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Pension Shocks and Wages

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Abstract
How do wages respond to firm-level idiosyncratic cost shocks? We create a unique dataset that links longitudinal data on workers' compensation to the unexpected costs that UK firms have been forced to pay to plug large deficits in their legacy defined benefit pension plans. We show that firms are able to share the burden of such costs when a significant share of their workers are current or former members of the plan. We also investigate how compensation responds to the closure of defined benefit plans to future benefit accrual. We find that firms are able to use such closures to effectively reduce total compensation of workers who are plan members. These results point to significant frictions in the labour market, which we show are a direct result of the pension arrangement that workers have. Closing schemes has an implicit cost for firms since it reduces the frictions that workers face.

Key words: wages, pensions, frictions
JEL: J31; J32; G32

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1. Introduction

There is a growing body of academic work that examines the impact of firm-specific shocks on wages. In almost all cases, this evidence relates to shocks to demand or profitability that are thought to be plausibly exogenous for wages. There is, for example, a large literature in labour economics that has focused on the link between firm profitability and wages, often understood within a rent-sharing context. Van Reenen (1996) shows that firms that innovate pay higher wages, with innovation being viewed as a good instrument for rents. In a similar vein, Kline, Petkova, Williams and Zidar (2017) show that firms that generate ex-ante valuable patents – relative to a control group of rejected patent applicant firms – share some of the surplus with workers. On average, workers capture 29 cents of every dollar of patent-induced surplus. Using a different identification approach, Garin and Silverio (2017) examine how sensitive wages are to idiosyncratic export demand shocks using Portuguese matched worker-firm data. They find that a shock that reduces a firm's value-added by 10 percent reduces the wages of incumbent workers by 1.5 percent. They additionally show that these effects are stronger in industries with longer worker tenure and lower turnover rates, suggesting that mobility frictions may be an important explanation for these findings.

This paper adds to the literature by focusing instead on a firm-specific cost shock – specifically, a shock to non-wage employment costs. On average, the non-wage elements of compensation account for around 20% of total worker remuneration.[1] The components of these additional costs differ across countries and over time, but key elements include employer pension contributions, private healthcare and employment taxes. The focus of this

[1] In 2016, non-wage labour costs represented 17.3% of total compensation in the UK, 18.9% in the US, and 22.2% in the Eurozone (source: OECD).

paper is on how unexpected shocks to the level of one of those non-wage components of labour cost are borne by the firm and the workers. Importantly, this cost shock differs dramatically across firms and is independent of current employment and wages as it arises from historical commitments that firms made.

The context for our analysis is the dramatic shift in private pension provision and the pension-related costs of UK firms over the last two decades. Pensions can essentially be divided into two types: defined benefit (DB) and defined contribution (DC). DB schemes provide members with a guaranteed lifetime income in retirement, typically a percentage of their final or average salary. DC schemes, on the other hand, are like individual savings accounts, where the size of the pension pot at the time of retirement depends on individual contributions and accumulated returns. Historically, UK firms that provided pensions as part of the remuneration package offered DB schemes. At the start of the 1980s, 97% of workers in the private sector that were active members of an employer pension scheme were in DB schemes. Whilst this figure declined as DC schemes became more commonly available, it was still 81% in 2000. Yet by 2015, it had fallen to 29%. Figure 1 shows these abrupt shifts in terms of the total number of workers. Interestingly, this is an entirely private-sector development – public sector workers have continued to have access to DB schemes, though often the generosity of these schemes has changed. A similarly dramatic move away from DB schemes occurred in the United States (Haverstick, Munnell, Sanzenbacher and Soto, 2010).

What has caused this precipitous fall in DB membership in the private sector since the start of the millennium? The key to understanding this change is to focus on the assets and liabilities of DB schemes. On the asset side, firms (and workers) make ongoing contributions to the scheme that are then invested in a portfolio of assets – typically a mix of equities, bonds and property. The value of the assets thus crucially depends on asset returns. To the extent that such returns are poor, there must be additional contributions from firms and/or workers to achieve a given asset level. On the liabilities side, there are two key elements. First, the longevity of workers affects the cost of the scheme, since workers are guaranteed a stream of income until death. Second, the discount rate affects the calculation of the present value of these liabilities. As the discount rate falls, the present value of liabilities rises – sometimes dramatically.

The last two decades have witnessed a perfect storm in all the elements that make up these calculations. Rising longevity, low interest rates that fell further following the 2008 financial crisis, and long periods of weak equity returns have depressed pension scheme assets and inflated the liabilities. As these market risks tend to be largely unhedged at the pension scheme level, they have led to a steep increase in deficits and, as a result, firms have begun to close their DB schemes. By 2016, 85% of DB schemes were closed to new members and 35% were also closed to future accrual of benefits.

What can firms do under these circumstances? An important point to note is that, as a result of pension fund legislation, firms are unable to renege on the DB commitments historically made to workers, nor are they able to decide for themselves how to deal with the deficit black holes that have developed in the schemes. The rules relating to DB pension plans in the UK are currently governed by the 2004 Pensions Act. A key aim of this Act is to ensure that DB schemes are funded appropriately given the expected value of liabilities and reasonable assumptions regarding asset returns. DB schemes are required to have a formal actuarial valuation every three years. This formal valuation determines the funding level of the scheme that triggers increased contributions by the sponsoring employer if a deficit exists and is unlikely to be eliminated without action. The trustees of the pension scheme must negotiate with the employer to establish a recovery plan. The resulting plan generally involves a sequence of deficit payments over subsequent years, which must satisfy the independent Pension Regulator.

The relative importance of deficit payments can be seen in Figure 2. During the 1990s, the majority of schemes were in surplus and thus required no such payments. On average, only 17% of total contributions were for deficit recovery. Since the start of the 2000s, this has risen to 32% and reached a peak of 42% in 2011. An alternative calculation simply asks how much in total has been spent on deficit contributions since 2000. The data underlying Figure 2 show that this equals £167bn. This steep rise in pension contributions is the main driver behind the sharp increase in the proportion of non-wage labour costs in total compensation that we observe in Figure 3 for the UK since 2000. Whilst these substantial deficit payments must be made by the firm, it is unclear who bears the ultimate burden: the firm, the workers, or both.

Firms can, however, change the future commitments they make, by adopting one of two approaches. First, they can close the DB scheme to new workers – potentially offering them membership of a DC scheme as an alternative. However, workers already in the DB scheme would continue to accrue benefits under the scheme. Second, firms can close the DB scheme completely – to both new and existing workers. All workers could be offered a DC scheme as an alternative and no future accrual of benefits would occur. Although closing the scheme lets the firm avoid making any new DB pension commitments, it still has to honour the commitments already made to current and past workers – it merely avoids making any new ones. There are no legal restrictions on firms following either of these strategies. In practice, most firms have adopted a two-stage approach. In the early 2000s they began to close the DB schemes to new members. As the deficits continued to rise, firms responded by closing the schemes completely to future benefit accruals.[2]

[2] Some firms have also attempted to cap the liabilities related to their past commitments by offering members a cash lump sum to quit the scheme entirely. Others have insured themselves, partly or wholly, against future cost increases by purchasing third-party insurance. These actions are typically expensive, as the regulator mandates a very conservative valuation method for pension liabilities in the context of cash buyouts.

