}	-0.026^{***}	-0.026^{***}
	(0.0020)	(0.0019)	(0.0019)	(0.0019)
2011-2012	-0.031^{***}	-0.031^{***}	-0.031^{***}	-0.030^{***}
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
2012-2013	-0.039^{***}	-0.038^{***}	-0.037^{***}	-0.037^{***}
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
2015-2016	-0.023^{***}	-0.023^{***}	-0.023^{***}	-0.023^{***}
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
2016-2017[a]	-0.035^{***}	-0.026^{***}		-0.026^{***}
	(0.0019)	(0.0018)		(0.0017)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: All individuals who appear at least once in two consecutive waves
Column 2: Only individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer
Column 3: As column two, but dropping the first and last observation in any time spell
Column 4: As column three but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier
[a] For 2016-2017, column 4 is based upon the same sample as column two, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier. Because 2016-2017 is the last year of data, we can not estimate this model when we restrict the sample by dropping the last year.

Table 8a provides the sample sizes for the cells of Table 8.

Table 8a: Sample sizes for Table 8

Year	(1)	(2)	(3)	(4)
2003-2004	78,808	78,658	77,792	77,729
2004-2005	85,734	85,589	84,663	84,587
2005-2006	92,542	92,377	91,392	91,316
2006-2007	99,852	99,686	98,875	98,762
2007-2008	99,052	98,821	97,536	97,435
2008-2009	120,302	119,963	118,601	118,484
2009-2010	138,783	138,491	136,964	136,824
2010-2011	143,410	143,153	141,529	141,376
2011-2012	147,378	147,069	145,218	145,036
2012-2013	147,759	147,418	145,675	145,523
2015-2016	134,446	134,217	131,876	131,763
2016-2017	138,327	136,701		136,515

Table 9 presents estimates of equation (5) for all of the years between 2003-2004 and 2016-2017 where the superannuation guarantee did not change. The percentages that are used to classify individuals as "above SG" or "at SG" are the same as in Table 8, however, we use a broader measure of compensation that includes personal services income, allowances and reportable fringe benefits.

Table 9: Difference in wage growth for individuals above the SG compared to individuals at the SG (Broad definition of wage/salary compensation)

Year	(1)	(2)	(3)	(4)
2003-2004	-0.030^{***}	-0.030^{***}	-0.031^{***}	-0.031^{***}
	(0.0032)	(0.0032)	(0.0031)	(0.0031)
2004-2005	-0.051^{***}	-0.050^{***}	-0.048^{***}	-0.048^{***}
	(0.0031)	(0.0031)	(0.0030)	(0.0030)
2005-2006	-0.037^{***}	-0.036^{***}	-0.036^{***}	-0.036^{***}
	(0.0030)	(0.0030)	(0.0029)	(0.0029)
2006-2007	-0.019^{***}	-0.019^{***}	-0.018^{***}	-0.018^{***}
	(0.0030)	(0.0030)	(0.0029)	(0.0029)
2007-2008	-0.013^{***}	-0.013^{***}	-0.013^{***}	-0.012^{***}
	(0.0029)	(0.0029)	(0.0028)	(0.0028)
2008-2009	-0.032^{***}	-0.031^{***}	-0.032^{***}	-0.031^{***}
	(0.0025)	(0.0025)	(0.0024)	(0.0024)
2009-2010	-0.0071^{***}	-0.0070^{***}	-0.0077^{***}	-0.0076^{***}
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
2010-2011	-0.027^{***}	-0.027^{***}	-0.027^{***}	-0.027^{***}
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
2011-2012	-0.029^{***}	-0.029^{***}	-0.028^{***}	-0.028^{***}
	(0.0021)	(0.0021)	(0.0020)	(0.0020)
2012-2013	-0.037^{***}	-0.036^{***}	-0.035^{***}	-0.035^{***}
	(0.0022)	(0.0021)	(0.0021)	(0.0021)
2015-2016	-0.028^{***}	-0.028^{***}	-0.028^{***}	-0.028^{***}
	(0.0023)	(0.0023)	(0.0022)	(0.0022)
2016-2017[a]	-0.047^{***}	-0.038^{***}		-0.037^{***}
	(0.0022)	(0.0020)		(0.0020)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: All individuals who appear at least once in two consecutive waves

Column 2: Only individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer
Column 3: As column two, but dropping the first and last observation in any time spell
Column 4: As column three but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier
[a] For 2016-2017, column 4 is based upon the same sample as column two, but also dropping any observations flagged as last return or where the individual is deceased in that financial year or earlier. Because 2016-2017 is the last year of data, we can not estimate this model when we restrict the sample by dropping the last year.

