

# What happens when employers are obliged to nudge? Automatic enrolment and pension saving in the UK

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# **What happens when employers are obliged to nudge? Automatic enrolment and pension saving in the UK**

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## **Abstract**

This paper studies the first nationwide introduction of automatic enrolment, in which employers in the United Kingdom are obliged to enrol employees into a workplace pension scheme, which employees can then choose to leave if they wish. We exploit the phased roll-out of automatic enrolment since 2012 to estimate its effect on pension saving. As a result of automatic enrolment, participation in workplace pensions among eligible private sector workers is estimated to have increased by 37 percentage points, and workplace pension membership reached 88% amongst those affected by April 2015. Automatic enrolment significantly increased the average pension contribution rate, in part because some newly-enrolled employees received an employer contribution well above the minimum mandated by the government. Furthermore, many employees who did not have to be automatically enrolled were nonetheless brought into a workplace pension scheme as a result of the policy. We find no evidence of employers reducing employer contributions for newly-hired employees or existing members of workplace pensions.

Keywords: automatic enrolment; private pensions; non-wage benefits

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## I. Introduction

There are concerns about individuals undersaving for retirement in countries across the developed world. In response, policymakers have proposed – and economists have studied – a large variety of schemes designed to increase individuals’ saving for retirement.<sup>1</sup> One instrument to increase saving for retirement of particular interest is ‘automatic enrolment’, where employers have to enrol employees automatically into a workplace pension scheme, which employees can then choose to leave.

This paper studies the effect of the first nationwide introduction of automatic enrolment. We exploit the phased roll-out in the United Kingdom of the obligation for employers to enrol their eligible employees into a pension automatically since 2012 to estimate its effect on saving in a workplace pension. This is of interest not least because automatic enrolment is becoming a more popular policy internationally. By 2016, California, Connecticut, Illinois and Oregon have all legislated to introduce automatic enrolment (Munnell et al., 2016).

Although automatic enrolment has been prominently highlighted as a particular success story of the real-world implementation of the insights of behavioural economics (Benartzi and Thaler, 2013; Madrian, 2014; Chetty, 2015; Thaler, 2016), until now all the evidence on the impact of automatic enrolment on participation in employer-provided pensions and pension saving comes from the voluntary introduction of automatic enrolment by large firms in the United States (see Madrian and Shea (2001) and Choi et al. (2004)). In many cases, these firms have introduced automatic enrolment to comply with the Internal Revenue Service’s non-discrimination rules<sup>2</sup> (see Choi et al. (2002) and Butrica and Karamcheva (2015)).

Since employers are obliged (in the UK) to enrol their employees automatically, with a minimum employer contribution, automatic enrolment increases the cost of employing workers. Any response by the employer to the policy may have a significant impact on pension saving. This is particularly important as, prior to automatic enrolment, 70% of contributions to employer-provided defined contribution (DC) pensions in the UK were made

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<sup>1</sup> See Choi et al. (2006) and Choi (2015) for review articles and, for example, Papke (1995) and Engelhardt and Kumar (2007) for articles assessing the effect of pension plan design on plan participation and saving.

<sup>2</sup> These rules essentially say that employee benefits cannot be only provided to highly-paid employees. Since low-paid employees are less likely to enrol in a pension plan (and receive an employer contribution to the pension scheme) than are their higher-paid colleagues, this risks the company failing to comply with the non-discrimination tests. Brady (2007) examines the incentive that firms have to introduce automatic enrolment in order to pay higher-earning employees a larger fraction of their compensation in pension benefits.

by the employer and only 30% by the employee.<sup>3</sup> Therefore, the effects of automatic enrolment in boosting pension saving could be diminished, or potentially enhanced, by the behaviour of employers in response to the policy. This kind of impact cannot be identified when automatic enrolment is introduced voluntarily by employers.

We find that automatic enrolment has led to large increases in the pension participation rates and in the total contributions to workplace pensions. For eligible private sector employees, automatic enrolment led to an increase of 37 percentage points in the probability of participating in a workplace pension scheme. By 2015, 88% of eligible private sector employees who were enrolled automatically were a member of a workplace pension. The policy increased the total contribution rate to a workplace pension (expressed as a percentage of total earnings) by 1.05 percentage points, compared with a pre-reform average of 7.0%, therefore significantly boosting pension saving. This was due, in part, to some employers enrolling their employees into pension schemes with employer contributions well above the minimum contributions mandated by the government. We do not find evidence of employers reducing the employer contributions to newly-hired employees or to existing pension scheme members as a way to mitigate the increased labour cost. We also find substantial spillover effects of the policy: the pension participation rates of workers who did not have to be automatically enrolled increased by 18 percentage points. Overall, we estimate that the impact of automatic enrolment has been to boost private sector saving in a workplace pension by around £2.5 billion per year by April 2015, with this almost certain to rise as the policy continues to be rolled out to affect smaller employers.

There are a number of mechanisms by which the introduction of automatic enrolment may increase pension participation and increase the proportion of employees saving the default minimum amount. First, automatic enrolment substantially reduces the *complexity* of the decision of whether to save in a pension. There are default contribution rates and default investment allocations under automatic enrolment (although many, but not all, employers that offered workplace pensions before automatic enrolment had certain default investment allocations). Automatic enrolment therefore ‘decouples’ the participation decision from the contribution rate or investment allocation decision. The decision whether to cease participation is simpler than the full investment allocation decision. This should lead to higher participation because complexity of a decision is known to lead to individuals putting

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<sup>3</sup> Authors’ calculations using the Annual Survey of Hours and Earnings.

off the decision (Tversky and Shafir, 1992). Indeed, evidence from ‘quick enrolment’, in which individuals can enrol in an employer’s savings plan with a pre-selected contribution rate and asset allocation, has been found to lead to increases in plan participation of between 10 and 20 percentage points (Beshears et al., 2013). Iyengar et al. (2004) also find that the higher the number of funds offered in a pension plan (looking at those with a choice of at least two), the lower the probability of participating, due to the increased complexity of choosing between the funds.

Second, individuals deciding whether (and how much) to save in a pension may have problems with ‘self-control’ and may procrastinate over this decision. This *procrastination* comes about because people think that they will save more in the future, but they are naive and, when the ‘future’ arrives, they put off saving once again. O’Donoghue and Rabin (1999) show that under these circumstances, individuals will not change their asset allocation from a bad investment even when there are low transaction costs, because they think (wrongly) they will instead do it in the future. This form of procrastination would imply that individuals will not opt out of a pension when automatically enrolled (because they can always do it later), but will actually continue to stay in, and at the default rates.

Third, the fact that employees are defaulted into a pension scheme under automatic enrolment may mean that the employee sees the default as an *endorsement*, either from the employer or from the government. Beshears et al. (2009) argue that individuals may see the default option as implicit advice on the best course of action, particularly if they are not financially literate. This may be less the case in the introduction of automatic enrolment studied in this paper. The minimum contribution rates (the minimum employer contribution is 1% of a band of ‘qualifying earnings’ and the minimum total contribution is 2% of qualifying earnings) are so low that it is unlikely that the employer or government is endorsing them and, indeed, the minimum total contribution rises to 8% of qualifying earnings in 2019. However, the fact that individuals are defaulted into a workplace pension may prevent people from opting out because they see that policy recommends that people become members of the pension scheme.

Fourth, there are some individuals who are automatically enrolled in a pension who were not previously offered an employer contribution to their pension. When introduced in the UK, automatic enrolment mandated employers to make contributions of at least 1% of qualifying earnings, and the minimum total (employee and employer) contribution is 2% of qualifying

earnings. Some employees who previously did not want to be part of a workplace pension, either because they did not want to save for retirement at all or because they saved outside a workplace pension scheme, may choose to be in their workplace pension in order to be able to receive the employer contribution.

Overall, these four mechanisms would suggest that automatic enrolment is likely to increase both the proportion of eligible employees participating in a workplace pension and the proportion of employees contributing the minimum amounts.

Previous empirical evidence on the impact of automatic enrolment has been based on its voluntary introduction by employers in the US. Madrian and Shea (2001) compare two cohorts of employees at a large healthcare firm in the US, where the cohort hired later were enrolled automatically into a 401(k) scheme, with a 3% default employee contribution and with all funds invested in a money-market scheme (i.e. invested in government and commercial bonds with short maturity). They find that participation rates in the pension scheme increased dramatically for the cohort that were enrolled automatically, with 86% of employees enrolled in the 401(k) after 3–15 months, compared with only 37% of those who were not subject to automatic enrolment. Moreover, they find that the 3% default contribution was extremely salient; almost 65% of the cohort eligible for automatic enrolment had contributions equal to the default rate, and the proportion with higher contributions fell, implying that automatic enrolment led to some employees contributing less than they would have in the absence of automatic enrolment. The authors also find that many employees stuck with the default investment strategy.

The defaults introduced into the pension saving decision have also been found to be highly persistent, such that three years after automatic enrolment, half of participants contribute the default and are invested in the default portfolio (Choi et al., 2004). Chetty et al. (2014) find that only 15% of people respond actively to automatic pensions contributions (by reducing other saving), implying that, for most people, higher pension saving due to automatic contributions is not offset by reductions in other saving.

It is not only from the literature on automatic enrolment that defaults have been found to be very important in determining saving behaviour. Cronqvist and Thaler (2004) study the privatisation of Swedish Social Security and find that a third of people remain with the default funds, even though they were actively encouraged to choose their own portfolios. Thaler and Benartzi (2004) find that, even when individuals have to choose to be part of a

savings scheme, the default of ‘automatically escalating’ contributions leads to much higher rates of savings. Goda and Manchester (2013) show that, in a firm where the default pension scheme changes from being a defined contribution to a defined benefit (DB) pension scheme at age 45, the proportion enrolled in the DC scheme falls by 60 percentage points. On the other hand, Bronchetti et al. (2013) study a randomised experiment where 10% of a tax refund is defaulted into a savings bond and find little evidence of any effect on total savings.

There is no evidence from other countries whose governments have introduced automatic enrolment. This is because, in the rare cases where it has been introduced by governments elsewhere, it has been very partial or introduced alongside a set of other changes. Chile introduced automatic enrolment between 2012 and 2014, but only for self-employed workers, and no opting out was allowed from 2015 on (see OECD (2014)). New Zealand introduced automatic enrolment into its ‘KiwiSaver’ scheme, with minimum contributions of 3% from both employer and employee. However, this scheme was also combined with a 50% match rate from the government, and the government ‘kick-started’ the savings account with a NZD\$1,000 payment, making it hard to distinguish the effect of automatic enrolment from the effect of the introduction of the other savings incentives.<sup>4</sup>

Given that automatic enrolment is found (in this and other papers) to increase participation in pension schemes, this is likely to increase the labour costs of employing a worker who is eligible for automatic enrolment. There are a large number of possible responses by employers faced with this higher labour cost. One could be to reduce the wages or salaries of employees (as compensation in the form of a pension has risen), which might be expected in a competitive labour market in which employees value these benefits and where wages are flexible (see Summers (1989)). Alternatively, employers that previously offered employer pension contributions above the minimum could reduce the contributions offered towards the minimum level. These responses would limit the extent to which automatic enrolment increases savings for retirement.