The analysis in this paper therefore focuses on two aspects of pension costs. First, we explore the impact of the deficit payments that firms are required to make to plug the black holes in the schemes on wages. Do current workers bear any of this burden and if they do, what share do they bear? Second, we examine the impact of DB scheme closure on workers' remuneration. In a standard frictionless competitive model, in which workers and firms value pension contributions in the same way, the elimination of employer DB contributions should be matched by either an equivalent rise in DC contributions or a rise in workers' wages. By contrast, a labour market characterized by rent-sharing or by frictions—caused, for example, by firm-specific human capital—will generally not give rise to exactly offsetting changes in other components of compensation. We investigate both the sharing of deficit costs and the impact of scheme closures by constructing a unique dataset that links longitudinal data on workers' compensation to data on the DB pension schemes of UK firms.

The literature provides limited evidence on how individual wages respond to shocks to pensions. Rauh, Stefanescu and Zeldes (2017) examine the second of our two impacts for US firms by focusing on the effect of the freezing of pension benefit accruals on total payroll costs. The authors find that firms are able to achieve net cost savings by closing their DB schemes, suggesting that employees are not fully compensated for the loss of future benefits through higher wages or higher contributions to DC schemes. Whilst we find similar effects for the UK, our paper differs in two important ways. First, we use worker-level data to estimate the effects of pension benefit changes on wages. This allows us to account for personal characteristics and individual components of compensation, rather than rely on the rather crude measure of average firm-level wages available from company accounts. Second, we are able to explore the reasons for this result by providing evidence of substantial frictions in worker mobility generated by the pension arrangements. The closure of schemes is shown to alter these frictions significantly and highlights a potential cost of scheme closure for the firm.

Our paper also complements the limited literature that measures the effect of DB pension contributions on other firm-level outcomes such as investment expenditure and dividends (Rauh, 2006; Phan and Hegde, 2012; Liu and Tonks, 2013; Chaudhry, Au Yong and Veld, 2017; Bunn, Mizen and Smietanka, 2018). We differ in our approach by focusing on wages and combining firm and individual-level data. Our analysis also has similarities with the work of Gruber (1997), whose analysis focused on the wage response to a large exogenous reduction in the payroll tax in Chile. Though the reduction was common across firms, the effective rate that applied differed across firms depending on the type of workers employed. While the legal incidence of the tax fell on employers, Gruber shows that the entire gain from the reduced payroll tax accrued to workers through higher wages. In our setting, the deficit payments required to support DB schemes are legally required to be paid by the firm. However, there is nothing to prevent this cost from being shared ex-post by workers. That is what we investigate in this paper.

The remainder of the paper is structured as follows. In Section 2, we describe the data sources and empirical strategy. Section 3 presents evidence on the impact of the cost shocks on wages, whilst Section 4 investigates how total compensation responds when firms close down pension schemes. In Section 5 we examine the source of the potential labour market frictions that our results imply. Section 6 concludes.

2. Data and Empirical Strategy

Data

We have collected data on pension schemes and payments from the annual reports of 475 UK-listed companies. The sampling frame requires companies to have been amongst the 300 largest UK-domiciled firms ranked by year-end market capitalization at any point over the period from 2000 to 2010. Of the 475 firms, 65% report exposure to at least one UK DB scheme – with the remaining 35% having either no pension exposure or only DC schemes. For each firm with a DB scheme, we collect annual data from the accounts on: (i) total employer contributions, (ii) current service costs, (iii) year-end assets, liabilities and surplus/deficit, (iv) the triennial valuations and (v) scheme closure dates if any. This data has been consistently reported since 2001 when accounting rules were changed to require more detailed reporting of pension exposure. We collect data only on the UK pension exposure rather than the exposure to all schemes, as many firms have DB schemes in other countries. Figure 4 shows that the trends in total DB contributions in our sample follow a similar pattern to those for UK firms as a whole – and account for around one-third of total contributions.

Our wage data for workers comes from the Annual Survey of Hours and Earnings (ASHE). These data are a panel of 1% of employees, sampled randomly based on their unique social security number. The survey is conducted every April and the data are collected directly from employers' payrolls, so they are both reliable and benefit from a high response rate – response is, in fact, legally required. For our purposes the strength of the data is that firms report both gross wages and, since 2005, employer and employee pension contributions – as well as the type of pension scheme paid into. We use data from 2002 to 2016, as 2002 was the first year that a firm identifier was included for each worker, allowing us to match individual wages to the pension data.

To match the wage data for workers to our listed firm sample, we use the Dun and Bradstreet code. Of the 475 listed-firms, we find at least one worker in ASHE for 393 firms. There are two key reasons why we do not match workers for every firm. First, since ASHE is only a 1% sample, firms with small employment levels will frequently not have an employee with the relevant social security number. Second, and more importantly, some firms listed and domiciled in the UK have almost their entire operation outside of the UK. This is particularly true for energy companies. Since ASHE only covers UK workers, such firms' employees will not be in the data. Table 1 provides some summary statistics.

We need a measure of the deficit payments to capture the firm-level cost shock and information on the closure of the pension scheme. The latter is easily identified as most firms report the closure date directly in the annual report. The only difficulty is if firms have multiple UK schemes and close them at different dates. The ASHE data does not allow us to distinguish which particular DB scheme the worker is enrolled in, so we cannot then precisely link the closure of a particular scheme to the individual worker. We take the conservative approach of using the closure date for the final UK scheme if more than one exists.

Firms are not required to separately report regular and deficit contributions, and when they do, the decision on how to classify contributions into the two types is not governed by a specific accounting standard. We therefore define the deficit payments that firms are required to make to their DB schemes as:

Deficit Payment = Total Employer Contributions – Current Service Cost

Current Service Cost is defined as "the increase in the present value of a defined benefit obligation resulting from employee service in the current period" (IAS 19). It therefore represents the current actuarial estimate of the cost of providing a DB scheme for the financial year for the current employees. It excludes the cost of any re-evaluation of the present value of the obligations for previous employees (or previous years of service for current employees). If the scheme has been closed to future accrual, the current service cost is zero. To assess the accuracy of this approach, Figure 5 shows that for the 111 firms in our dataset that do voluntarily break out deficit contributions in their annual report, our measure of deficit payments matches the firms' own classification very closely. Like in firms' own reports, we estimate relatively stable aggregate deficit payments during the early 2000s, followed by a steep rise during the financial crisis and an improvement from 2013 onwards as more firms close their DB schemes. These trends are similar to the aggregate estimates from the national accounts, shown earlier in Figure 2.