Table 9a provides the sample sizes for the cells of Table 9.

Table 9a: Sample sizes for Table 9

Year	(1)	(2)	(3)	(4)
2003-2004	66,919	66,744	66,011	65,959
2004-2005	71,699	71,521	70,723	70,663
2005-2006	76,753	76,567	75,740	75,675
2006-2007	82,625	82,456	81,784	81,690
2007-2008	82,082	81,846	80,751	80,661
2008-2009	101,086	100,758	99,583	99,482
2009-2010	117,559	117,277	115,981	115,858
2010-2011	121,573	121,328	119,914	119,774
2011-2012	124,576	124,274	122,699	122,541
2012-2013	124,815	124,497	123,021	122,889
2015-2016	104,616	104,413	102,541	102,452
2016-2017	108,585	107,191		107,042

Lessons learned

What we learn from Tables 8 and 9 is:

- Much smaller sample sizes when we use the more narrow definitions of "at SG" and "above SG".
- The sample selection doesn't matter in terms of the results
  The columns are all statistically equal
- Some variation using the broad or narrow definition of compensation but neither gives consistently larger impact estimates than the other.
- There is a significant difference in wage growth between the two groups in all years including during the GFC
- If we estimate the above models by pooling all of the data and estimating one regression for all time periods, the results are the same.
- We find slightly larger differences in wage growth when we use the 'narrow' definitions for the "above SG" and "at SG" groups. The average gaps across all years (not weighted by year-specific sample sizes) in Tables 8 and 9 are 0.0284 and 0.0283, respectively. This compares to 0.0262 and 0.0260 in Tables 5 and 6.

4.4 Dealing with outliers with the narrow definitions of "at SG" and "above SG"

Table 10 examines the sensitivity of our results to outliers. This is potentially a concern because in the data that generate Tables 8 and 9 mean wage growth for the "above SG" group, across all years, is 1.6 per cent. The median wage growth is 2.1 percent. For the "at SG" group, the mean is 5.8 per cent and the median is 2.7 per cent. So the "at SG" group has a much longer right-hand tail in the distribution than the "above SG" group.

The first two columns of Table 10 explore what happens when we trim the outliers from the data. We drop all individuals with wage changes above and below 100 per cent. The second two columns of Table 10 keep all the data but estimate the models using median regression rather than linear regression. This minimises the sum of absolute deviations (rather than the squared deviations) and thus minimises the effect of extreme observations.

In all the columns of Table 10 we use the most restrictive definition for the sample size–that used in column (4) of Tables 8 and 9. We only keep individual spells of three years or longer, we drop the first and last time that people appear in the data and we drop anyone flagged as deceased or where the tax return is flagged as the final return.

Table 10: Difference in wage growth for individuals above the SG compared to individuals at the SG; Two definitions of wage/salary compensation; Sensitivity to outliers

	Dropping outliers		Robust regression	
Year	(1)	(2)	(3)	(4)
2003-2004	-0.014^{***}	-0.014^{***}	-0.045^{***}	-0.0050^{***}
	(0.0015)	(0.0017)	(0.00067)	(0.00071)
2004-2005	-0.031^{***}	-0.027^{***}	-0.016^{***}	-0.015^{***}
	(0.0015)	(0.0017)	(0.00079)	(0.00089)
2005-2006	-0.0098^{***}	-0.013^{***}	0.0015^{**}	-0.00019
	(0.0014)	(0.0016)	(0.00061)	(0.00067)
2006-2007	-0.011^{***}	-0.0066^{***}	-0.0017^{***}	0.00039
	(0.0014)	(0.0016)	(0.00068)	(0.00075)
2007-2008	-0.0027^{**}	0.0012	0.0061^{***}	0.0075^{***}
	(0.0014)	(0.0016)	(0.00074)	(0.00080)
2008-2009	-0.013^{***}	-0.013^{***}	-0.00041	-0.00049
	(0.0012)	(0.0013)	(0.00063)	(0.00068)
2009-2010	-0.00015	-0.0030^{***}	0.010^{***}	0.011^{***}
	(0.0010)	(0.0012)	(0.00049)	(0.00053)
2010-2011	-0.010^{***}	-0.012^{***}	-0.0018^{***}	-0.0030^{***}
	(0.0010)	(0.0012)	(0.00055)	(0.00059)
2011-2012	-0.014^{***}	-0.012^{***}	-0.0011^{**}	-0.00020
	(0.0010)	(0.0011)	(0.00049)	(0.00053)
2012-2013	-0.015^{***}	-0.014^{***}	0.0012^{***}	0.0012^{**}
	(0.0010)	(0.0012)	(0.00045)	(0.00049)
2015-2016	-0.0078^{***}	-0.012^{***}	0.0045^{***}	0.0012^{**}
	(0.0010)	(0.0012)	(0.00050)	(0.00056)
2016-2017[b]	-0.012^{***}	-0.022^{***}	-0.0041^{***}	-0.010^{***}
	(0.0010)	(0.0011)	(0.00044)	(0.00047)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Sample: Only individuals who appear at least once in three consecutive waves & only using observations from spells that are three consecutive years or longer. We drop the first and last