There has been limited published literature on whether employers that introduce automatic enrolment offer lower employer contributions, as a way to limit the increase in labour costs associated with the increased participation in pension schemes. Butrica and Karamcheva

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<sup>4</sup> The OECD (2014) study also cites Italy as a case of automatic enrolment. However, employees were asked to complete a form asking whether the employee did or did not accept the default option, making the process more of an ‘active decision’ rather than ‘automatic enrolment’ (Rinaldi, 2011).



(2015) find in a cross-section of US private sector pension funds that, controlling for a set of firm and plan characteristics, employer match rates are 0.38 percentage points (11%) lower under automatic enrolment. On the other hand, Andrietti (2015) uses plan-level panel data and finds a positive association between automatic enrolment and employer match rates. One difficulty with this literature has been establishing a convincing counterfactual for those employers that introduce auto-enrolment. This is because employers have chosen to introduce automatic enrolment, and employers that decide to do so (and employees who work for those employers) may be different from employers where automatic enrolment is not introduced.

The remainder of this paper proceeds as follows. Section II describes the institutional setting for pensions in the UK and the details of the introduction of automatic enrolment there. Section III describes the data used in this paper, Section IV sets out the empirical strategy and Section V presents the results. Section VI concludes.

## **II. Policy background**

### *a) The UK pensions policy environment*

Here we set out briefly the pensions policy environment that provides the background to the introduction of automatic enrolment in the UK. Unlike in many European countries, the UK government does not provide a pension at a level that provides high ‘replacement rates’ for individuals who are retiring after a full working life. A full public pension (known as a ‘state pension’) in the UK is £155.65 per week (in 2016–17), equivalent to around only 30% of median full-time weekly earnings.<sup>5</sup> Individuals build entitlement to a state pension by working and paying a payroll tax (known as ‘National Insurance contributions’) or alternatively by undertaking other ‘qualifying’ activities such as caring for children, searching for work or receiving disability benefits. Those reaching the state pension age with more than 10 years’ qualifying activities are entitled to some state pension, with the full amount payable to those who have amassed 35 years of contributions. The state pension received is not related to the earnings of the individual during their lifetime. State pensions

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<sup>5</sup> We describe here the state pension system from April 2016, which will be the system for the vast majority of employees currently working in the UK. This system, legislated in the Pensions Act 2014, replaced a system that had a lower ‘basic state pension’ and the option of an ‘earnings-related’ state pension for those who did not have an employer-provided pension. For many more details of the new system and how it has changed, see Crawford et al. (2013).

are not means-tested or subject to an earnings test, but are taxable and can only be claimed from the state pension age, which in April 2016 was 65 for men and 63 for women.<sup>6</sup>

Given the relatively low level of the state pension, income from private pensions (which include both employer-organised and personal pensions) makes up a large proportion of income in retirement for individuals in the UK. Crawford and O’Dea (2012) find that, in 2008–09, median private pension wealth of those between 50 and the state pension age was £90,700, while 25% of individuals had private pension wealth of over £237,800. For DC schemes, individuals who contribute to a pension scheme (and/or receive contributions from their employer) make contributions to their pension scheme before income tax (they receive tax relief at their marginal rate of income tax). Income from the investments is re-invested untaxed in the pension. Income tax is paid upon drawing a pension, although up to one-quarter of the pension pot can be taken free of income tax. With a few exceptions, individuals can draw on their DC pension pot from age 55. Prior to April 2015, it was (near) compulsory to annuitise three-quarters of their pension pot; that is no longer the case: individuals can draw on their pension pot in any way they want. Contributions to DB pensions also attract tax relief, and DB pensions are taxed upon receipt in the same way as DC pensions, although the age at which an income from these schemes can start to be received depends on the exact scheme rules.

While a large majority of public sector workers are active members of an employer-provided pension scheme (85% in 2012), only 36% of private sector employees were in 2012; the latter figure had fallen from 50% in 1997 (Cribb and Emmerson, 2016). Prior to October 2012 (when automatic enrolment started), all employers with five or more employees were obliged, if requested by an employee, to facilitate membership of a pension scheme where employees’ contributions could be deducted directly from employees’ pay packets, although employers were not obliged to make contributions to a scheme.<sup>7</sup>

Finally, it should be noted that prior to the introduction of automatic enrolment by the government, it was relatively uncommon for private sector employers to decide to enrol their employees automatically into a pension scheme. McKay (2006) finds that only 4% of private

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<sup>6</sup> The state pension age for women has been rising gradually from 60 to 65 between 2010 and 2018. From 2018 to 2020, the state pension age will rise to 66 for both men and women. See Cribb et al. (2016) for more details.

<sup>7</sup> These were known as stakeholder pensions. For more details, see Disney et al. (2010).

sector employers (representing 16% of private sector employees) enrolled their workers automatically into a scheme in 2005.

*b) Introduction of automatic enrolment in the UK*

Following the recommendation of the report of the independent Pensions Commission in 2005, the UK government legislated in the Pensions Act 2008 to oblige employers to enrol their employees automatically into a workplace pension scheme with at least a minimum level of contributions. A workplace pension scheme is a scheme that is facilitated by the employer (but not necessarily run by the employer). The introduction of automatic enrolment was recommended due to a falling proportion of employees saving in a pension and fears of undersaving for retirement (see Pensions Commission (2005)). The obligation to enrol eligible employees automatically has been introduced gradually, starting in October 2012. Here we set out the details of the policy as they were implemented by the government.<sup>8</sup>

Employees are eligible for automatic enrolment if they are aged at least 22, are aged below the state pension age and earn more than a given earnings level. In 2015–16, this level was £10,000 per year.<sup>9</sup> Employers can postpone automatically enrolling new employees for up to 3 months. Once automatic enrolment is introduced by the employer, all eligible employees must be enrolled into a pension scheme, which they are then able to choose to leave at any point.<sup>10</sup>

Employers introducing automatic enrolment must enrol their employees (who have not actively elected not to be enrolled in the pension) into a pension with (at least) minimum levels of contributions. Up to and including March 2018, the minimum employer contribution is 1% of qualifying earnings and the minimum total contribution is 2% of qualifying earnings, where the ‘total’ is the sum of employee and employer contributions, including any tax relief. ‘Qualifying earnings’ are earnings in a certain band set by the government. In

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<sup>8</sup> Information on how employers must introduce automatic enrolment is provided in exhaustive detail here: <http://www.thepensionsregulator.gov.uk/doc-library/automatic-enrolment-detailed-guidance.aspx>.

<sup>9</sup> Individuals’ earnings were assessed against a threshold in each ‘pay period’ (period for which they were paid). This threshold was equivalent to £10,000 per year – e.g. if they are paid weekly, it is assessed against a threshold of £192 per week.

<sup>10</sup> Technically, all eligible employees are initially enrolled. From this point, employees have up to one month to ‘opt out’ and receive a refund of contributions. After this point, an employee can still choose to leave the pension scheme (and therefore cease contributions) at any time, although all contributions remain invested.

2015–16, qualifying earnings were those between £5,824 and £42,385 per year.<sup>11</sup> The minimum total contribution will increase to 5% of qualifying earnings from April 2018 (with a minimum of 2% from the employer) and to 8% from April 2019 (with a minimum of 3% from the employer). Employers can choose to enrol their employees automatically into schemes with higher (employee and employer) contributions, although they are prevented from setting the employee contribution rate so high as to deliberately encourage a large proportion of employees to opt out.

Employees can cease being in a pension scheme at any time. To do this, employees must inform their employer, confirming that they do not want to be enrolled in the pension scheme. If employees opt out within one month of being enrolled automatically, any contributions they have made to the scheme will be repaid in full. If employees opt out at a later time, any contributions will remain invested. Employers are required to re-enrol any eligible employees who have left the pension scheme around 3 years after the employer's staging date.<sup>12</sup>

The obligation of employers to enrol their eligible employees automatically has been introduced gradually since October 2012. Each employer is given a 'staging date'. Employers must automatically enrol eligible employees from this date, unless they apply to postpone enrolment by up to 3 months from the staging date. An employer's staging date is determined by the number of employees the organisation employs in April 2012, as measured by the number of employees on its Pay-As-You-Earn scheme (the scheme by which income and payroll tax payments are withheld from employees' earnings). Appendix Table A1 sets out the staging dates for employers based on the size of the employer. Employers can introduce automatic enrolment earlier than their staging date if they wish, although they must inform the Pensions Regulator that they are doing so.

Employers with 120,000 or more employees were the first employers to be affected, with a staging date of 1 October 2012. By February 2018, all employers will have had to introduce automatic enrolment. This affects both public and private sector employers, although some large public sector pension schemes had already introduced automatic enrolment prior to 2012. For example, all teachers in England and Wales aged 18 to 70 were enrolled automatically into the Teachers' Pension Scheme from January 2007, and all full-time

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<sup>11</sup> As a percentage of total earnings, the minimum total contribution is therefore a maximum of 1.73% – for those earning at the top of the qualifying earnings band (£42,385 p.a.).

<sup>12</sup> The first automatic re-enrolments occurred in Autumn 2015, which is after the period of the data used in this paper.

teachers were enrolled automatically prior to 2007 (see Emmerson and Wakefield (2009)). By April 2015 (which is the latest data we use in this paper), all employers with 50 or more employees (in 2012) have passed their staging date, although employers with 50 to 57 employees are not 3 months past their staging date and so they may not have introduced automatic enrolment yet. All employers with 58 or more employees will be more than 3 months past their staging date and therefore are obliged to have introduced automatic enrolment by April 2015.<sup>13</sup> For this reason, our results focus on the impact of automatic enrolment on private sector employees working for employers with 58 or more employees.

Finally, there are groups of employees who are not enrolled automatically into a pension scheme, but are nonetheless potentially affected by automatic enrolment. Individuals who earn over the earnings threshold, but are aged 16 to 21 or over the state pension age (but under 75), as well as individuals of all ages earning between £5,824 and £10,000 per year (in 2015–16) are ‘non-eligible jobholders’. They do not have to be enrolled automatically; however, they can opt in to join the scheme, where employers and employees must make minimum contributions. Employees earning below £5,824 per year (in 2015–16) are ‘entitled workers’. They are not enrolled automatically but can apply to join a pension scheme, although their employer does not have to make a contribution.

### **III. Data**

The data used in this paper are from the Annual Survey of Hours and Earnings (ASHE), which is collected by the UK’s Office for National Statistics (ONS). ASHE is a survey of employees with the survey being completed by employers in April of each year.<sup>14</sup> Data are available from April 1997 to April 2015. The survey is approximately a 1% sample of employees in Britain, with employees included in the survey if their National Insurance (NI) number<sup>15</sup> ends in a specific pair of digits. This sample frame means ASHE is a panel data set following the same employees over time.<sup>16</sup> The number of responses to this survey was

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<sup>13</sup> The exception to this is that, if an employer has an open DB pension scheme which all employees are entitled to join, then they can have ‘transitional arrangements’ by which they delay introduction of automatic enrolment until 30 September 2017. However, there are very few open DB schemes, and employers can choose not to apply this delay.