Empirical Strategy

Our empirical approach exploits the panel nature of the data to identify the effect of DB deficit cost shocks using within-firm variation over time. We estimate models of the form:

$$y_{ijt} = \alpha_i + \beta_j + \gamma_t + \sum_{k=1}^{2} \delta_k DB\_Deficit\_Payment_{jt-k} + \pi X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where y_{ijt} is a measure of remuneration for individual *i*, in firm *j*, at time *t*. We control for individual- and firm-fixed effects (respectively α_i and β_j), and further report estimates with match fixed-effects. We also allow for common time shocks, γ_t, and a set of other observables, X_{ijt} that control for time-varying individual and firm characteristics. Our parameters of interest, δ_k, measure the effect on the outcome variable of up to two lags of the DB deficit payment measure. To generate a measure that is both comparable across firms and easily interpretable, we deflate the DB deficit payment measure by the initial level of employment. It is therefore a measure of the annual deficit payment per worker, and the distribution of this variable is shown in Figure 6. It is clear that there is substantial variation in this variable across firms.

To assess the effects of scheme closure, we add an indicator variable, ω_t, which equals 1 after the firm's scheme is closed to future accruals, to equation (1). We use either wages, employer contributions, or employee contributions as the dependent variable, y_{ijt}. This enables us to measure how the individual components of employee compensation are affected by the firm's decision to close the scheme.

One potential concern is that the firm's decision to close the scheme may be jointly determined with wages, for instance in response to an external shock. To examine this potential endogeneity, we exploit the panel and allow for the indicator variable to affect y_{ijt} both before and after the actual closure date. Letting t = 0 be the actual closure date, we estimate:

$$y_{ijt} = \alpha_i + \beta_j + \gamma_t + \sum_{k=-4}^{4} \theta_k \omega_{jt+k} + \pi X_{ijt} + \varepsilon_{ijt} \qquad (2)$$

When $k < 0$, the estimated coefficients θ_k measure the impact of future scheme closure on wages or pension contributions and therefore provide evidence on whether elements of compensation have a pre-trend for those firms that close their scheme relative to a control group of firms that do not. For $k \geq 0$, the estimated θ_k measure the impact of actual scheme closure on the components of remuneration. By estimating separate coefficients for each year since closure, we can test whether any effect is immediate and sustained or whether effects grow over time. Rauh et al (2017) account for the potential endogeneity of scheme closure by using a propensity score matching approach to find "equivalent" firms that do not close their DB scheme at the same time. The approach we adopt here is essentially the same since the extensive set of controls in the regression, e.g., time interacted with industry dummies, means that we are comparing treatment and control firms that are similar.

To further address the potential endogeneity of ω_t, we assess whether the impact of DB scheme closure on pension contributions and wages differs for firms at which scheme closure coincides with the triennial actuarial valuation, compared to firms that close their DB schemes at other times. The actuarial valuation happens every three years based on a pre-determined schedule and is the basis for scheme trustees to require additional contributions from the firm. Firms that close their DB scheme in the same year as the valuation are therefore more likely to be doing so in response to exogenous changes in the funding level, rather than as a result of other considerations. This hypothesis is consistent with the cross-sectional findings of Munnell and Soto (2007) from the US, who find that the firm's decision to close the DB scheme is correlated with the underfunding level.

3. Firm-Level Cost Shocks and Wages

We begin our results by examining the effect of the deficits on the hourly wages of workers. We estimate fixed-effect panel wage regressions as in (1), with ln(hourly wages) as the dependent variable. The results are presented in Table 2. As we move across the columns 1 to 4, we include increasingly more controls to test the robustness of the results. Column 5 then uses ln(weekly earnings) as an alternative measure of compensation available in ASHE that takes into account the number of hours worked. Comparing the results across the columns, it is clear that the estimates are similar regardless of which control variables or specifications are used. This supports the contention that the deficit payments are indeed firm-specific shocks that are exogenous to other factors that affect wages. Overall, we find a statistically significant reduction in wages as a result of the deficit payments, suggesting that firms share some of the burden with workers.

We might, however, expect the impact of deficit payments on workers to depend on the extent to which the firm's labour force is exposed to the DB pension scheme. If the legacy costs that are being incurred are partly a result of historic promises made to current workers, it may prove easier for the firm to shift some of the cost burden than if the costs are a result of promises made to workers who are no longer with the firm. This is examined in Table 3. We take two approaches. First, we begin by estimating how the impact differs depending on whether the workers are themselves members of the DB scheme. To do so, we identify two mutually-exclusive groups of workers. The first group are DB members, defined as workers who are currently members of the scheme (active members) or have been members in the past while working at the same firm (deferred members). The second group are workers who have never belonged to the firm's DB scheme. The second approach is to classify firms into those that have large active membership (defined as the proportion of total pension scheme members who are still accruing benefits in the firm being above the median) and firms that have small active membership (i.e. most of the scheme members have retired or are deferred members). The reason for using this approach is that in practice, firms may not be able to set wages differentially for individuals based on their pension membership. Columns 1 to 3 report the results by individual worker pension membership status, while columns 4 to 6 report the results by active membership at the firm level. Each row in the table reports the sum of the coefficients (and associated standard error) on two lags of the DB deficit measure for each type of worker. Again, as we go across the table we include more controls to test the robustness of the results.

Focusing on column (3), which reports the impact on scheme members controlling for match fixed-effects, measures of contemporaneous and lagged firm performance, and industry*year dummies, we find a strongly significant negative effect of the deficit payments on the wages of workers who are DB scheme members. In contrast, there is no impact on non-members. To assess the size of the estimated effect, Table 3 also presents estimates of the “Sharing Rate.” This is calculated for the current members using the mean level of annual deficit payments per worker in the sample (£1,561) and calculated using mean wages and hours. It is therefore an estimate of what proportion of the deficit payment is accounted for by reduced wages for these workers. We estimate a reduction in wages of around £144 per year, implying that these workers pay for about 9% of the deficit costs. The results are similar when we consider the wages of all workers at firms with large active membership. These sharing estimates are on the low-side of those reported using demand shocks which suggest a range of 15-30%. One important factor that differs between these studies is that the cost shock here does not relate to the current activity of the firm but to historic liabilities, whilst shocks to exports or innovation relate more directly to the efforts of the current workforce.

Do these magnitudes seem sensible? One way of addressing this is to compare them with the share of costs that workers in DB schemes commonly pay in accruals. In general, our data show that normal worker contributions to DB schemes account for around 30% of the total normal contributions, i.e., current members pay for around one-third of the normal costs of a DB scheme. So, an estimate of a sharing rate of around 10% for the deficit payments suggests that workers are paying a much lower share of those costs. This is unsurprising, given that many of the beneficiaries of the schemes are no longer with the firm, and in any case the accrued benefits for current workers are protected by law.

4. The Impact of Scheme Closure

We now consider the second type of pension shock, namely the closure of the scheme to future accrual and its impact on the two relevant components of employee remuneration: employer pension contributions and wages. In Table 4, we present estimates of the employer pension contribution rate (as a percentage of gross pay) in which we include a dummy variable that turns on when the DB scheme closes. It therefore measures the long-run change in contribution rates from closing the DB scheme. Note that after the closure the rate can either fall to zero (if the employer decides to no longer offer any pension provision) or to any rate that the employer chooses for a DC scheme.