observation in any time spell. We drop any observations flagged as last return or where the individual is deceased in that financial year or earlier.
[b] Except 2016-2017 where we do not drop the last year.
Columns 1 & 3: Using narrow definition of compensation (only wages and salary).
Columns 2 & 4: Using broad definition of compensation. See description in text.

Table 10a provides the sample sizes for the cells of Table 10.

Table 10a: Sample sizes for Table 10

Year	(1)	(2)	(3)	(4)
2003-2004	75,526	64,059	77,729	65,959
2004-2005	82,178	68,602	84,587	70,663
2005-2006	84,741	73,491	91,316	75,675
2006-2007	95,795	79,136	98,762	81,690
2007-2008	94,491	78,162	97,435	80,661
2008-2009	114,950	96,456	118,484	99,482
2009-2010	133,468	113,034	136,824	115,858
2010-2011	137,883	116,748	141,376	119,774
2011-2012	141,611	119,606	145,036	122,541
2012-2013	142,180	120,045	145,523	122,889
2015-2016	128,611	99,836	131,763	102,452
2016-2017	133,733	104,827	136,515	107,042

Lessons learned

What we learn from Table 10 is:

- Impacts are generally smaller when we get rid of outliers or control for their influence through robust regression
- Average impact in columns (1) through (4) is 0.0119, 0.0124, . These compare to impacts of 0.0284 and 0.0283 from column (4) of Tables 8 and 9.
- Impacts when we trim outliers are about half of what we found when we didn't trim outliers
- Robust regression estimates are generally slightly smaller than the OLS on the trimmed data, but they are a bit all over the place. Some years are positive and significant. This seems to contradict every other model that we estimate.
- We now find a significant difference in wage growth between the two groups in all years including the GFC
- The standard errors get smaller when we trim the outliers

Notes about source files

- Tables 8 and 9: `superannuation_analyse3.log`

- Table 10, columns (1) and (2): `superannuation_analyse3a.log`
- Table 10, columns (3) and (4): `superannuation_analyse3b.log`

4.5 Notes on using fixed effects

What we learn from Table 2 is:

- Impacts are generally larger when we estimate the equation where we include fixed effects in the wage growth
- If the fixed effects appeared in the level equation (equation (1)) then fixed effects should be insignificant in this model and should not affect the estimates
- The fact that the estimates change suggests that fixed effects, that is equation (6), is the correct model. If there were no bias (or no fixed effects in growth rates) then the two should give the same results. The fact that they give different results leads us to prefer fixed effects.
- There seems to be some unobservable characteristics about those in the "above SG" group that generates lower wage growth and once we control for these (through the fixed effect) we find a smaller gap between the "above SG" and "at SG" group.
- Dropping the first and last years of the policy doesn't seem to make much difference–we also found this for the earlier tables.
- These insights were consistent across all models that we estimated, even those that are not included here.

Notes about source files

- Table 2: `superannuation_analyse4.log`
- Tables 3 and 4: `superannuation_analyse6.log`

4.6 Conclusions on sample selection

In all of the above analysis, we learn that we prefer the:

- Narrow definition of compensation (wages and salary only)
- Narrow definition of "at SG"
  - 7.5% - 8.5% in 2000-2001 through 2001-2002
  - 8.5% - 9.1% in 2002-2003 through 2012-2013
  - 9.1% - 9.4% in 2013-2014
  - 9.3% - 9.9% in 2014-2015 through 2016-2017
- Narrow definition of "above SG"
  - 11% - 18% in all years

- Most restrictive sample definition
  - In data at least 3 consecutive years, dropping the first and last year of any spell for the 2001-2013 period
  - In data at least 3 consecutive years for the 2013-2017 period
- Trimming large observations; that is those where the change in $ln\,(wages)$ is greater than 1 in absolute value
- We present both OLS and fixed effects regressions although the results above suggest that we should prefer the fixed effects regressions.
- We call "above SG" "treatment" and "at SG" control.

This is what we apply to the impact estimates below.