<sup>14</sup> Employers are asked to fill out the ASHE form with reference to a particular date in April of each year. The list of exact dates for each year of the ASHE data is shown in Appendix Table A2.

<sup>15</sup> This is a government-provided number used for the administration of taxes and social security and is needed to work legally in the UK.

<sup>16</sup> In 2007 and 2008, the ONS cut the sample size of the survey by approximately 20%, targeting the cuts on ‘industries that exhibit the least variation in their earnings patterns’ (see UK Statistics Authority (2011)). The

181,052 in 2015.<sup>17</sup> The data are stored at the job level, meaning that if an individual has two jobs, they will appear twice in the data in that year (and these can be linked to each other).

The ASHE data include detailed information on the pay and hours of work of each employee. Given that the survey is completed by employers with reference to their payroll records, these data are thought to be the most reliable measures of earnings of any publicly available UK data set (see Gregg et al. (2014)). Importantly for this paper, the survey asks whether the employee was a member of a workplace pension scheme ('run or facilitated by [the] organisation'). From 2004 onwards, it also asks how much the employer and the employee contributed to the pension.<sup>18</sup>

The ASHE data contain a number of variables on the employee, including, age, sex, occupation, job tenure, whether the job is a temporary contract, and region. It also contains information on the employer, such as industry and sector (public/private). Using these data, we can define the set of individuals who are 'eligible' for automatic enrolment: those aged 22 to state pension age, earning more than the automatic enrolment threshold (£10,000 per year in 2014–15) and who have been working for their employer for at least 3 months.

In this paper, our main outcomes of interest are the participation in a workplace pension scheme and the pension contribution rates. We define an individual to be participating in a workplace pension scheme if their employer indicates they are a member of a workplace pension scheme and the employer does not record there being a zero contribution to the pension (from employee and employer combined). We calculate pension contribution rates by dividing the amount contributed by employee or employer by total pay in the pay period.<sup>19</sup> We 'top code' the employee and employer pension contribution rates at the 99<sup>th</sup> percentile of

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full sample was restored in 2009. For this reason, with the exception of one descriptive chart (Figure 1), we restrict our use of these data to the period 2009 to 2015.

<sup>17</sup> Non-response to the survey, particularly by small employers, means that the survey is not quite a 1% sample of employees. In Q2 2015, according to the Labour Force Survey, there were 25,500,000 employees in Britain, implying there is a (valid) response rate of around 72%. This is substantially higher than many household survey data sets in Britain. For example, the Living Costs and Food Survey in 2014 has a response rate of around 48% ([https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/486047/familyfood-method-sampling-17dec15.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486047/familyfood-method-sampling-17dec15.pdf)).

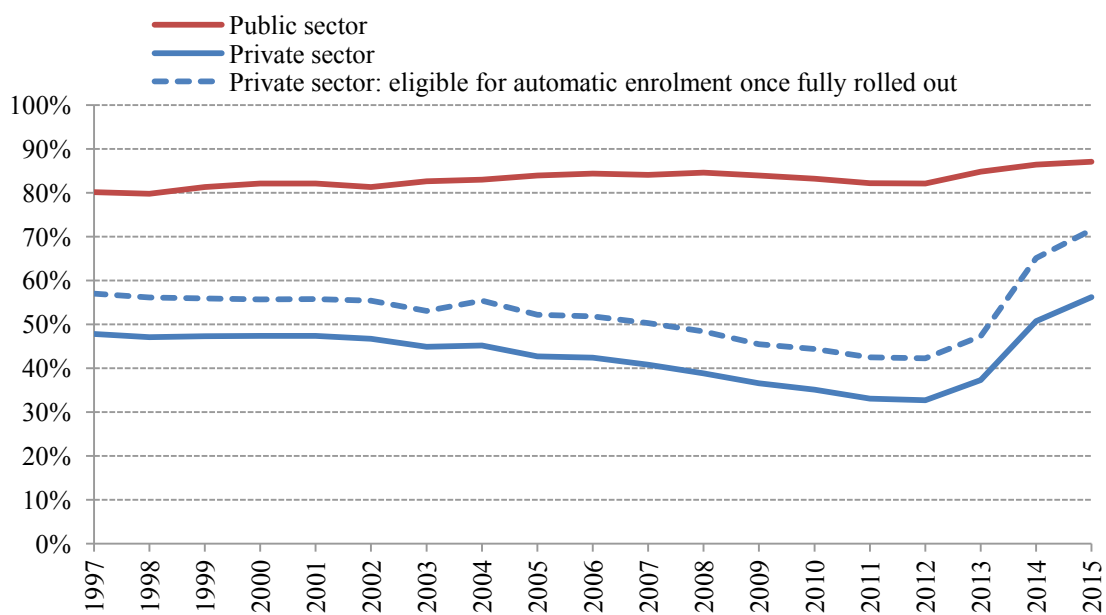
<sup>18</sup> In the UK, there are tax advantages for employers to contribute to a pension on behalf of an employee, through a process called 'salary sacrifice'. Usefully, the ASHE questionnaire specifically asks for any contributions made through 'salary sacrifice' to be recorded as an employee rather than an employer contribution.

<sup>19</sup> This is different from the way the ONS normally calculates pension contribution rates, i.e. as a fraction of 'pensionable pay'. We use our method because the minimum contributions imposed by automatic enrolment are calculated as a fraction of total pay, not pensionable pay.

the distribution of the contribution rates of private sector employees who are in a pension scheme in 2012.

Most importantly for our empirical strategy, the data contain a measure of the number of employees in the employer in each year. This measure comes from the UK government’s business register. This is crucial because, as was discussed in Section II, it is the number of employees employed in April 2012 that determines when employers are obliged to introduce automatic enrolment.

**Figure 1. Workplace pension membership rates among public and private sector employees, 1997 to 2015**



Note: ‘Eligible’ means those aged 22 to state pension age, earnings over automatic enrolment threshold, working for employer for over 3 months. It does not restrict to those employers where automatic enrolment had been introduced. Source: Authors’ calculations using the Annual Survey of Hours and Earnings.

It is instructive to show the rates of pension membership and the contributions to workplace pensions prior to automatic enrolment being introduced. Figure 1 uses the ASHE data to show how pension membership has changed from 1997 to 2015. It is clear from the figure that public and private sector workers have had very different participation rates in pensions. The proportion of private sector employees in a workplace pension scheme fell from 48% in 1997 to 33% in 2012, before rising to 56% in 2015, indicating that automatic enrolment has potentially increased pension membership. Looking only at those meeting the automatic enrolment eligibility requirements (those aged 22 to the state pension age, earning over the threshold and in work, but not restricting to those employers where automatic enrolment had

been introduced), it fell throughout the 2000s, before rising from 42% in 2012 to 72% in 2015.

**Table 1a. Distribution of employee and employer pension contributions for private sector employees, 2012 (before automatic enrolment)**

<i>Contribution rate</i>	<i>All</i>		<i>Eligible in employers with 58+ employees</i>	
	<i>Employee</i>	<i>Employer</i>	<i>Employee</i>	<i>Employer</i>
None	73.5%	68.8%	59.6%	53.1%
0% to 1%	0.3%	0.3%	0.5%	0.4%
1% to 2%	1.6%	0.8%	2.3%	1.0%
2% to 5%	12.2%	6.7%	18.3%	9.1%
5% to 10%	11.4%	9.8%	18.0%	15.4%
10%+	0.9%	13.6%	1.3%	21.1%
All	100.0%	100.0%	100.0%	100.0%

Note: Contribution rates are expressed as weekly contribution to pension scheme divided by gross weekly earnings. For employee and employer contributions, 'None' includes both employees who are in a pension, but where either the employee or employer makes no contribution to it, and employees not in a pension. Columns do not always sum to 100 due to rounding.

Source: Authors' calculations using the Annual Survey of Hours and Earnings

**Table 1b. Distribution of total pension contributions for private sector employees, 2012 (before automatic enrolment)**

<i>Total contribution rate</i>	<i>All</i>	<i>Eligible in employers with 58+ employees</i>
None	67.9%	52.0%
0% to 2%	0.5%	0.6%
2% to 5%	2.9%	3.7%
5% to 10%	8.5%	12.2%
10% to 20%	12.4%	19.2%
20%+	7.7%	12.4%
All	100.0%	100.0%

Note and Source: See Table 1a.

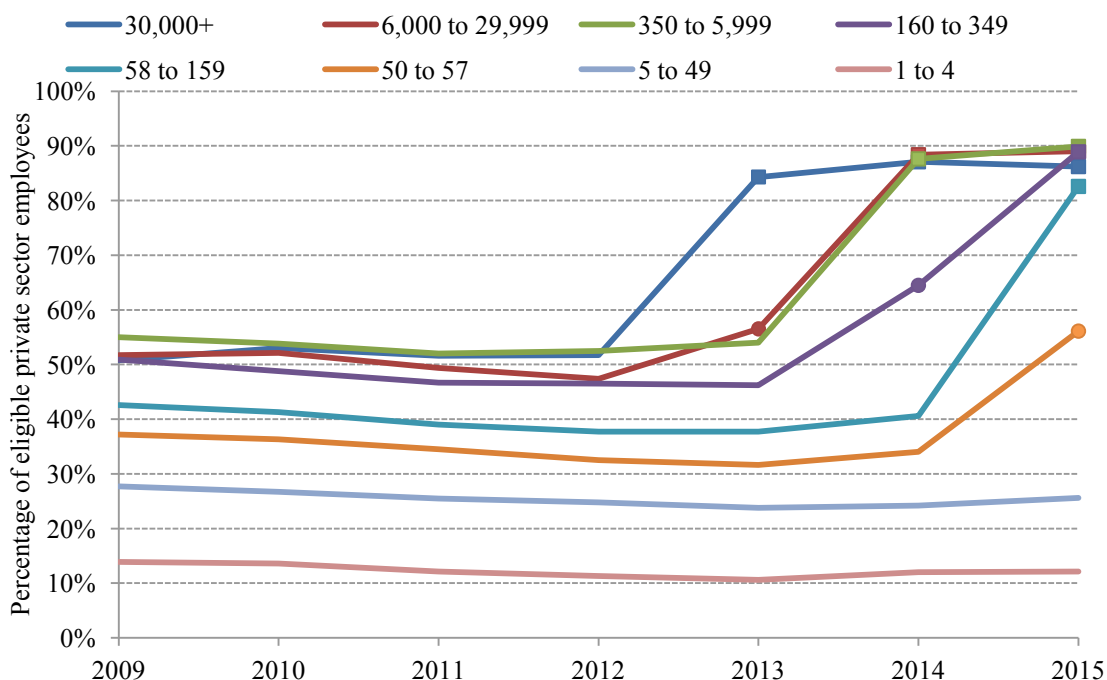
Tables 1a and 1b show the distribution of pension contribution rates, from employees, employers and total, including non-participants prior to automatic enrolment (in April 2012). These distributions include the proportion without any contributions because they are not in a pension scheme. It shows that there are very few employees with very low, positive contribution rates, which are the levels at which the minimum contributions are set under automatic enrolment. Looking at employee contributions, 24% of employees contribute between 2% and 10%, with very few contributing more than 10%. On the other hand, 14% of employees have an employer contribution of more than 10% of earnings. Looking only at those who are eligible for automatic enrolment working for an employer with 58 or more



employees (and therefore auto-enrolled by April 2015), they are significantly more likely to have higher employer and employee contribution rates.