We distinguish between workers that are exposed to the closure of the scheme and all other workers. In column 1, we define exposed workers simply as members of the DB scheme. In column 2, we define exposed workers as DB scheme members whose employer reported a non-zero DB pension contribution at some point in the past, while in column 3, we restrict this definition further to workers whose employer reported a positive contribution in the year the scheme closed. Overall, we find that employer contributions fall by 6-7 percentage points for scheme members, whilst those not currently exposed to the scheme see no significant change in contribution rates. The last column restricts the group of exposed workers even further to cases where the scheme closed in the year corresponding to the triennial valuation. This is to address potential concerns about the endogeneity of the decision to close the scheme. Here we see a fall in contributions of 14 percentage points as well as a marginally significant negative impact of 3 percentage points on all other workers.

Table 5 reports identical specifications except that we now have log hourly wages as the dependent variable. Given the results in Table 4, we might expect a significant increase in wages for DB members when the scheme is closed to offset the decline in compensation coming from the 6-7% reduction in employer pension contributions[3]. However we can see that regardless of the exact specification used, there is no evidence of any offset in wages – none of the coefficients are statistically different from zero and they are all small in economic

[3] We also estimated models with employee contributions as the dependent variable but these were all insignificant – they are available from the authors upon request.

magnitude. So DB workers see a substantial fall in total compensation when the firm closes down the DB scheme.

Figures 7 and 8 illustrate how the closure of the DB scheme leads to a reduction in employer contributions with no offsetting increase in wages, and show that there is no evidence that this is because of endogeneity of scheme closure. These figures plot employer contributions and wages, respectively, for exposed DB members and all other workers for four years prior to and subsequent to scheme closure. Exposed DB members are defined as those who received a positive contribution from the firm in the year when the scheme closed. The figures show no evidence of trends in pension contributions or wages in the years preceding the closure of the scheme or any differences in remuneration between exposed and non-exposed workers, supporting the interpretation of the results in Tables 4 and 5. We have also examined whether there are different pre-trends in other indicators of firm performance, such as profits, revenue, total employment, for treated and control firms and find no evidence to support such a concern.

5. Frictions and Worker Mobility

Our results thus far point to significant costs being borne by workers who work in firms affected by pension deficits and scheme closures. These costs generally fall on those exposed to the DB scheme and this suggests that frictions for these workers give firms some monopsony power. An obvious source of these frictions is the DB scheme itself. Workers in final salary DB schemes have an incentive to remain with a firm that continues to allow accruals because the pension entitlement generally depends upon the final salary of the worker which will grow both because of inflation and real wage growth. If the worker leaves the firm today, the final salary will be calculated by taking the current salary and uprating to account for inflation only, so any real wage growth effect will be lost. To give a concrete example, suppose a worker aged 40 has accrued 15 years of DB entitlement and will retire at age 65. Her current salary is £50,000 per year and she does not expect future promotions. The DB scheme is final-salary, accrues at the rate of 1/80th per year, inflation is 2% and real wage growth in the economy is 1%. Ignoring future accruals, if the worker leaves today, she will receive a pension of £15,380 per year from age 65 (which is £9,375 in today's prices). If instead she remains, the pension would be £19,629 (£12,023 in today's prices) – and this of course ignores the 25 years of future accrual. This illustrates the increased mobility costs for DB workers compared to otherwise identical workers in a DC scheme, whose pension pay-out is wholly unrelated to their current or future salary.

To assess the importance of these frictions – and how they may change when a scheme is closed – we estimate probit models of worker mobility. We start with the full sample of all workers in ASHE and then focus on the subset of workers in our sample of firms. In panel A of Table 6 we present estimates of the marginal effect of being in a DB scheme on annual mobility in those two samples. All regressions control for age and tenure effects and year and industry dummies. Looking at all workers, being a member of a DB scheme reduces the probability of exit from the firm by around 5 percentage points (compared to a mean exit rate of 24.5% for non-members). Panel B shows that the effects are significantly stronger within our sample of firms, with exit probabilities being about 9% lower for DB members. These results point to substantially lower mobility for those workers who are members of DB schemes. This is in line with earlier results obtained by McCormick and Hughes (1984) and Haverstick et al. (2010) in the US, and Disney and Emmerson (2002) in the UK. It is consistent with the lock-in hypothesis and helps us to understand how firms can impose some of the deficit costs on these workers.

What happens when the firm closes the scheme to future accruals? In the example above, the worker no longer gets the added benefit of the real wage growth effect because when a scheme is closed, final salaries are computed using the salary at closure date and subsequently uprated only by inflation. There is now no lock-in effect – the workers DB pension pay-out is identical whether the worker stays or leaves the firm - and we might expect to see increased mobility for DB members. Panel A of Table 7 shows that this is exactly what happens. The exit rate of those workers who were current members of the DB scheme rises by around 13% relative to those who were never members. This is similar in magnitude to the estimate of the lock-in from Table 6, therefore suggesting that post-closure, prior DB members regain a similar degree of mobility as all other workers who are not locked in to the firm by their pension benefits.

The increased mobility of DB members after scheme closure can be thought of as imposing a cost on firms, which mitigates the savings identified earlier. This is because greater mobility of workers may lead both to an outflow of firm-specific human capital and to additional hiring and training costs for the firm. The cost is likely to be higher the more experienced the departing workers are. Panel B of Table 7 assesses whether this is a likely concern for firms by comparing the mobility of high-wage and low-wage workers. We define high-wage workers as those whose average wage is above the median in the dataset. The results show that low-wage DB workers experience a relatively small degree of lock-in prior to scheme closure – 6% relative to non-DB low-wage workers – and their mobility rises by the same 6% following scheme closure, relative to comparable non-DB workers. The effects are much larger and significant for high-wage DB workers, however. The exit rate of those workers rises by 18% after the scheme closes compared to similar non-DB workers. This suggests that the overall effect of removing pension-related frictions is driven to a greater extent by high earners and their pent-up demand for mobility. As the wages of those workers likely reflect high human capital – either general or firm-specific – their increased exit rates suggest a potentially significant cost for the firm.

6. Conclusions

This paper presents evidence on the impact of firm-specific cost shocks on workers. Using hand-collected data on the costs of funding historic pension liabilities, our analysis shows that firms have, to a limited extent, been able to transfer some of the cost of these liabilities onto workers in the form of lower wages. This burden sharing has been limited to those workers who have some exposure to the pension scheme, and even in this case, the firm bears the substantial share of the cost. However, firms have also increasingly chosen to close these pension schemes down in order to avoid incurring additional future liabilities. These closures have been associated with significant immediate savings for firms, as they contribute less to the replacement pension scheme. There is no evidence that workers are able to offset these losses by obtaining compensating wage increases.

These results imply frictions in the labour market that prevent the standard competitive results emerging. To explore these frictions in more detail, we examine the extent of job mobility. Importantly we show that workers who are currently members of a DB scheme have much lower exit rates than other workers. This effect is distinct from a tenure effect – though it is, of course, true that DB workers tend to have longer tenure with a firm. This helps us to understand why some of the burden of deficit payments can be shifted onto these workers. However, when the firm closes down the DB scheme, we show that this "lock-in" vanishes – workers have the same exit rates regardless of former DB membership. This highlights a risk for the firm in closing down the scheme. Whilst immediate savings are made, there will be increased turnover. This is costly to the firm, and maybe more so given that the increased exits of DB workers who are now freed tend to come from the upper part of the wage distribution.