4.7 Heterogeneity by annual earnings

In this section we look at heterogeneity by income. Treatment and control group members both have to be in the treatment and control group in consecutive years and must also be in the bottom (or top) half of the income distribution in each of those years (estimated on a year-by-year basis, not pooled across years).

One problem with these estimates is that the sample sizes become quite small.

4.7.1 At or below median annual earnings

There are 107,868 observations in the "above SG" group. There are 286,699 observations in the "at SG" group. Median wage growth for the "above SG" group is 1.7%; mean wage growth in 0.9%. Median wage growth for the "at SG" group is 2.3%; mean wage growth in 4.0%.

Table 12: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of “above SG” and “at SG”, excluding outliers, below or at median income)

Year	(1)	(2)
2002-2003	-0.021^{***} (0.0082)	-0.037^{***} (0.0014)
2003-2004	-0.034^{***} (0.0072)	-0.036^{***} (0.0011)
2004-2005	-0.054^{***} (0.0063)	-0.070^{***} (0.0010)
2005-2006	-0.031^{***} (0.0059)	-0.052^{***} (0.0098)
2006-2007	-0.034^{***} (0.0055)	-0.047^{***} (0.0094)
2007-2008	-0.016^{**} (0.0054)	-0.035^{***} (0.0091)
2008-2009	-0.024^{***} (0.0049)	-0.030^{***} (0.0088)
2009-2010	0.0017^{***} (0.0047)	-0.022^{**} (0.0087)
2010-2011	-0.016^{***} (0.0046)	-0.019^{***} (0.0087)
2011-2012	-0.021^{***} (0.0043)	-0.027^{***} (0.0087)
2012-2013	-0.020^{***} (0.0041)	-0.0081 (0.0087)
Impact Estimate (previous 2 years)	0.023^{**} (0.0095)	0.016 (0.012)
Impact Estimate (previous 5 years)	0.012 (0.0086)	0.011 (0.012)
Impact Estimate (previous 10 years)	0.0053 (0.0083)	-0.0020 (0.012)
N	148,866	148,866

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth

Table 13: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of “above SG” and “at SG”, excluding outliers, below or at median income)

Year	(1)	(2)
2011-2012	-0.022^{***} (0.0042)	-0.044^{***} (0.013)
2012-2013	-0.021^{***} (0.0040)	-0.031^{**} (0.013)
2013-2014	-0.012^{***} (0.0041)	-0.013 (0.013)
2014-2015	-0.011^{***} (0.0042)	-0.0069 (0.013)
2015-2016	-0.0051 (0.0043)	-0.0053 (0.014)
2016-2017	-0.0021 (0.0044)	0.0011 (0.014)
Impact Estimate (2014 compared to previous 2 years)	0.0092^{*} (0.0050)	0.024^{***} (0.0059)
Impact Estimate (2014 compared to final 2 years)	-0.0087^{*} (0.0051)	-0.011^{*} (0.0067)
Impact Estimate (2014 compared to 2 years before and two years after)	0.00030^{***} (0.0046)	0.0065 (0.0053)
Impact Estimate (2015 compared to previous 2 years)	0.010^{**} (0.0051)	0.031^{***} (0.0064)
Impact Estimate (2015 compared to final 2 years)	-0.0077 (0.0052)	-0.0049 (0.0064)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0013 (0.0047)	0.013^{**} (0.0055)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0098^{**} (0.0041)	0.028^{***} (0.0053)
Impact Estimate (2014 & 2015 compared to final 2 years)	-0.0082^{*} (0.0043)	-0.0081 (0.0058)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.00080 (0.0036)	0.0097^{**} (0.0045)
N	103,126	103,126

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

4.7.2 Above median annual earnings

Median wage growth for the "above SG" group is 2.1%; mean wage growth in 2.6%. Median wage growth for the "at SG" group is 2.2%; mean wage growth in 3.6%.

Table 14: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of "above SG" and "at SG", excluding outliers, above median annual wage and salary)

Year	(1)	(2)
2002-2003	-0.0060^{***} (0.0013)	-0.0080^{***} (0.0018)
2003-2004	-0.0081^{***} (0.0012)	-0.0090^{***} (0.0017)
2004-2005	-0.021^{***} (0.0011)	-0.021^{***} (0.0016)
2005-2006	-0.0015 (0.0011)	-0.0018 (0.0016)
2006-2007	-0.0030^{***} (0.0011)	-0.0029^{*} (0.0015)
2007-2008	0.0024^{**} (0.0010)	-0.0021 (0.0015)
2008-2009	-0.0070^{***} (0.00093)	-0.010^{***} (0.0014)
2009-2010	0.0053^{***} (0.00086)	0.00085 (0.0014)
2010-2011	-0.0075^{***} (0.00085)	-0.013^{***} (0.0014)
2011-2012	-0.0081^{***} (0.00084)	-0.014^{***} (0.0014)
2012-2013	-0.0087^{***} (0.00087)	-0.019^{***} (0.0014)
Impact Estimate (previous 2 years)	0.0084^{**} (0.0015)	0.0072^{***} (0.017)
Impact Estimate (previous 5 years)	0.00017 (0.0013)	-0.00060 (0.016)
Impact Estimate (previous 10 years)	-0.00031 (0.0013)	0.0013 (0.016)
N	972,360	972,360