In Appendix Table A3, we provide descriptive statistics on private sector employees in 2012 working in employers with 58 or more employees who are eligible for automatic enrolment. They have median gross weekly earnings of £460, 61% are male, 89% work full-time, over 50% of them have worked for their employer for 5 years or more, they have a median age of 41 and they work across a wide range of industries, of which the largest are ‘retail and wholesale’ and ‘manufacturing’, employing 20% and 16% of the employees respectively.

**Figure 2. Workplace pension membership rates among private sector employees eligible for automatic enrolment, by employer size in 2012**



Note: Square data points indicate periods when employers were over 3 months past their staging date, and therefore had to enrol their eligible employees automatically. Circular data points indicate employers that are past their staging date, but not 3 months past their staging date and so are ‘partially affected’.

Source: Authors’ calculations using the Annual Survey of Hours and Earnings.

Figure 2 provides graphical evidence for the effect of automatic enrolment on the pension membership rate of private sector employees who meet the eligibility conditions for auto-enrolment.<sup>20</sup> Each series represents employees working for private sector firms of different

<sup>20</sup> The data underlying Figure 2, and the analysis in the remainder of the paper, include one observation per job rather than one observation per person. Therefore, if an individual has two jobs, they are included in the data twice. We do not restrict the analysis to main jobs because automatic enrolment operates at the ‘job level’: if an

sizes, grouped together based on when they were eligible for automatic enrolment. It shows that between 2009 and 2012, the membership rates of each group move in a similar way, although, on average, employees working for larger employers have higher membership rates than those working for smaller employers.

In Figure 2, data points in which employees are enrolled automatically are shown with a square data point (and a circle for those who are ‘partially affected’ by automatic enrolment). Those periods in which employees are enrolled automatically see far higher pension membership rates than prior to automatic enrolment, with participation rates under auto-enrolment of between 80% and 90%, suggesting that there is a large impact of automatic enrolment on pension membership.

#### **IV. Empirical methodology**

Using ASHE data on pension membership and contribution rates to pensions of eligible private sector workers, we can estimate the causal impact of automatically enrolling eligible workers on different measures of pension saving. To do this, we exploit the roll-out of the obligation of employers to introduce automatic enrolment for their eligible employees, where the largest employers are affected first, as described in Section II. Since the ASHE data only observe each employee in April of each year, we can calculate whether an employee works for an employer that has introduced automatic enrolment based on the date and the size of the employer. We can sort employers into seven ‘employer size groups’ based on whether automatic enrolment was in place in April of each year (specifically on the ASHE reference date, shown in Appendix Table A2). These groups are shown in Table 2.

If an employer has not reached their staging date by April of a given year, automatic enrolment was not in place. In April 2012, none of the employers were past their staging dates. Once employers have reached their staging date, they can postpone automatic enrolment for up to 3 months; therefore the employer may not have introduced automatic enrolment for the first 3 months after the staging date. In April 2013, employers with between 6,000 and 29,999 employees were in this situation. We do not know whether they have introduced automatic enrolment, but many of them will have. For this reason, we categorise them as ‘partially affected’. Finally, employers that are at least 3 months past their staging date must have introduced automatic enrolment (assuming that they are complying with the

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individual is in a job and they meet the eligibility requirements for auto-enrolment, they will be enrolled automatically, even if it is not their main job.

legislation). By April 2013, eligible employees working for employers with 30,000 or more employees were auto-enrolled. The number affected increases over time; by April 2015, all eligible employees in employers with 58 or more employees were auto-enrolled. This represented 73% of all eligible private sector employees in 2015.

**Table 2. Roll-out of automatic enrolment obligations by employer size**

<i>Employer size in April 2012</i>	<i>Was automatic enrolment in place in:</i>			
	<i>April 2012</i>	<i>April 2013</i>	<i>April 2014</i>	<i>April 2015</i>
30,000+	No	Yes	Yes	Yes
6,000 to 29,999	No	Partially	Yes	Yes
350 to 5,999	No	No	Yes	Yes
160 to 349	No	No	Partially	Yes
58 to 159	No	No	No	Yes
50 to 57	No	No	No	Partially
5 to 49	No	No	No	No

Source: Authors' calculations using <http://www.nowpensions.com/auto-enrolment-staging-dates/> and the Annual Survey of Hours and Earnings.

The roll-out of the obligation to enrol eligible employees automatically means that we can estimate the causal effect of automatic enrolment on membership of a workplace pension and the contributions into it using a difference-in-difference empirical strategy. Employees (and employers) are affected by automatic enrolment at a given time exogenously based entirely on how many employees there were in 2012 and the roll-out timetable chosen by the government.

Equation (1) sets out the difference-in-difference specification that we use to estimate the impact of automatic enrolment:

$$(1) \ y_{ift} = \alpha + \beta(\text{autoenrol})_{ift} + \sum_{a=2013}^{2015} \gamma_a [\text{partial}_a = 1] + \theta_f + \mu_t + \delta X_{ift} + \varepsilon_{ift}.$$

We want to estimate the effect of automatic enrolment on an outcome (such as pension membership)  $y$ , for an individual  $i$ , working for an employer in 'employer size group'  $f$ , observed at time  $t$ .  $(\text{autoenrol})_{ift}$  is a dummy variable taking the value 1 if automatic enrolment is in place in the employee's employer when they are observed, and 0 otherwise.  $\beta$  is the coefficient of interest. It is also necessary to control for the fact that some employees work for employers that are 'partially affected'. We therefore introduce a dummy variable for being 'partially affected', which varies for each year that there are people who are partially affected (2013 to 2015):  $\sum_{a=2013}^{2015} \gamma_a [\text{partial}_a = 1]$ . We control for fixed differences in the

outcome for employees working for employers of different sizes using six ‘employer size group’ fixed effects  $\theta_f$  and we control for time using year fixed effects  $\mu_t$ . Under this specification, we assume that the ‘employer size group’ fixed effects are fixed over time. This is the usual common trends assumption which says that, in the absence of the reform, affected and unaffected employees would see their pension membership and contribution rates change in the same way. The evidence from Figure 2 suggests that pension participation does indeed evolve in the same way over time for employees working for firms of different sizes.

We also control for a vector of characteristics of employees and the employers they work for,  $X$ . These include controls for sex, age (in cubic), job tenure (three dummies), dummies for working for a non-profit institution, being in a full-time job, the job not being the individual’s ‘main’ job and the job being temporary, 10 regional dummies, 12 dummies for industry of the employer and 8 dummies for occupational category of the employee. The full list of covariates can be found in Appendix Table A6.

We do not include individuals who work for employers who had between one and four employees in 2012. This is because the pension membership and contributions rates are unlikely to evolve in a similar way to those for larger employers, partly because many employers with only one employee may be sole proprietors. Moreover, prior to 2012, employers with fewer than five employees did not have to provide a pension scheme if requested by the employee.

The primary outcomes of interest are the effects of automatic enrolment on the probability of membership of a workplace pension scheme and on the level and distribution of contributions. We estimate the effect on the probability of pension membership using a linear probability model and a probit model, the effect on mean contribution rates using ordinary least squares (OLS) and the effect on the distribution of contributions using multinomial logit models (and, as a robustness check, multinomial probit models). The models are estimated on data from April 2011 to April 2015, therefore including two years (2011 and 2012) in which nobody was affected by automatic enrolment and three years in which progressively more employees are enrolled automatically. Our sample size of eligible private sector employees in employers with five or more employees from 2011 to 2015 is 457,443, working for 64,849 employers. The sample size for each ‘employer size group’ in each year is shown in Appendix Table A4. There are a small number of individuals with missing pension contributions, so the sample size for the effect on pension contributions is 452,212.

Since automatic enrolment is implemented by employers, and they may implement it in slightly different ways (particularly in terms of how much they offer as an employer contribution), there may be a correlation in the error  $\varepsilon_{ift}$  between employees working for the same employer. In headline results, we therefore cluster our standard errors at the employer level. We show the number of clusters (employers) as well as the number of observations (employees) underlying each regression in our results section. For some results, we also show how the standard errors change when we instead cluster at the individual level.

## V. Results

### a) *Effect of automatic enrolment on membership of a workplace pension*

Table 3 reports the results of estimating the effect of automatic enrolment on the proportion of employees who are members of a workplace pension, using equation (1), with the dependent variable being a dummy indicating whether the employee is participating in a workplace pension. Our preferred specification is specification 5, which estimates the effect using a probit model, controls for the characteristics of employees ( $X$ ) and clusters the standard errors at the employer level. We find that automatic enrolment substantially increases the proportion of employees participating in a workplace pension, by almost 37 percentage points. This compares with a pre-reform (2012) membership rate of 49% of eligible employees working for employers with 58 or more employees. By 2015, eligible employees in employers of the same size had a pension membership rate of 88%. With pension participation rates under automatic enrolment nearing 90%, these are similar to the rates found by Madrian and Shea (2001) and Choi et al. (2004) in their studies of US firms.

The alternative specifications in Table 3 show that this result is robust to estimating the model using a linear probability model (specifications 1–3) rather than a probit model (as shown in specifications 4–6) and to not controlling for control variables  $X$  (specifications 1 and 4). The full results of the OLS regression (in specification 2) are shown in Appendix Table A6. Clustering at the individual level rather than the employer level substantially reduces the standard errors. In all the results in Table 3, the effect of automatic enrolment is highly significantly different from zero (at below the 1% level). Almost all of the 37 percentage point increase was due to increased membership of DC pension schemes (a 35 percentage point effect), with only a 1 percentage point increase in the membership of DB schemes, an effect which is not statistically significantly different from zero at standard significance levels.