The paper adds to a growing literature on the importance of firm-specific shocks to wages and highlights yet again the shortcomings of the standard competitive model for the labour market. Frictions are important in understanding how workers are compensated and how firms deal with cost shocks.

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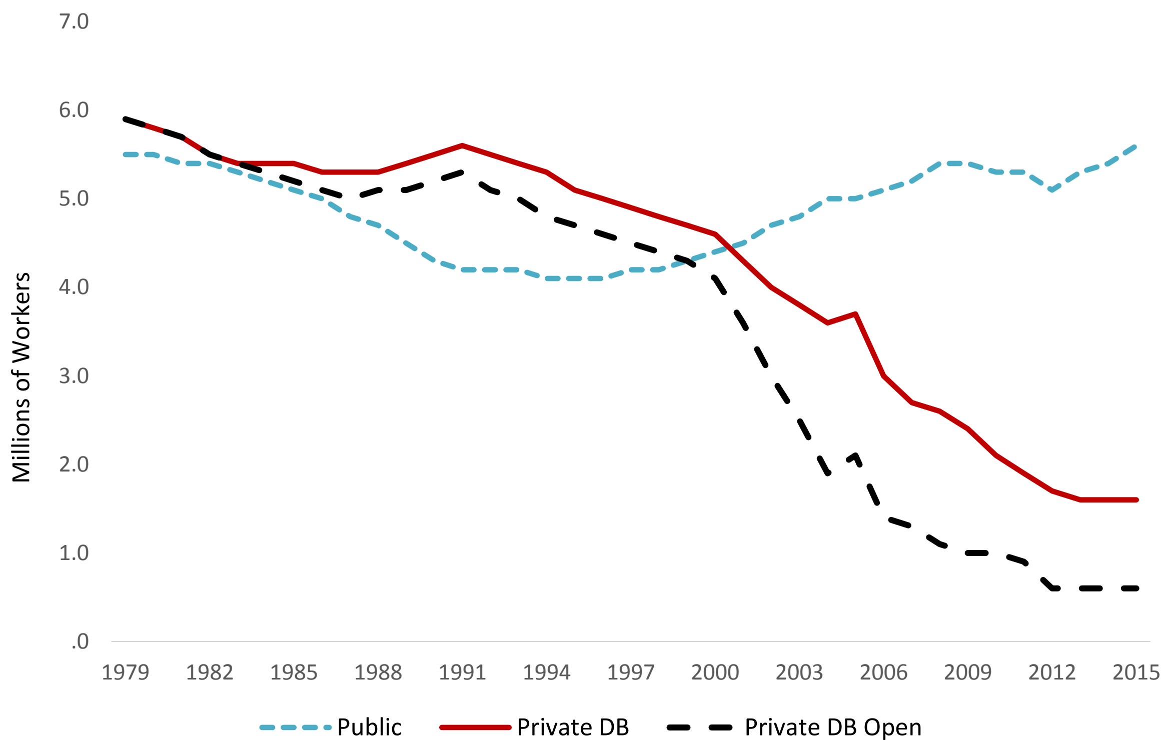
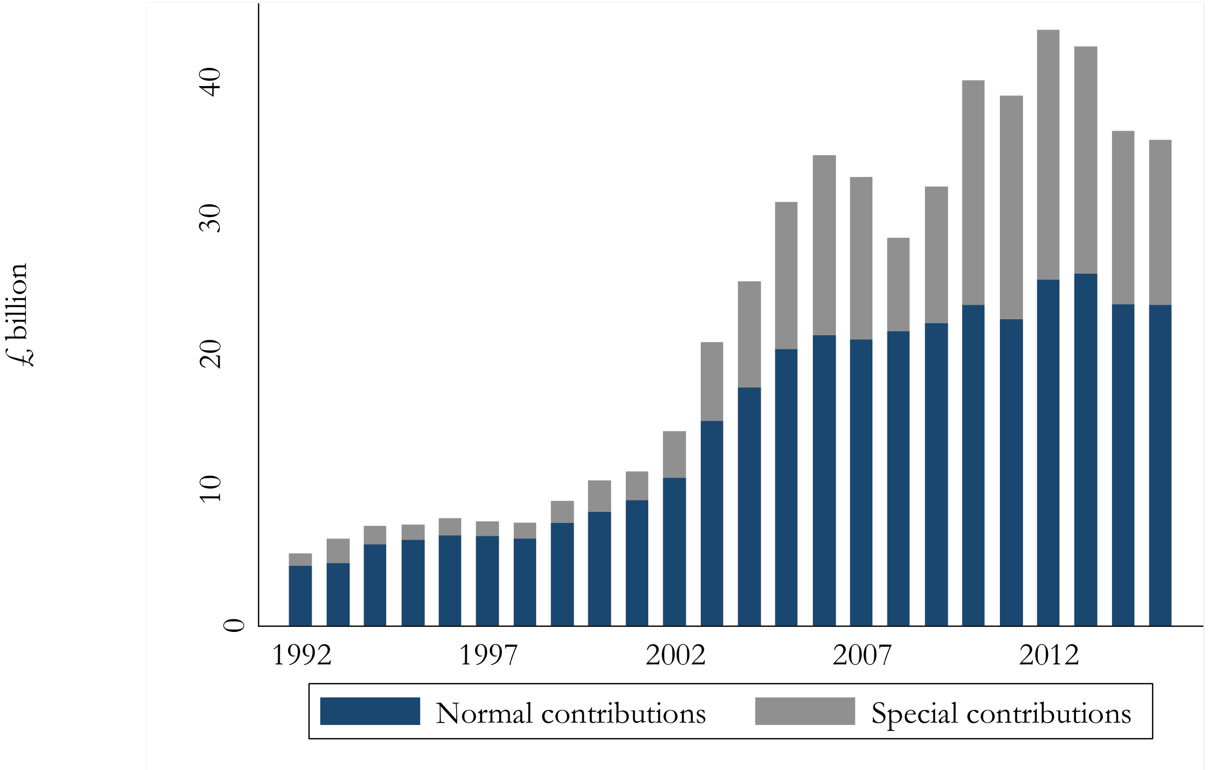
FIGURE 1. ACTIVE MEMBERS OF DEFINED BENEFIT PENSION SCHEMES, 1979-2015