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth

Table 15: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of "above SG" and "at SG", excluding outliers, above median annual wage and salary)

Year	(1)	(2)
2011-2012	-0.0083^{***} (0.00080)	-0.0056^{***} (0.0019)
2012-2013	-0.0088^{***} (0.00083)	-0.0088^{***} (0.0019)
2013-2014	-0.0049^{***} (0.00084)	-0.0053^{***} (0.0019)
2014-2015	-0.0045^{***} (0.00082)	-0.0051^{***} (0.0019)
2015-2016	-0.0068^{***} (0.00081)	-0.0084^{***} (0.0019)
2016-2017	-0.012^{***} (0.00080)	-0.015^{***} (0.0019)
Impact Estimate (2014 compared to previous 2 years)	0.0035^{***} (0.0010)	0.0018 (0.0012)
Impact Estimate (2014 compared to final 2 years)	0.0046^{***} (0.0010)	0.0065^{***} (0.0012)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0041^{***} (0.00093)	0.0042^{***} (0.0011)
Impact Estimate (2015 compared to previous 2 years)	0.0040^{***} (0.0010)	0.0021^{*} (0.0012)
Impact Estimate (2015 compared to final 2 years)	0.0050^{***} (0.0010)	0.0068^{***} (0.0012)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0045^{***} (0.00092)	0.0044^{***} (0.0010)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0038^{***} (0.00082)	0.0020^{**} (0.0010)
Impact Estimate (2014 & 2015 compared to final 2 years)	0.0048^{***} (0.00082)	0.0067^{***} (0.0010)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0043^{***} (0.00071)	0.0043^{***} (0.00084)
N	662,396	662,396

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

4.8 Impact of including outliers

These tables show what happens if we include the values of change in $ln\,(wages)$ that are greater than one in absolute value in estimating our main impacts of Tables 3 and 4. In other words, these results don't trim the very large and very small observations.

Table 16: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of "above SG" and "at SG", including outliers)

Year	(1)	(2)
2002-2003	-0.018^{***} (0.0029)	-0.035^{***} (0.0038)
2003-2004	-0.030^{***} (0.0027)	-0.043^{***} (0.0035)
2004-2005	-0.052^{***} (0.0025)	-0.060^{***} (0.0033)
2005-2006	-0.032^{***} (0.0025)	-0.040^{***} (0.0032)
2006-2007	-0.024^{***} (0.0024)	-0.035^{***} (0.0031)
2007-2008	-0.017^{***} (0.0023)	-0.037^{***} (0.0031)
2008-2009	-0.033^{***} (0.0021)	-0.047^{***} (0.0029)
2009-2010	-0.012^{***} (0.0020)	-0.025^{***} (0.0028)
2010-2011	-0.026^{***} (0.0019)	-0.037^{***} (0.0028)
2011-2012	-0.030^{***} (0.0019)	-0.038^{***} (0.0028)
2012-2013	-0.037^{***} (0.0019)	-0.036^{***} (0.0029)
Impact Estimate (previous 2 years)	0.023^{***} (0.0034)	0.016^{***} (0.0036)
Impact Estimate (previous 5 years)	0.013^{***} (0.0031)	0.0079^{**} (0.0035)
Impact Estimate (previous 10 years)	0.011^{***} (0.0030)	0.0047 (0.0035)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth

Table 17: Impact of increasing SG (Narrow definition of wage/salary compensation and narrow definition of "above SG" and "at SG", including outliers)