**Table 3. Effect of automatic enrolment on pension membership rates of eligible private sector employees**

	(1)	(2)	(3)	(4)	(5)	(6)
Effect of automatic enrolment	+0.365***	+0.361***	+0.361***	+0.376***	+0.368***	+0.368***
Standard error	[0.016]	[0.016]	[0.002]	[0.018]	[0.017]	[0.002]
Number of observations	457,443	457,443	457,443	457,443	457,443	457,443
Number of clusters	64,849	64,849	159,842	64,849	64,849	159,842
Estimated by:	OLS	OLS	OLS	Probit	Probit	Probit
Clustering level	Employer	Employer	Individual	Employer	Employer	Individual
Control variables ( <i>X</i> ) included?	No	Yes	Yes	No	Yes	Yes

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Probit models are estimated using maximum likelihood. Standard errors for specifications 4–6 are estimated by bootstrapping the average marginal effect of automatic enrolment on pension membership 250 times. Control variables (*X*) are listed in Appendix Table A6. Sample includes all eligible private sector employees from April 2011 to April 2015. Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table 4. Placebo test: testing for any evidence of an effect had automatic enrolment been introduced 3 years earlier**

	(1)	(2)	(3)	(4)
Effect of 'automatic enrolment'	+0.002	+0.002	+0.002	+0.002
Standard error	[0.005]	[0.002]	[0.005]	[0.002]
Number of observations	350,848	350,848	350,848	350,848
Number of clusters	56,308	140,559	56,308	140,559
Estimated by:	OLS	OLS	Probit	Probit
Clustering level	Employer	Individual	Employer	Individual
Control variables ( <i>X</i> ) included?	Yes	Yes	Yes	Yes

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Probit models are estimated using maximum likelihood. Standard errors for specifications 3 and 4 are estimated by bootstrapping the average marginal effect of the (placebo) policy dummy on pension membership 250 times. Control variables (*X*) are listed in Appendix Table A6. Sample includes all eligible private sector employees from April 2009 to April 2012.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

One test of validity of this empirical strategy is to conduct a placebo test, in which we see whether there is an effect when we would not expect there to be one. In order to do this, we imagine that automatic enrolment had been introduced in exactly the same way, but 3 years earlier, such that in April 2010 employers with more than 30,000 employees had automatic enrolment in place, by April 2011 it was in place for employers of 350 or more, etc. We then estimate the same equation (1), except using data from 2009 to 2012 (all years are prior to

auto-enrolment actually being introduced). Table 4 shows that, using both a linear probability model and a probit model, there is no effect. The tiny point estimate is not statistically significant, even when we cluster our standard errors at the individual level rather than the employer level.

**Table 5. Effect of automatic enrolment on pension membership rates of different subgroups**

	<i>Effect</i>	<i>Standard error</i>	<i>N</i>	<i>Number of clusters</i>	<i>Membership rate of eligible employees in:</i> 2012 2015	
<b>All</b>	0.361***	[0.016]	457,443	64,849	48.6%	88.1%
<b>Age group</b>						
22 to 29	0.521***	[0.023]	94,294	24,329	27.6%	85.4%
30 to 39	0.372***	[0.017]	116,337	25,480	48.0%	88.4%
40 to 49	0.306***	[0.016]	124,806	25,370	56.4%	89.9%
50 to state pension age	0.279***	[0.013]	122,006	23,570	57.7%	88.0%
<b>Job tenure (years with employer)</b>						
<1 year	0.538***	[0.013]	49,771	23,459	21.6%	81.3%
1 to 2 years	0.494***	[0.016]	54,653	25,773	30.0%	86.1%
2 to 5 years	0.444***	[0.019]	109,154	30,377	38.2%	87.3%
≥ 5 years	0.266***	[0.016]	243,865	34,820	62.0%	90.4%
<b>Sex</b>						
Male	0.356***	[0.016]	275,633	42,758	50.0%	88.7%
Female	0.369***	[0.018]	181,810	32,757	46.4%	87.1%
<b>Employer type</b>						
Private / publicly-listed company	0.381***	[0.018]	410,050	59,668	46.3%	88.0%
Non-profit institution	0.205***	[0.014]	47,393	5,447	65.7%	88.8%
<b>Earnings quartile</b>						
Lowest quartile	0.539***	[0.035]	114,361	28,007	22.3%	81.1%
Second quartile	0.457***	[0.020]	114,361	28,805	36.0%	86.1%
Third quartile	0.315***	[0.013]	114,362	25,907	55.5%	89.5%
Fourth quartile	0.161***	[0.009]	114,359	19,071	76.6%	93.5%

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. All models estimated by OLS including control variables (*X*, listed in Table A6). Standard errors clustered at the employer level. 'Membership rate of eligible employees' in 2012 and 2015 is based only on eligible employees working for employers that had 58 or more employees in 2012.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

The increase in participation in workplace pensions caused by automatic enrolment is heterogeneous, which is not surprising because, prior to automatic enrolment, different groups of workers had very different membership rates. Table 5 shows the effect of automatic enrolment on different subgroups. These are the results of estimating equation (1) only on given subgroups (using a linear probability model and including control variables). Overall, it shows that those groups that had the lowest pre-reform pension membership rates see the largest impact of automatic enrolment, but that those groups with the highest pre-automatic-enrolment membership rates still have the highest rates after its introduction. For example, automatic enrolment increased pension membership of 22- to 29-year-olds by 52 percentage points, compared with a baseline of 28%, whereas the effect for those in their 40s was 31 percentage points, compared with a base of 56%. By 2015, the membership rate of eligible employees in employers with 58 or more employees was 85% for those in their 20s, compared with 90% for those in their 40s.

Table 5 also shows that there is a larger effect for people with low job tenure than for those with high job tenure – increasing the membership rate by almost 54 percentage points for those in their first year with an employer, compared with 27 percentage points for those with 5 or more years with the employer. Before automatic enrolment, job tenure is highly correlated with pension membership, and while there is still a positive relationship after automatic enrolment, it is much less pronounced.

We also divide the sample into quartiles of the weekly earnings distribution in each year (restricting only to eligible private sector employees) and look at the effect on each quartile. The effect for the lowest earnings quartile of eligible employees (in April 2015, this was composed of those earning between £10,000 and £16,730 per year) is 54 percentage points, compared with only 16 percentage points for the highest quartile, with the participation rate for the highest quartile reaching 94% in 2015. There is a slightly larger impact for women than for men (although not statistically significantly different), and a larger increase for those working for private or publicly-listed companies as opposed to non-profit institutions, such that by 2015 the two types of employers have very similar pension participation rates.

*b) Effect of automatic enrolment on workplace pension contribution rates*

While the impact of automatic enrolment on pension membership is clear, the impact on the levels of contributions made into workplace pensions may only be quite small (and could even be negative), if those who are newly enrolled into a pension scheme are enrolled at the



legal minima (1% of qualifying earnings from employer, 2% of qualifying earnings in total) and if the introduction of the default means that some employees reduce their contributions to the default level, as is found in Madrian and Shea (2001).

We estimate the effect of automatic enrolment on the mean pension contribution rates (from employee/employer/total) using equation (1) with these outcomes as the dependent variable. The results of this are shown in Table 6. It shows that there was an increase in the mean employee contribution rate by 0.45 percentage points, from a baseline of 2.1% in 2012 (a 21% increase). The effect on employer contribution rates was larger, at 0.60 percentage points (although this increase is a lower fraction of the pre-reform mean). The effect on the mean total contribution rate was 1.05 percentage points, compared with an average contribution rate of 7.0% in 2012 prior to automatic enrolment being introduced. All of these impacts are statistically significant at the 1% level.

**Table 6. Effect of automatic enrolment on mean employee, employer and total contribution rates to workplace pensions among eligible employees**

	<i>Effect of auto-enrolment</i>	<i>Standard error</i>	<i>N</i>	<i>Number of clusters</i>	<i>Mean contribution rate of eligible employees in 2012</i>
Employee contribution rate	+0.45***	[0.06]	452,212	64,428	2.1%
Employer contribution rate	+0.60***	[0.11]	452,212	64,428	4.9%
Total contribution rate	+1.05***	[0.13]	452,212	64,428	7.0%

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated by OLS including control variables (*X*, listed in Table A6). Standard errors clustered at the employer level. Contribution rate is the weekly amount contributed by the employee/employer to the pension, as a fraction of gross weekly earnings. Total contribution rate is the sum of the employee and employer contribution rates. Source: Authors' calculations using the Annual Survey of Hours and Earnings.

In order to estimate what impact automatic enrolment has had on overall pension saving (in £ per year), we can estimate the effect of automatic enrolment on total pension contributions in £ per week using the same methodology (by estimating equation (1) with pension contributions in £ per week as the dependent variable). The results of that regression, presented in Appendix Table A5, show that automatic enrolment increased mean total pension contributions by £4.31 per week on average (expressed in 2015 prices), from a pre-reform baseline of £52.49 per week (this includes those with zero contributions).

Combining information from ASHE and the Labour Force Survey, we estimate that 10.3 million employees are eligible for automatic enrolment and work in private sector firms

where automatic enrolment had been introduced by April 2015.<sup>21</sup> This implies that the effect of automatic enrolment on eligible private sector employees was to increase pension saving by £2.3 billion per year by April 2015. This compares with the total contributions to workplace pensions of £28.1 billion per year by this group in 2012 (expressed in 2015 prices, calculated in ASHE). Of this £2.3 billion, about half was from employee contributions and half from employer contributions.

Unless opt-out rates increase dramatically, this effect is very likely to rise significantly as more people are automatically enrolled and as minimum contributions increase. Indeed, analysis from the Department for Work and Pensions (2016b) suggests that automatic enrolment would increase workplace pension saving by £17 billion per year by 2019, although the DWP calculation includes an impact on the public sector.

**Table 7. Effect of automatic enrolment on distribution of employee, employer and total contribution rates to workplace pensions, among eligible employees**

<i>Contribution rate</i>	<i>Employee</i>		<i>Employer</i>		<i>Contribution rate</i>	<i>Total</i>	
	<i>Effect</i>	<i>Standard error</i>	<i>Effect</i>	<i>Standard error</i>		<i>Effect</i>	<i>Standard error</i>
0%	-0.333***	[0.019]	-0.373***	[0.016]	0%	-0.390***	[0.015]
0% to 1%	+0.200***	[0.018]	+0.206***	[0.016]	0% to 2%	+0.237***	[0.016]
1% to 2%	+0.060***	[0.010]	+0.060***	[0.007]	2% to 5%	+0.082***	[0.009]
2% to 5%	+0.056***	[0.009]	+0.065***	[0.008]	5% to 10%	+0.051***	[0.006]
5%+	+0.016*	[0.009]	+0.041***	[0.008]	10%+	+0.020***	[0.007]

Note: For the bands with upper and lower contribution rates (e.g. 1% to 2%), the contributions are strictly greater than the lower value and weakly less than the higher amount. \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated using a multinomial logit model by maximum likelihood including control variables (*X*, listed in Table A6). Standard errors are estimated by bootstrapping the average marginal effect of automatic enrolment 250 times, while clustering at the employer level. Number of observations: 452,212. Number of clusters (employers): 64,428.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

Because the mean contribution rate includes zeros, and is affected by some high contribution rates (generally from DB schemes), it is potentially more interesting to estimate the impact on the distribution of contribution rates, by banding contributions together and estimating the probability of being in a given band of contributions, e.g. contributing between 2% and 5% of earnings. We split the distribution of contribution rates into five bands and estimate a

<sup>21</sup> Note that this includes individuals enrolled in a pension scheme prior to the introduction of automatic enrolment.

multinomial logit model of the effect of automatic enrolment on the probability of being in each band. Table 7 shows the estimated effect on employee, employer and total contribution rates.

As well as the large falls in the proportion with no contributions (the mirror image of the increase in membership), there are very large increases in the proportion with low positive contribution rates, on both the employee and employer side. We find that there is an increase of 20.0 percentage points in the proportion of employees contributing between 0% and 1%, compared with a baseline of essentially no one contributing this little in 2012 (as shown in Table 1a). There is a similar increase in the proportion of employees receiving an employer contribution of between 0% and 1%. The minimum default of 1% of qualifying earnings as employer contribution (2% total contribution) has led to a very large increase in the proportion saving small amounts through a workplace pension.