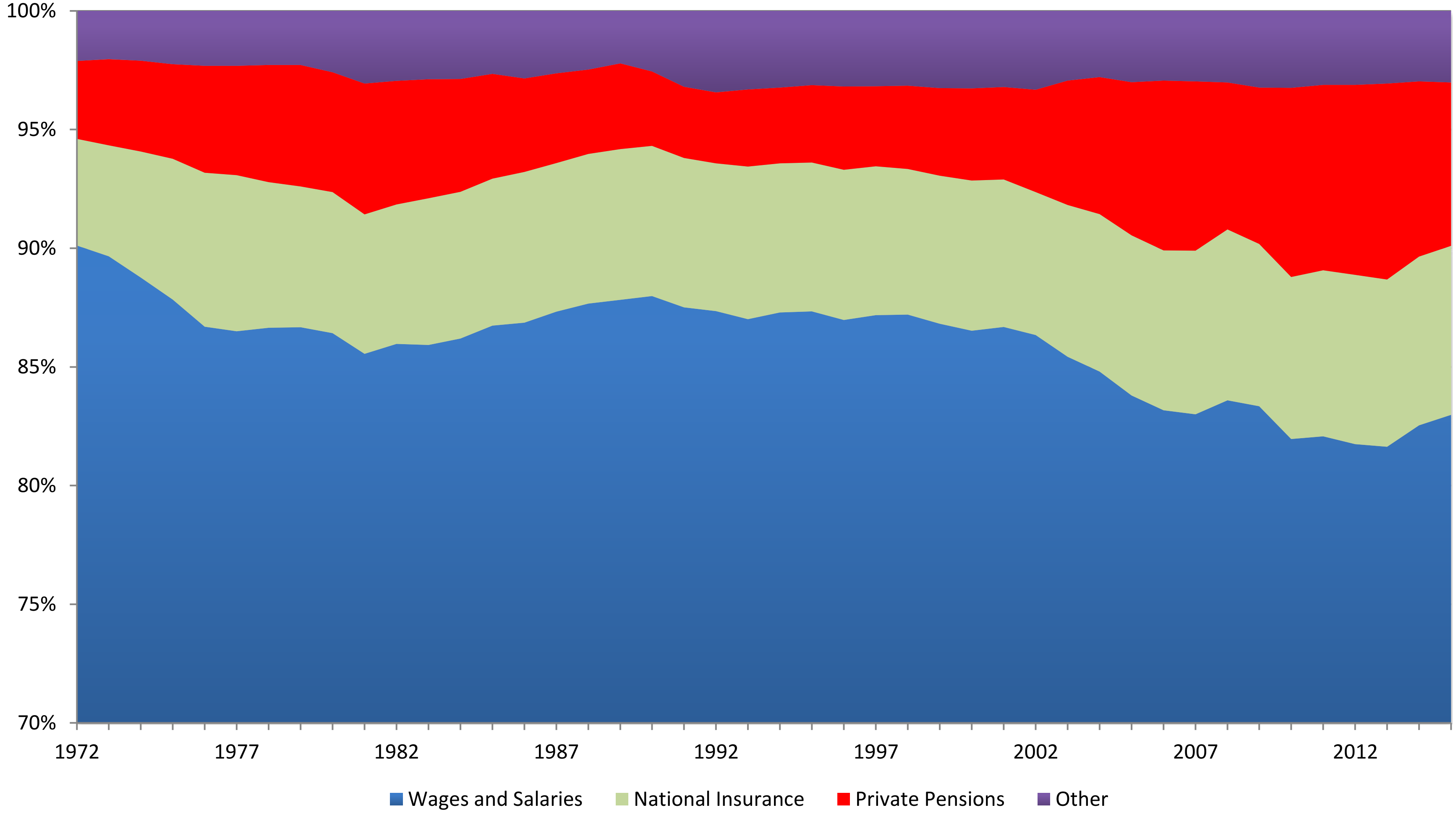
Note: The chart plots the total number of workers who are active members of DB pension schemes in the UK, by sector and scheme status. Source: Pension Regulator.

FIGURE 2. AGGREGATE NORMAL AND SPECIAL PENSION CONTRIBUTIONS, 1992-2015



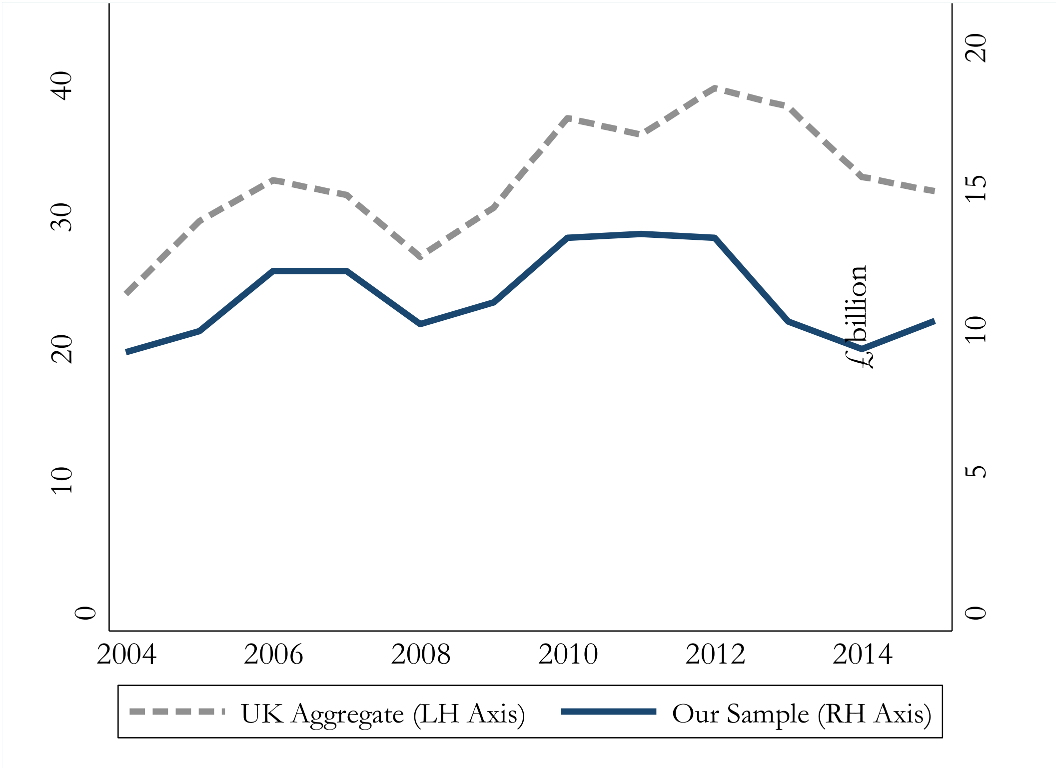
Note: The chart plots the aggregate estimates of employers' normal (regular) and special (deficit) contributions to pension schemes from the UK national accounts. Source: Office for National Statistics.