Year	(1)	(2)
2011-2012	-0.031^{***} (0.0018)	-0.043^{***} (0.0038)
2012-2013	-0.038^{***} (0.0019)	-0.044^{***} (0.0038)
2013-2014	-0.025^{***} (0.0018)	-0.028^{***} (0.0039)
2014-2015	-0.027^{***} (0.0018)	-0.021^{***} (0.0038)
2015-2016	-0.023^{***} (0.0018)	-0.017^{***} (0.0038)
2016-2017	-0.026^{***} (0.0018)	-0.018^{***} (0.0038)
Impact Estimate (2014 compared to previous 2 years)	0.0096^{***} (0.0023)	0.016^{***} (0.0024)
Impact Estimate (2014 compared to final 2 years)	-0.0003 (0.0023)	-0.010^{***} (0.0025)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0047^{**} (0.0021)	0.0028 (0.0022)
Impact Estimate (2015 compared to previous 2 years)	0.0069^{***} (0.0023)	0.023 (0.0025)
Impact Estimate (2015 compared to final 2 years)	-0.0031 (0.0023)	-0.0029 (0.0024)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0019 (0.0021)	0.0098^{**} (0.0022)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0082^{***} (0.0018)	0.020^{***} (0.0021)
Impact Estimate (2014 & 2015 compared to final 2 years)	-0.0017 (0.0019)	-0.0064^{***} (0.0022)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0033^{**} (0.0016)	0.0063^{***} (0.00317)

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

Lessons learned

What we learn from Tables 16 and 17 is:

- Consistent impacts from the increase in SG in 2001-2002 to 2002-2003.
- Not much difference for 2012-2017 if we compare the last row–our preferred impact estimator.
- Some counter-intuitive results in some of the comparisons to the years after the policy.
- Larger effects when we use fixed effects estimation
- If we compare to the two years after the policy change we either find no effect or a positive effect–that is wage changes are even larger for the “at SG” group than the “above SG” group relative to what one would expect when there are no policy changes.
- This result could be the result of slower wage growth in the final few years of the policy.

Notes about source files

- Tables 12 and 13: `superannuation_analyse6_poor.log`
- Tables 14 and 15: `superannuation_analyse6_rich.log`
- Tables 16 and 17: `superannuation_analyse6(old).log`

5 Results: Post-2010 removing voluntary super contributions

In this section, we recalculate the percentage of superannuation that individuals receive by removing voluntary contributions. This involves calculating `sc_empl_cont-it_rept_empl_super_cont` and then dividing this by wages.

In the results that follow, we use:

- Narrow definition of remuneration (wages)
- Narrow definitions of “at SG” and “above SG” as described in section 2.1 above.
- Use individuals who are in the data for three consecutive years
- We do <u>not</u> drop the first and last spell since the number of years after 2010 are fairly limited and we don’t want to reduce the sample any further.
- Age range 25-60 inclusive
- Removing deceased and final return
- Trimming changes in $ln(wage)$ greater than 1 in absolute value

Table 18 provides descriptive statistics for this new sample from 2010 forward using the definition of superannuation receipt where voluntary contributions have been removed. Table 19 provides the same thing for the same sample restrictions but using the original definition of superannuation receipt which included voluntary contributions.

Using this new definition of non-voluntary superannuation contributions produces a slightly smaller sample size. However, it makes the ‘at SG” and “above SG” groups more similar in terms of income levels, marriage levels and sex. It also results in some smaller values of superannuation percentage being removed from the data. These were probably people at SG who made small, additional, voluntary contributions.

Table 20 compares occupations (across all years 2010-2017) for the “at SG” and “above SG” groups using the new definition of superannuation where voluntary contributions have been removed. As expected, Managers, Community and Personal Services Workers and Clerical and Administrative workers are over-represented among the “above SG” group. Sales workers and labourers are over-represented among the “at SG” group.

Table 18: Descriptive statistics for “above SG” and “at SG” groups

	2010-2013		2014		2015-2017	
	“at SG”	“above SG”	“at SG”	“above SG”	“at SG”	“above SG”
Mean wage	63334	65087	69480	67370	76586	70717
Median wage	56019	60068	62774	61661	69102	64719
Mean wage growth	3.8%	2.6%	2.3%	1.5%	3.0%	2.2%
Median wage growth	2.0%	2.3%	0.7%	1.6%	1.6%	2.1%
Mean Super (%)	8.9	13.5	9.2	13.5	9.5	13.4
Median Super (%)	8.9	13.1	9.2	13.1	9.5	13
Male (%)	44.9	42.4	44.9	40.1	47	39.5
Married (%)	57.3	61.5	63.2	66.5	63.4	66.3
Sample size	283419	127437	80563	45536	234454	156957