However, Table 7 also shows that, on both the employee and employer side, automatic enrolment has caused a large increase in the proportion of employees saving well over the minimum contribution rates. Not only is there an increase in the proportion with employee contributions of 1% to 2% (6.0 percentage points), but there is also a significant 5.6 percentage points increase in the proportion with employee contributions of 2% to 5% of earnings. On the employee side, this means that individuals are not responding to the default minimum by reducing their contributions towards it, as is found by Madrian and Shea (2001). Instead, there is an increase in the proportion making contributions that are much higher than the minimum.

This is an important result, because one of the worries about the introduction of automatic enrolment is the fact that it has (in some introductions) led to some people saving less, prompting calls for other policies such as auto-escalation (see Benartzi and Thaler (2013)). Although our results do not rule out this behaviour, they show that if it is present then the lower saving is more than outweighed by the effect of employers and employees contributing more than the minimum. One reason for this could be the fact that employers are enrolling their employees automatically into schemes with much higher employer contribution rates than the minimum and that they also have higher minimum employee contributions. Indeed, there are also significant impacts of automatic enrolment on the proportion of eligible

employees who are receiving 2% to 5% in employer contribution (6.5 percentage points ) and even on the proportion with employers contributing 5% or more (4.1 percentage points).<sup>22</sup>

One reason for the increase in contributions that are well above the statutory minimum could be that employers are introducing automatic enrolment with the long-run minimum contribution rates (which will be in place from 2019 onwards) of a total of 8% of qualifying earnings. To investigate this possibility, we create bands of contribution rates as a fraction of *qualifying* earnings and estimate the effect of automatic enrolment on the probability of being in each band using a multinomial logit model. The results are shown in Table 8. Looking in particular at the total contributions, automatic enrolment has led to an increase of 5.2 percentage points in the proportion of individuals receiving more than the long-run minimum levels of contributions (‘Above 8.1%’).<sup>23</sup> This means that the increase in contributions that are well above the statutory minimum is not simply explained by employers choosing to move straight to the long-run minimum contribution rates.

**Table 8. Effect of automatic enrolment on distribution of contributions to workplace pensions as a percentage of qualifying earnings, among eligible employees**

<i>Contribution as % of qualifying earnings</i>	<i>Employee</i>		<i>Employer</i>		<i>Contribution as % of qualifying earnings</i>	<i>Total</i>	
	<i>Effect</i>	<i>Standard error</i>	<i>Effect</i>	<i>Standard error</i>		<i>Effect</i>	<i>Standard error</i>
0%	-0.335***	[0.019]	-0.373***	[0.017]	0%	-0.393***	[0.016]
Up to 1.1%	+0.159***	[0.019]	+0.175***	[0.021]	Up to 2.1%	+0.191***	[0.020]
1.1% to 5.1%	+0.144***	[0.015]	+0.110***	[0.012]	2.1% to 8.1%	+0.149***	[0.013]
Above 5.1%	+0.033***	[0.011]	+0.089***	[0.012]	Above 8.1%	+0.052***	[0.009]

Note: For the bands with upper and lower contribution rates (e.g. 1.1% to 5.1%), the contributions are strictly greater than the lower value and weakly less than the higher amount. \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated using a multinomial logit model by maximum likelihood including control variables (*X*, listed in Table A6). Standard errors are estimated by bootstrapping the average marginal effect of automatic enrolment 250 times, while clustering at the employer level. Number of observations: 452,212. Number of clusters (employers): 64,428.

Source: Authors’ calculations using the Annual Survey of Hours and Earnings.

<sup>22</sup> These results are robust to estimating the effect using a multinomial probit model (rather than a multinomial logit model). Although it is not possible to estimate a multinomial probit model with four or five outcomes on these data, it is possible to do so with only three outcomes. In Appendix Table A7, we compare the results of a multinomial logit and multinomial probit model and find that our results are robust to using a multinomial probit model instead.

<sup>23</sup> The long-run minimum contribution rate is 8% of qualifying earnings. We allow for a very small amount of potential measurement error in the contributions, and so look at thresholds of 8.1% (rather than 8%), 5.1% rather than 5%, etc.

As mentioned in Section I, one reaction of employers to automatic enrolment could be to reduce the employer contributions of newly-hired employees. In Table 9, we estimate the effect of automatic enrolment on individuals who have worked for their employer for less than a year. Among employees in firms with automatic enrolment who had worked for their employer for less than a year, 70% were hired after their employer's staging date. The results in Table 9 confirm that automatic enrolment caused a large fall in the proportion of people with no contributions (larger than the effect for all eligible employees) and that there was a larger impact of automatic enrolment on increasing the proportion with very low contributions. However, automatic enrolment also led to sizeable increases in the proportion of employees contributing more than 2% (and more than 5%) of salary and in the proportion receiving higher employer contributions too. This means that, if some newly-hired employees were offered lower employer contributions than before, this is more than offset by other individuals receiving higher employer contributions than mandated by the legislation. This is true even when looking at those who might be most likely to receive lower employer contributions – employees aged 22–29, earning less than median earnings, who have worked for their firm for less than a year (not shown in the table).

**Table 9. Effect of automatic enrolment on distribution of contributions to workplace pensions among eligible employees who have worked for their employer for less than a year**

<i>Contribution rate</i>	<i>Employee</i>		<i>Employer</i>		<i>Contribution rate</i>	<i>Total</i>	
	<i>Effect</i>	<i>Standard error</i>	<i>Effect</i>	<i>Standard error</i>		<i>Effect</i>	<i>Standard error</i>
0%	-0.390***	[0.024]	-0.442***	[0.021]	0%	-0.471***	[0.021]
0% to 1%	+0.258***	[0.026]	+0.258***	[0.026]	0% to 2%	+0.300***	[0.029]
1% to 2%	+0.051***	[0.010]	+0.054***	[0.011]	2% to 5%	+0.086***	[0.014]
2% to 5%	+0.053***	[0.014]	+0.078***	[0.013]	5% to 10%	+0.060***	[0.011]
5%+	+0.029***	[0.007]	+0.052***	[0.011]	10%+	+0.027***	[0.009]

Note: For the bands with upper and lower contribution rates (e.g. 1% to 2%), the contributions are strictly greater than the lower value and weakly less than the higher amount. \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated using a multinomial logit model by maximum likelihood including control variables (*X*, listed in Table A6). Standard errors are estimated by bootstrapping the average marginal effect of automatic enrolment 250 times, while clustering at the employer level. Number of observations: 147,834. Number of clusters (employers): 23,241.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table 10. Effect of automatic enrolment on distribution of contributions to workplace pensions among eligible employees, by pay quartile of the industry in 2012**

<i>Employer contribution rate</i>	<i>Lowest-pay industries (1<sup>st</sup> quartile)</i>	<i>2<sup>nd</sup> quartile</i>	<i>3<sup>rd</sup> quartile</i>	<i>Highest-pay industries (4<sup>th</sup> quartile)</i>
0%	-0.522*** [0.049]	-0.456*** [0.014]	-0.376*** [0.015]	-0.175*** [0.017]
0% to 1%	+0.348*** [0.043]	+0.222*** [0.014]	+0.156*** [0.021]	+0.048*** [0.009]
1% to 2%	+0.051*** [0.018]	+0.075*** [0.008]	+0.074*** [0.008]	+0.035*** [0.006]
2% to 5%	+0.068*** [0.022]	+0.085*** [0.008]	+0.077*** [0.008]	+0.048*** [0.008]
5%+	+0.055*** [0.015]	+0.074*** [0.010]	+0.068*** [0.011]	+0.043*** [0.012]
Number of observations	76,973	120,013	123,709	131,701
Number of clusters	9,616	20,062	22,283	14,362

Note: For the bands with upper and lower contribution rates (e.g. 1% to 2%), the contributions are strictly greater than the lower value and weakly less than the higher amount. Industry is defined by three-digit SIC (2007) code, subject to some being aggregated together, and a small number being disaggregated to the four-digit level. There are 210 industries in the private sector under this definition. Pay quartile is based on the median pay of employees in the industry in 2012. \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated using a multinomial logit model by maximum likelihood including control variables (*X*, listed in Table A6). Standard errors (shown in square brackets) are estimated by bootstrapping the average marginal effect of automatic enrolment 250 times, while clustering at the employer level.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

One way to try to understand these results (of finding that automatic enrolment leads to increases in the proportion of employees with higher employer contribution rates) is to look at whether this effect is heterogeneous across different employees. In Table 10, we split employees into four groups, based on the median level of pay in their industry in 2012. We define industry using three-digit Standard Industrial Classification (2007) codes, leaving us with 210 industries.<sup>24</sup> Table 10 shows that the fall in the proportion of employees with no employer contribution is larger in low-paying industries and that the rise in the proportion with employer contributions of 0% to 1% is much higher in low-paying industries. There are also still large increases in the proportion of employees in lower-paying industries who are automatically enrolled into pension schemes with higher employer contributions. However,

<sup>24</sup> There are a few exceptions: we aggregate some small industries together, and we disaggregate very large ones using the four-digit SIC code.

of the people brought into a pension scheme by automatic enrolment, they are much more likely to be enrolled in a scheme with a higher employer pension contribution rate if they are in a high-paying industry. This may be because high-paying industries are much more likely to have had higher pension membership rates prior to automatic enrolment, meaning that automatic enrolment is a lower additional cost for them (as a proportion of their labour costs) and so they are less likely to default people into a scheme with the minimum employer contribution as a way of limiting the cost of the scheme.

**Table 11. Change in distribution of employer contributions for employees who start the period in a pension and remain with the same employer for 3 years (2012–15 and 2009–12)**

<i>Employer contribution rate</i>	<i>Employees in pension in 2012 who are with same employer in 2015</i>		<i>Employees in pension in 2009 who are with same employer in 2012</i>	
	<i>2012</i>	<i>2015</i>	<i>2009</i>	<i>2012</i>
Not in a pension	NA	2.9%	NA	9.8%
0%	2.5%	1.7%	3.2%	2.0%
0% to 1%	0.6%	1.2%	0.9%	0.4%
1% to 2%	1.9%	2.1%	1.7%	1.5%
2% to 5%	18.6%	17.3%	18.4%	14.9%
5% to 10%	30.3%	29.8%	26.8%	27.9%
10%+	46.2%	45.2%	49.0%	43.5%
Number of observations	20,282	20,282	25,558	25,558

Note: The left-hand panel shows the distribution of employer pension contribution rates in 2012 and 2015 for those who were in a pension in 2012 and still with the same employer in 2015. The right-hand panel is the equivalent for those in a pension in 2009 who remained with their employer until at least 2012.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

Finally, another way that firms may have reacted to automatic enrolment is to reduce the amount of employer contributions to those already in a workplace pension scheme. To investigate this possibility, Table 11 takes the sample of people in ASHE who are in a workplace pension scheme in 2012 (before auto-enrolment) and are still working for the same firm in 2015. We restrict attention to firms that have introduced automatic enrolment by 2015. We then compare the distribution of pension contributions of these same people in 2012 and 2015. For a benchmark, we undertake the same exercise between 2009 and 2012, before automatic enrolment was introduced. We do not find any evidence of employers reducing the generosity of employer pension contributions to already-enrolled employees, particularly when the fact that 3% of them are no longer enrolled in a pension is accounted

for. This case is strengthened when comparing with the 2009 to 2012 benchmark, which saw falls in the proportion of people receiving higher contribution rates. Therefore we do not find any evidence of employers reducing their employer contributions to existing pension scheme members in response to automatic enrolment.