FIGURE 3. COMPONENTS OF TOTAL COMPENSATION OF EMPLOYEES IN THE UK, 1972-2015



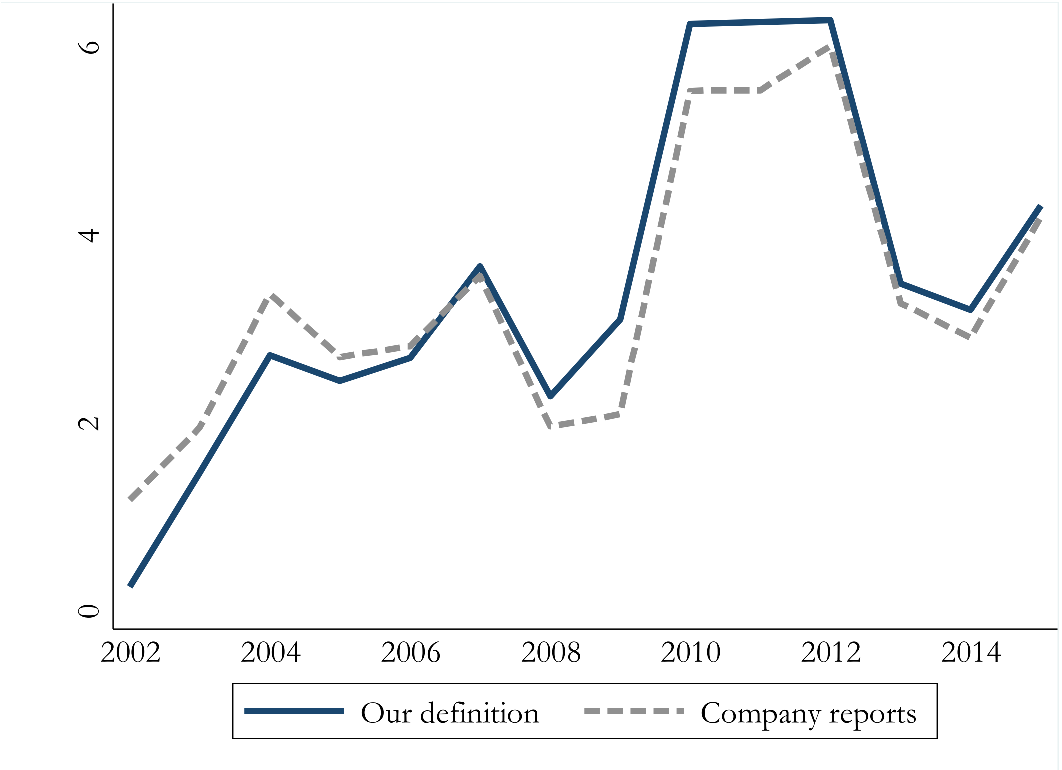
Note: The chart plots the breakdown of aggregate compensation of employees from the UK national accounts. Source: Office for National Statistics.

FIGURE 4. ECONOMY-WIDE VS SAMPLE DB CONTRIBUTIONS, 2003-2015



Note: The chart plots the aggregate estimates of employers' DB contributions to pension schemes from the UK national accounts (UK Aggregate) and the total for our sample of UK-listed firms (Our Sample). Source: Office for National Statistics.

FIGURE 5. DEFICIT CONTRIBUTIONS: OUR DEFINITION VS. COMPANY REPORTS, 2002-2015



Note: The chart compares our calculation of deficit DB contributions (total employer DB contributions – current service cost) to the deficit contributions as reported by the firms themselves, for the 111 firms in our dataset for which we are able to extract both measures from the annual reports in at least one of the years.

FIGURE 6. DISTRIBUTION OF DEFICIT PAYMENTS PER WORKER IN THE SAMPLE

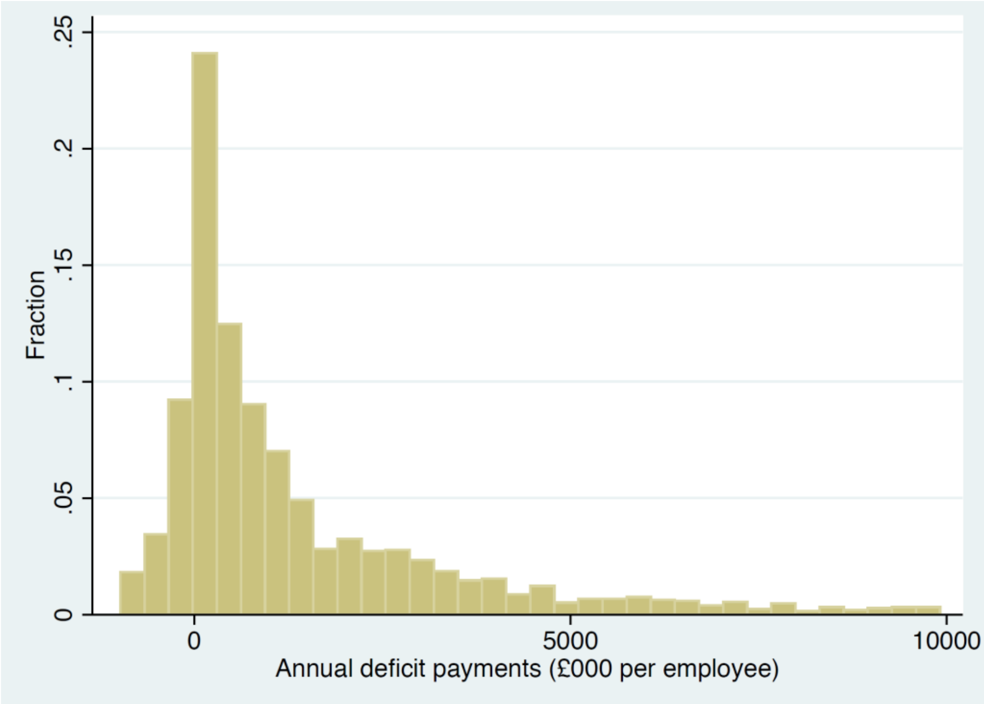
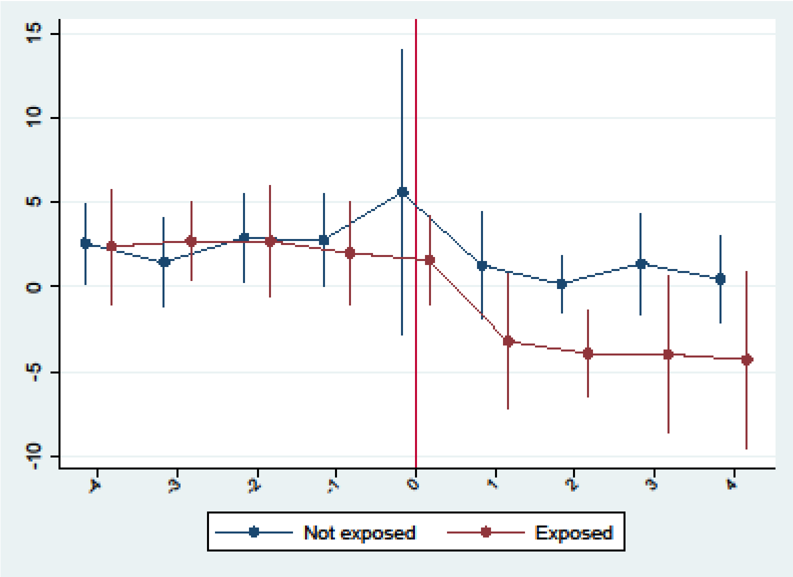
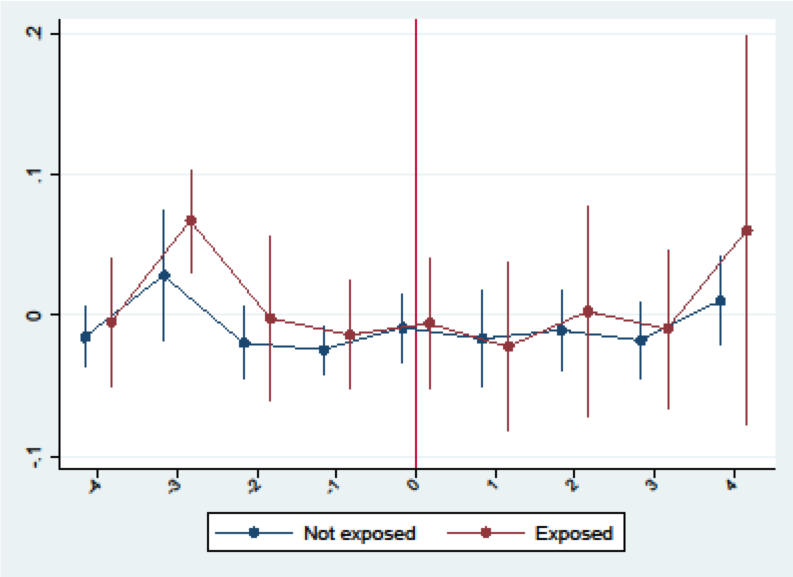