Table 19: Descriptive statistics for “above SG” and “at SG” groups

	2010-2013		2014		2015-2017	
	“at SG”	“above SG”	“at SG”	“above SG”	“at SG”	“above SG”
Mean wage	62414	73190	68728	76916	75509	79955
Median wage	55100	65816	62045	68021	67899	70277
Mean wage growth	3.9%	2.6%	2.4%	1.5%	3.2%	2.3%
Median wage growth	2.1%	2.1%	0.8%	1.4%	1.8%	2.0%
Mean Super (%)	8.8	11.7	9.2	12.1	9.4	12.0
Median Super (%)	8.9	12.0	9.2	11.9	9.5	12.0
Male (%)	44.4	48.1	44.5	46.2	46.7	44.8
Married (%)	56.6	61.7	62.3	67.2	62.3	66.6
Sample size	268253	155322	75749	53232	214801	177305

Table 20: Occupation distribution for "above SG" and "at SG" groups

	"above SG"	"at SG"
Managers	12.53%	15.3%
Professionals	37.38%	31.88%
Technicians and Trades Workers	7.12%	8.01%
Community and Personal Services Workers	13.08%	8.1%
Clerical and Administrative Workers	20.4%	18.68%
Sales Workers	1.38%	8.06%
Machinery Operators and Drivers	2.38%	3.41%
Labourers	3.94%	5.16%
Missing occupation	1.78%	1.4%

5.1 No change periods

Table 21: Differences in wage growth between "above SG" and "at SG groups"
Voluntary contributions removed

Year	(1)	(2)	(3)	(4)
2010-2011	-0.011^{***}	-0.011^{***}	-0.011^{***}	-0.0073^{***}
	(0.0011)	(0.0082)	(0.0013)	(0.0091)
2011-2012	-0.012^{***}	-0.011^{***}	-0.010^{***}	-0.0069^{***}
	(0.0011)	(0.0083)	(0.0012)	(0.0091)
2012-2013	-0.012^{***}	-0.011^{***}	-0.012^{***}	-0.0093^{***}
	(0.0011)	(0.0082)	(0.0012)	(0.0091)
2015-2016	-0.0065^{***}		-0.0034^{***}	
	(0.0010)		(0.0011)	
2016-2017	-0.0099^{***}		-0.0076^{***}	
	(0.0010)		(0.0011)	
Average across all periods	-0.011	-0.011	-0.009	-0.0075

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
sample 3; extreme values trimmed
Column 1: OLS regression on wage changes
Column 2: Fixed effects regression on wage changes
Column 3: OLS regression on wage changes, age range restricted to 25-54
Column 4: Fixed effects regression on wage changes, age range restricted to 25-54
Sample sizes: 674,926 for column (1); 410,856 for column (2); 581888 for column (3); 357487 for column (4)

We see consistently larger and statistically significant wage growth for the "at SG" group relative to the "above SG" group. This is consistent with the hypothesis that workers who receive higher superannuation pay a wage growth penalty.

Fixed effects regressions seem to be the same as the OLS regressions. If there were no fixed effects in wage growth, then these two sets of estimates should be the same. So here it seems that we might prefer the OLS regressions since there is no evidence of fixed effects in wage growth.

Restricting to ages under 55 seems to dampen the effects slightly.

The results are not vary different from Table 2 above.

For easy comparison, we present the exact same specification and estimation, but using the original definition of superannuation which includes the voluntary contributions. The results are presented in Table 22 below. Neither re-defining the percentage of superannuation over salary and wages nor changing the age range has any substantive effect on the results.

Table 22: Differences in wage growth between "above SG" and "at SG groups"
Voluntary contributions included (old definition)

Year	(1)	(2)	(3)	(4)
2010-2011	-0.0099^{***}	-0.0095^{***}	-0.0098^{***}	-0.0080^{***}
	(0.0010)	(0.0071)	(0.0011)	(0.0077)
2011-2012	-0.014^{***}	-0.013^{***}	-0.013^{***}	-0.011^{***}
	(0.0010)	(0.0071)	(0.0011)	(0.0078)
2012-2013	-0.016^{***}	-0.014^{***}	-0.015^{***}	-0.011^{***}
	(0.0010)	(0.0070)	(0.0011)	(0.0077)
2015-2016	-0.0081^{***}		-0.0071^{***}	
	(0.0010)		(0.0011)	
2016-2017	-0.012^{***}		-0.011^{***}	
	(0.0010)		(0.0011)	
Average across all periods	-0.012	-0.012	-0.011	-0.010

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
sample 3; extreme values trimmed
Column 1: OLS regression on wage changes
Column 2: Fixed effects regression on wage changes
Column 3: OLS regression on wage changes, age range restricted to 25-54
Column 4: Fixed effects regression on wage changes, age range restricted to 25-54
Sample sizes: 687,361 for column (1); 423,575 for column (2); 601,333 for column (3); 373,052 for column (4)

5.2 Periods of increasing superannuation guarantee

Table 23 presents the results from our D-i-D-i-D estimation of the change in the superannuation guarantee from 9% to 9.25% and then from 9.25% to 9.5% in 2012-2013 through 2014-2015. We compare each of the years where superannuation increased to the periods before and after the change separately and together. We also compare the average of the two years to the years before and after the change separately and together.