Table 12 undertakes the equivalent exercise for employee contribution rates. It finds rising proportions with higher employee contribution rates between 2012 and 2015 compared with falling proportions between 2009 and 2012.

**Table 12. Change in distribution of employee contributions for employees who start period in a pension, and remain in the same employer for 3 years (2012-2015 & 2009-2012)**

<i>Employee contribution rate</i>	<i>Employees in pension in 2012 who are with same employer in 2015</i>		<i>Employees in pension in 2009 who are with same employer in 2012</i>	
	<i>2012</i>	<i>2015</i>	<i>2009</i>	<i>2012</i>
Not in a pension	NA	2.9%	NA	9.8%
0%	15.0%	6.3%	13.9%	13.6%
0% to 1%	0.9%	1.9%	1.0%	0.8%
1% to 2%	4.5%	4.1%	5.2%	3.7%
2% to 5%	38.0%	36.9%	40.4%	32.4%
5% to 10%	39.0%	42.7%	36.9%	37.2%
10%+	2.5%	5.1%	2.6%	2.6%
Number of observations	20,282	20,282	25,558	25,558

Note: The left-hand panel shows the distribution of employee pension contribution rates in 2012 and 2015 for those who were in a pension in 2012 and still with the same employer in 2015. The right-hand panel is the equivalent for those in a pension in 2009 who remained with their employer until at least 2012.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

*c) Effects of automatic enrolment on non-eligible employees*

Automatic enrolment potentially has impacts on those who are not eligible for automatic enrolment, for two main reasons. First, as described in Section II, those who are ineligible for automatic enrolment but earn at least £5,824 per year (known as the lower earnings limit or LEL) can ask to be enrolled in a pension. They may want to do so (even if they did not want to prior to automatic enrolment) as peer effects have been shown to influence pension plan participation (Duflo and Saez 2002), so increased participation of eligible workers might encourage non-eligible workers to ask their employers to enrol them in a scheme. Second, employers automatically enrol employees when they are eligible and employees could continue to participate even if they are no longer formally eligible. Although this is not a



possible mechanism for some groups of ineligible employees – specifically those who have not yet worked for the employer for 3 months and those who are aged under 22 – it may be important for those who have variable earnings and are automatically enrolled because at some point they earn over the earnings threshold. Third, employers can decide to enrol automatically employees who are not ‘eligible’ for automatic enrolment under the legislation.<sup>25</sup> There are a number of reasons that employers might do this, such as a paternalistic desire to provide pensions to all staff, including low earners, or to reduce the administrative burden of monitoring whether staff do or do not earn over the earnings threshold in each pay period.

Table 13 shows the effect on different non-eligible groups, by estimating equation (1) on non-eligible groups from 2011 to 2015. For the first four rows of the table, we select those who are non-eligible for only one reason (such as being too young, but who would otherwise be eligible). The last row includes employees ineligible for automatic enrolment for any reason.

**Table 13. Effect of automatic enrolment on pension membership rates of private sector employees who are not eligible for automatic enrolment (for those who earn at least the LEL)**

<i>Non-eligible group for automatic enrolment</i>	<i>Effect</i>	<i>Standard error</i>	<i>N</i>	<i>Number of clusters</i>	<i>Membership rate of eligible employees in:</i>	
					<i>2012</i>	<i>2015</i>
0 to 2 months’ job tenure	+0.203***	[0.017]	9,478	5,915	10.5%	32.8%
Aged under 22	+0.059***	[0.013]	18,476	7,719	11.1%	19.5%
Aged over state pension age	+0.087***	[0.016]	11,567	4,253	29.2%	38.8%
Under earnings threshold	+0.281***	[0.022]	51,059	14,971	18.4%	52.1%
All not eligible	+0.178***	[0.013]	110,554	31,387	14.7%	35.6%

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. All models estimated by OLS including control variables (*X*, listed in Table A6). Standard errors clustered at the employer level. Analysis restricted to those earning at least the lower earnings limit in the year they are observed.

Source: Authors’ calculations using the Annual Survey of Hours and Earnings.

Table 13 shows that there are significant spillover effects of automatic enrolment onto groups that are not eligible for automatic enrolment under the government rules. Auto-enrolment increases participation rates by 20 percentage points for people who have not yet worked for

<sup>25</sup> For example, the UK Civil Service Pension Scheme is enrolling all employees automatically, irrespective of age or income (<http://www.civilservicepensionscheme.org.uk/media/30016/automatic-enrolment-factsheetv3-230812.pdf>). Note that this is part of the public sector, so not included in the analysis here.

their employer for 3 months and by 28 percentage points for those earning under the earnings threshold. The spillovers on those aged above and below the age cut-offs are smaller, but still sizeable, with auto-enrolment increasing pension membership by 6 percentage points for individuals who are aged under 22 and by 9 percentage points for those over the state pension age. All of these effects are statistically significant at the 1% level. Taking all non-eligible private sector employees together (who earn at least £5,824 per year), the effect is to increase pension participation by 18 percentage points.<sup>26</sup>

The fact that there are large spillover effects of automatic enrolment on the pension participation rates of non-eligible workers is both interesting and important, even though we cannot distinguish the exact mechanism that is causing it at the moment. If it is that these employees are asking to participate, it cannot be that procrastination was causing them not to enrol previously. However, it could be because the decision is now less complex, because of the endorsement factor or in order to receive the employer contribution. Given that there is evidence of employees not enrolling in pension schemes even when there are no mandatory employee contributions (see Benartzi and Thaler (2007)), it might be unlikely that employees asking to participate is the major driver of this impact.

On the other hand, it could be that employers are choosing to enrol their non-eligible employees automatically into a pension scheme, even though this will come at some cost to the employer. This would be more evidence of firms choosing to pay more in pension remuneration than is mandated by the legislation introducing automatic enrolment. One piece of evidence for this is that, when looking at the effect of automatic enrolment on employer contributions of non-eligible employees, the proportion of employees receiving more than 1% contribution rose by 5 percentage points, suggesting that many of those who are participating are receiving more than the minimum contribution.

By estimating the impact of automatic enrolment on the total pension contributions of non-eligible private sector employees, we can estimate the impact that the spillovers of automatic enrolment have on total pension saving (in the same way as was done for eligible employees in Section Vb). Given that the spillover effect increases non-eligible employees' contributions by £0.80 per week (see Table A5) and we estimate there are 3.4 million non-

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<sup>26</sup> We do not look at the effect on those earning less than £5,824 per year. This is because historically, the ASHE data have captured those employees earning under the LEL relatively poorly. For more details, see Adam et al. (forthcoming).

eligible private sector employees working for employers who had introduced automatic enrolment by April 2015, this implies the spillover effects increase pension saving by £0.1 billion per year. In addition to the effect on eligible employees, automatic enrolment has increased private sector pension saving by around £2.5 billion per year by April 2015.

## **VI. Conclusion**

With concerns about undersaving for retirement across the developed world, there is intense interest amongst economists and policymakers regarding policies that can boost saving for retirement. This paper has studied the first nationwide introduction of automatic enrolment in which employers are obliged to enrol employees into a workplace pension scheme, which employees can then choose to leave if they wish. We exploit the roll-out of the obligation in the United Kingdom for employers to enrol their eligible employees automatically into a pension between 2012 and 2015 to estimate the effect of automatic enrolment on saving in a workplace pension.

We find that the introduction of automatic enrolment substantially increases the probability of participation in a workplace pension scheme, by 37 percentage points. In 2015, after automatic enrolment had been introduced, the workplace pension membership rate for private sector employees who were eligible to be enrolled automatically reached 88%. The largest effects on pension membership were seen for those with the lowest membership rates prior to automatic enrolment: those in their 20s, lower-paid employees and those who have joined their employer more recently.

These increases in pension membership have led to large increases in saving in a workplace pension by employees eligible for automatic enrolment, on average increasing the total workplace pension contribution rate (expressed as a percentage of earnings) by 1.05 percentage points, compared with a pre-reform average of 7.0%. This effect is large in part because a large fraction of employers are making employer contributions above the minimum mandated under the automatic enrolment legislation. While the proportion of employees receiving between 0% and 1% of earnings as an employer contribution rose by 21 percentage points, the fraction receiving more than 2% rose by 11 percentage points.

These are effects that cannot be estimated by studying the voluntary introduction of automatic enrolment. They show that how employers respond to the obligation to enrol their employees automatically has an important impact on the policy's effectiveness at boosting

pension saving. We find no evidence of employers responding to automatic enrolment by reducing the employer contributions to newly-hired employees or to employees who were participating in a workplace pension scheme prior to the introduction of automatic enrolment. We also find important evidence that the policy has led to large increases in the participation rate of employees who are not eligible for automatic enrolment, by 18 percentage points on average, probably driven by employers deciding to enrol non-eligible employees automatically as well as eligible employees. Overall, we estimate that the impact of automatic enrolment has been to boost private sector saving in a workplace pension by around £2.5 billion per year by April 2015, with this figure very likely to rise as the policy continues to be rolled out to affect smaller employers.

There are a number of further considerations when understanding the impact of automatic enrolment on saving for retirement. First, in 2018 and 2019, minimum contribution rates (from employees and employers) will be increased to reach a total of 8% of qualifying earnings (of which 3% from the employer). While many employees are already making contributions above this ‘long-run’ minimum level, for some employees the change will lead to higher employee contributions – which could potentially lead to higher fractions of employees deciding to leave their workplace pension scheme (particularly if individuals are credit constrained or if they feel the larger increase in the employee contribution is not worth the employer contribution they would receive as a result) – and to higher employer contributions, which could lead to employers taking action to mitigate the rise in employer costs.

Second, this paper does not consider where the incidence of higher employer contributions (caused by automatic enrolment) falls. By increasing employer pension contributions, automatic enrolment increases the cost of employing labour. We have no evidence of employers reducing their offer of pension contributions in response. Other responses could be for employers to reduce wages and salaries or reduce employment (both of which would also reduce the employer’s payroll taxes), to increase prices, or for the higher labour cost to depress firms’ profits. Indeed, 18% of employers surveyed by the Department for Work and Pensions (2016a) reported that they had had lower wage increases in response to automatic enrolment. But analysis of this is outside the scope of the present paper.

Third, this paper only looks at the effect of saving through a workplace pension. It is possible that increases in saving in a workplace pension are offset by reduced saving elsewhere,

principally in ‘personal pensions’ (pensions arranged completely independently of the employer), or in other savings accounts or assets. However, given that one of the reasons that automatic enrolment is thought to increase pension saving is procrastination (which leads to people not joining in the absence of automatic enrolment and not leaving once they are enrolled), we may not think that many individuals are ‘active’ enough to reduce their other saving in reaction to automatic enrolment (as is found by Chetty et al. (2014)).