Table 23: Impact of increasing SG
Difference-in-difference-in-difference estimation

Year	(1)	(2)
2011-2012	-0.013^{***} (0.0011)	-0.013^{***} (0.0025)
2012-2013	-0.012^{***} (0.0011)	-0.013^{***} (0.0025)
2013-2014	-0.0076^{***} (0.0011)	-0.0064^{***} (0.0025)
2014-2015	-0.0095^{***} (0.0011)	-0.0062^{***} (0.0025)
2015-2016	-0.0065^{***} (0.0011)	-0.0046^{***} (0.0025)
2016-2017	-0.0099^{***} (0.0010)	-0.010^{***} (0.0025)
Impact Estimate (2014 compared to previous 2 years)	0.0033^{***} (0.0013)	0.0069^{***} (0.0014)
Impact Estimate (2014 compared to final 2 years)	0.00060 (0.0013)	0.00091 (0.0015)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0025^{**} (0.0012)	0.0039^{***} (0.0013)
Impact Estimate (2015 compared to previous 2 years)	0.0025^{*} (0.0013)	0.0071^{***} (0.0015)
Impact Estimate (2015 compared to final 2 years)	-0.0012 (0.0013)	0.0011 (0.0014)
Impact Estimate (2015 compared to 2 years before and two years after)	0.00061 (0.0012)	0.0041^{***} (0.0013)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0035^{***} (0.0010)	0.0070^{***} (0.0013)
Impact Estimate (2014 & 2015 compared to final 2 years)	-0.00034 (0.0011)	0.0013 (0.0010)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0016^{*} (0.00093)	0.0040^{***} (0.0010)
N	789,089	789,089

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 60, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group

The average impact effect from column (1) is 0.0015 (0.0019 averaged across the non-negative values; 0.0027 averaged across the statistically significant values); the average from column (2) is 0.0040 (0.0052 across the statistically significant values). These are close to the results comparing the average for the two change years to the two years prior to the change and the two years after the change. Thus, the last row of Table 4 are our preferred results. Again, the fixed effects results are a bit larger and ought to be preferred on theoretical grounds.

Table 24 presents results similar to Table 23 but uses the more restrictive age definition which drops those 55 years old and older.

Table 24: Impact of increasing SG
Difference-in-difference-in-difference estimation

Year	(1)	(2)
2011-2012	-0.010^{***} (0.0012)	-0.0085^{***} (0.0028)
2012-2013	-0.012^{***} (0.0012)	-0.0097^{***} (0.0028)
2013-2014	-0.0054^{***} (0.0012)	0 (0.0029)
2014-2015	-0.0066^{***} (0.0012)	0.0014 (0.0028)
2015-2016	-0.0034^{***} (0.0012)	0.0021 (0.0028)
2016-2017	-0.0076^{***} (0.0012)	-0.0061^{**} (0.0028)
Impact Estimate (2014 compared to previous 2 years)	0.0060^{***} (0.0015)	0.0091^{***} (0.0016)
Impact Estimate (2014 compared to final 2 years)	0.00017 (0.0015)	0.0019 (0.0017)
Impact Estimate (2014 compared to 2 years before and two years after)	0.0030^{**} (0.0013)	0.0055^{***} (0.0014)
Impact Estimate (2015 compared to previous 2 years)	0.0048^{*} (0.0014)	0.010^{***} (0.0017)
Impact Estimate (2015 compared to final 2 years)	-0.0010 (0.0014)	0.0034^{**} (0.0016)
Impact Estimate (2015 compared to 2 years before and two years after)	0.0019 (0.0013)	0.0069^{***} (0.0014)
Impact Estimate (2014 & 2015 compared to previous 2 years)	0.0054^{***} (0.0012)	0.0098^{***} (0.0014)
Impact Estimate (2014 & 2015 compared to final 2 years)	-0.00044 (0.0012)	0.0027^{*} (0.0014)
Impact Estimate (2014 & 2015 compared to 2 years before and two years after)	0.0025^{*} (0.0010)	0.0062^{***} (0.00101)
N	685,691	685,691

Standard errors in parentheses
***, ** and * indicate significance at the one, five and ten per cent levels
Restricted to individuals aged 25 to 54, inclusive
Column 1: OLS estimates on changes in wage growth
Column 2: Fixed effects estimates on changes in wage growth control group