Nevertheless, this paper has shown that the UK’s implementation of automatic enrolment has so far led to substantial increases in workplace pension participation and saving. This is likely to lead to many individuals having higher levels of private resources for retirement than they would have had in the absence of this policy.

## Appendix

**Table A1. Staging dates for introduction of automatic enrolment for employers**

<i>PAYE scheme size in April 2012</i>	<i>Staging date</i>
120,000 or more	1 October 2012
50,000–119,999	1 November 2012
30,000–49,999	1 January 2013
20,000–29,999	1 February 2013
10,000–19,999	1 March 2013
6,000–9,999	1 April 2013
4,100–5,999	1 May 2013
4,000–4,099	1 June 2013
3,000–3,999	1 July 2013
2,000–2,999	1 August 2013
1,250–1,999	1 September 2013
800–1,249	1 October 2013
500–799	1 November 2013
350–499	1 January 2014
250–349	1 February 2014
160–249	1 April 2014
90–159	1 May 2014
62–89	1 July 2014
61	1 August 2014
60	1 October 2014
59	1 November 2014
58	1 January 2015
54–57	1 March 2015
50–53	1 April 2015
40–49	1 August 2015
30–39	1 October 2015
Fewer than 30	1 June 2015 to 1 July 2017
New employers (no PAYE income payable by April 2012)	1 May 2017 to 1 February 2018

Note: The staging dates for employers with fewer than 30 employees in April 2012 are based on the last digits of their PAYE reference number. The staging dates of ‘new employers’ are based on when they first had PAYE income payable.

Source: <http://www.nowpensions.com/auto-enrolment-staging-dates>.

**Table A2. Date with reference to which employers complete the ASHE form**

<i>Year</i>	<i>Reference date</i>
2009	22 April
2010	21 April
2011	13 April
2012	18 April
2013	17 April
2014	9 April
2015	22 April

Source: ASHE documentation,

<http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/method-quality/specific/labour-market/annual-survey-of-hours-and-earnings/annual-survey-of-hours-and-earnings/index.html>.

**Table A3a. Characteristics of eligible private sector employees working for employers with 58 or more employees in 2012**

<i>Characteristic</i>	<i>Percentage with each characteristic</i>
Male	60.7%
Works for non-profit institution	11.5%
Works full-time	89.1%
Job is second job	0.4%
Temporary job	4.3%
<b>Industry (based on SIC2007)</b>	
Manufacturing	15.7%
Retail & wholesale	20.4%
Transport & storage	7.3%
Accommodation & food services	4.3%
Information & communications	5.7%
Finance & insurance	6.9%
Mining, electricity & gas	1.9%
Professional, science & technology	7.0%
Administrative & support	7.1%
Education	7.4%
Health	7.0%
Other	9.4%
<b>Age (banded)</b>	
22 to 29	20.9%
30 to 39	25.8%
40 to 49	27.9%
50 to state pension age	25.4%
<b>Years working for employer</b>	
<1 year	9.9%
1 to 2 years	11.4%
2 to 5 years	24.2%
≥5 years	54.4%

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table A3b. Further characteristics of eligible private sector employees working for employers with 58 or more employees in 2012**

<i>Characteristic</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>Median</i>	<i>N</i>
Gross weekly pay (£)	559.56	345.99	459.62	68,970
Member of workplace pension	0.49	0.50	0	68,970
Member of DB pension	0.18	0.38	0	68,970
Employee contribution rate to pension (% of earnings)	2.06	2.95	0	68,285
Employer contribution rate to pension (% of earnings)	4.94	7.09	0	68,285
Total contribution rate to pension (% of earnings)	7.00	9.20	0	68,285
Age (years)	40.71	11.14	41	68,970
Job tenure (months)	97.72	97.69	66	68,970

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table A4. Sample sizes: number of eligible private sector employees observed in each 'employer size group' in each year, 2011 to 2015**

<i>Year</i>	<i>Number of employees in employer in April 2012:</i>						
	<i>30,000+</i>	<i>6,000 to 29,999</i>	<i>350 to 5,999</i>	<i>160 to 349</i>	<i>58 to 159</i>	<i>50 to 57</i>	<i>5 to 49</i>
2011	8,162	13,933	29,118	7,913	10,267	1,472	19,201
2012	8,207	14,607	28,730	7,479	9,947	1,470	18,403
2013	8,439	14,517	30,267	7,844	10,200	1,499	18,925
2014	9,790	14,456	30,682	8,039	10,503	1,563	19,184
2015	8,314	14,237	29,309	7,847	10,451	1,680	20,788

Source: Authors' calculations using the Annual Survey of Hours and Earnings.



**Table A5. Effect of automatic enrolment on mean pension contributions (£ per week), for eligible and non-eligible (earning above the LEL) private sector employees**

<i>Contributions (£ per week, 2015 prices)</i>	<i>Effect of auto-enrolment</i>	<i>Standard error</i>	<i>N</i>	<i>Number of clusters</i>	<i>Mean weekly contributions in 2012</i>
<b>Eligible</b>					
Employee	2.18***	[0.42]	452,212	64,428	£15.16
Employer	2.12***	[0.77]	452,212	64,428	£37.33
Total	4.31***	[0.85]	452,212	64,428	£52.49
<b>Not eligible</b>					
Employee	0.30***	[0.08]	110,554	31,387	£1.07
Employer	0.50***	[0.15]	110,554	31,387	£2.66
Total	0.80***	[0.19]	110,554	31,387	£3.73

Note: \*\*\* denotes that the effect is significantly different from zero at the 1% level, \*\* at the 5% level and \* at the 10% level. Estimated by OLS including control variables (*X*, listed in Table A6). Standard errors clustered at the employer level. Non-eligible employees are restricted to those earning over the LEL. Contributions are expressed in 2015 prices. Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table A6. Effect of automatic enrolment on workplace pension membership among eligible employees: OLS regression results**

<i>Independent variable</i>	<i>Effect</i>	<i>Standard error</i>	<i>P value</i>
Auto-enrolment (AE) in place	0.361	[0.016]	0.000
AE partially introduced (2013)	0.067	[0.020]	0.001
AE partially introduced (2014)	0.170	[0.010]	0.000
AE partially introduced (2015)	0.204	[0.015]	0.000
Year is 2012	-0.007	[0.003]	0.017
Year is 2013	-0.004	[0.007]	0.596
Year is 2014	0.002	[0.005]	0.614
Year is 2015	0.032	[0.006]	0.000
Employer size: 6,000 to 29,999	-0.043	[0.043]	0.314
Employer size: 350 to 5,999	-0.037	[0.042]	0.384
Employer size: 160 to 349	-0.075	[0.043]	0.077
Employer size: 58 to 159	-0.137	[0.043]	0.001
Employer size: 50 to 57	-0.200	[0.045]	0.000
Employer size: 5 to 49	-0.280	[0.044]	0.000
Male	0.009	[0.003]	0.001
Age	-0.008	[0.005]	0.153
Age squared	0.000	[0.000]	0.000
Age cubed	0.000	[0.000]	0.000
Non-profit institution	0.091	[0.008]	0.000
Full-time job	0.034	[0.006]	0.000
Non-main job	-0.146	[0.013]	0.000
Temporary job	-0.079	[0.010]	0.000
North West	0.010	[0.009]	0.244
Yorkshire and the Humber	0.003	[0.010]	0.730
East Midlands	0.017	[0.010]	0.100
West Midlands	0.008	[0.010]	0.382
South West	0.032	[0.009]	0.000
East	0.034	[0.009]	0.000
London	0.033	[0.009]	0.000
South East	0.048	[0.009]	0.000
Wales	0.024	[0.012]	0.040
Scotland	0.040	[0.009]	0.000
Industry: retail & wholesale	-0.134	[0.013]	0.000
Industry: transport & storage	-0.035	[0.019]	0.057
Industry: accommodation & food services	-0.206	[0.012]	0.000
Industry: information & communications	-0.030	[0.014]	0.028
Industry: finance & insurance	0.070	[0.016]	0.000
Industry: mining, electricity & gas	0.103	[0.021]	0.000
Industry: professional, science & technology	-0.029	[0.010]	0.003
Industry: administrative & support	-0.167	[0.014]	0.000
Industry: education	-0.028	[0.011]	0.013
Industry: health	-0.113	[0.013]	0.000

Industry: other services	-0.119	[0.011]	0.000
Industry: other – not services	-0.110	[0.009]	0.000
Occupational group: professionals	0.061	[0.005]	0.000
Occupational group: associated professionals	0.012	[0.005]	0.017
Occupational group: administrative/secretarial	-0.017	[0.005]	0.001
Occupational group: skilled trades	-0.093	[0.006]	0.000
Occupational group: caring/leisure	-0.171	[0.012]	0.000
Occupational group: sales/customer service	-0.115	[0.008]	0.000
Occupational group: plant and machinery	-0.145	[0.008]	0.000
Occupational group: elementary occupations	-0.143	[0.008]	0.000
Job tenure: 1 to 2 years	0.036	[0.003]	0.000
Job tenure: 2 to 5 years	0.072	[0.003]	0.000
Job tenure: 5 years or more	0.181	[0.004]	0.000
Constant	0.399	[0.063]	0.000

Note: Estimated by OLS with standard errors clustered at the employer level. This regression model uses private sector employees eligible for automatic enrolment, excluding those working for employers with 1 to 4 employees in 2012. Years included: 2011 to 2015. Number of observations: 457,443. Omitted categorical variables: year = 2011, employer size = 30,000+, region = North East, industry = manufacturing, occupation group = managerial, job tenure = less than 1 year. Industry is measured using Standard Industrial Classification 2007 (main letter). Occupational group is measured using Standard Occupational Classification 2010 (one-digit).

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

**Table A7. Effect of automatic enrolment on pension contribution rates, estimated by multinomial logit and multinomial probit models**

<i>Contribution rate</i>	<i>Effect on employee contribution</i>		<i>Effect on employer contribution</i>		<i>Contribution rate</i>	<i>Effect on total contribution</i>	
	<i>Mlogit</i>	<i>Mprobit</i>	<i>Mlogit</i>	<i>Mprobit</i>		<i>Mlogit</i>	<i>Mprobit</i>
0%	-0.330	-0.332	-0.367	-0.362	0%	-0.386	-0.380
0% to 1%	+0.201	+0.208	+0.207	+0.209	0% to 2%	+0.240	+0.241
1%+	+0.128	+0.125	+0.160	+0.153	2%+	+0.146	+0.139
0%	-0.350	-0.347	-0.376	-0.370	0%	-0.398	-0.386
0% to 2%	+0.280	+0.280	+0.273	+0.277	0% to 5%	+0.331	+0.322
2%+	+0.069	+0.067	+0.103	+0.094	5%+	+0.067	+0.063

Note: These are the results of estimating equation (1) by maximum likelihood using multinomial logit and multinomial probit models. 'Mlogit' refers to the results of a multinomial logit model and 'Mprobit' refers to the results of a multinomial probit model. For the bands with upper and lower contribution rates (e.g. 0% to 1%), the contributions are strictly greater than the lower value and weakly less than the higher amount. Standard errors have not yet been produced for these results.

Source: Authors' calculations using the Annual Survey of Hours and Earnings.

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