FIGURE 7. SCHEME CLOSURE AND EMPLOYER CONTRIBUTIONS



This chart plots the evolution of employer contributions for the period between four years prior to DB scheme closure and four years subsequent to DB scheme closure, separately for exposed DB members and all other workers. Exposed DB members are defined as those whose employer reported a positive contribution in the year the scheme closed.

FIGURE 8. SCHEME CLOSURE AND WAGES



This chart plots the evolution of wages for the period between four years prior to DB scheme closure and four years subsequent to DB scheme closure, separately for exposed DB members and all other workers. Exposed DB members are defined as those whose employer reported a positive contribution in the year the scheme closed.

TABLE 1. SUMMARY STATISTICS

	Mean	Median	Standard Deviation
A) Firm Sample			
Employment	10,361	2,096	27,111
Revenue (£m)	2,209	327	6,227
Wage Bill (£m)	297	55	909
DB Plan (0/1)	0.72	1.00	0.45
DB Pension Liabilities (£m)	2,094	391	5,380
DB Net Accounting Deficit (£m)	-159	-25	698
DB Deficit Payments per Employee (£ 000)	2.09	0.84	3.73
DB Member %	29.86	22.22	30.31
Sample Size (firm-year obs.)		2,638	
B) Worker Sample			
Hourly Wage (£)	13.70	10.19	11.83
Weekly Wage (£)	479	376	441.26
DB Employer Contribution Rate (%)	11.79	10.41	10.48
Tenure (years)	8.80	6.00	8.84
DB Member (0/1)	0.27	0.00	0.45
Sample Size (worker-year obs.)		197,748	

Notes: Panel A (Firm Sample): data were hand-collected from the annual reports of the 450 listed firms in the sampling frame described in the main text, publicly available from Companies House. The data covers the period 2001-2015. Panel B (Worker Sample): data are from the Annual Survey of Hours and Earnings, 2002-2016.

TABLE 2. PENSION DEFICITS AND WORKERS' WAGES

	Hourly Wage				Weekly Wage
	(1)	(2)	(3)	(4)	(5)
db_emp(-1)	-0.085*	-0.128**	-0.127**	-0.087	-0.133**
	(0.050)	(0.056)	(0.056)	(0.060)	(0.069)
db_emp(-2)	-0.151*	-0.178*	-0.171*	-0.148	-0.175*
	(0.082)	(0.092)	(0.092)	(0.091)	(0.096)
∑db_emp	-0.237*	-0.306**	-0.298**	-0.235*	-0.308**
	(0.123)	(0.142)	(0.144)	(0.134)	(0.158)
Individual FE	x				
Year FE	x	x	x	x	x
5-digit Industry FE	x				
1-digit Industry * Year FE		x	x	x	x
Firm Performance Controls				x	
Firm FE		x			
Match FE			x	x	x
Sample Size	197,748	197,748	197,748	158,396	197,748

Notes: The dependent variable is the log of hourly wages, unless specified otherwise in the column heading. Reported coefficient estimates are multiplied by 100. All regressions include age, age squared and tenure. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5% and 10% level respectively.

TABLE 3. PENSION DEFICITS AND DB MEMBERSHIP

	(1)	(2)	(3)	(4)	(5)	(6)
∑db_emp (DB Member)	-0.410**	-0.458**	-0.380***			
	(0.163)	(0.179)	(0.145)			
∑db_emp (Non-DB Member)	-0.048	-0.025	0.143			
	(0.093)	(0.091)	(0.205)			
∑db_emp (Large Active Membership)				-0.355**	-0.402**	-0.240**
				(0.151)	(0.163)	(0.116)
∑db_emp (Small Active Membership)				-0.114	-0.106	-0.180
				(0.143)	(0.143)	(0.328)
Estimated Sharing Rate	9.8%	11.0%	9.1%	8.5%	9.6%	5.8%
Individual FE	x			x		
Year FE	x	x	x	x	x	x
5-digit Industry FE	x			x		
1-digit Industry x Year FE	x	x	x	x	x	x
Firm Performance Controls			x			x
Firm FE						
Match FE		x	x		x	x
Sample Size	197,748	197,748	158,413	197,748	197,748	158,413

Notes: The dependent variable is the log of hourly earnings. All regressions include age, age squared and tenure. Each row reports the sum of the coefficients (multiplied by 100) for different DB membership at the individual or firm level on the pension deficit measure, which has two lags included in all specifications. Standard errors are clustered at the firm-level. The estimated sharing rate is calculated by multiplying the estimate of ∑db_emp for DB members or for workers at firms with large active membership by the mean hourly wage of £13.70, mean weekly hours of 33.7 and 52 weeks in a year (calculated from the sample of 197,748), divided by 1000 since annual deficit payments per worker are expressed in £ thousands. ***, **, and * indicate significance at the 1%, 5% and 10% level respectively.

TABLE 4. SCHEME CLOSURE AND EMPLOYER PENSION CONTRIBUTIONS

	All	Employer rate not zero	DB rate positive in year of close	Scheme closed in valuation year
	(1)	(2)	(3)	(4)
Scheme Closed (Exposed DB Members)	-7.679**	-7.407**	-6.542***	-14.036***
	(3.556)	(3.515)	(2.103)	(2.093)
Scheme Closed (All Other Workers)	0.691	1.000	-2.735	-2.820*
	(1.051)	(0.919)	(2.385)	(1.542)
Year FE	x	x	x	x
1-Digit Industry * Year FE	x	x	x	x
Match FE	x	x	x	x
Sample Size	112,497	106,932	112,497	95,090

Notes: The dependent variable is the employer pension contribution rate (in percentage points). The table reports the comparison between employer contributions post- and pre-closure for exposed DB members and all other workers, as defined in the main text. All regressions include age, age squared and tenure. Standard errors are clustered at the firm-level. ***, **, and * indicate significance at the 1%, 5% and 10% level respectively.

TABLE 5. SCHEME CLOSURE AND WAGES

	All	Employer rate not zero	DB rate positive in year of close	Scheme closed in valuation year
	(1)	(2)	(3)	(4)
Scheme Closed (Exposed DB Members)	-0.017	-0.013	-0.017	0.008
	(0.017)	(0.015)	(0.021)	(0.036)
Scheme Closed (All Other Workers)	-0.001	0.001	-0.004	-0.007
	(0.012)	(0.009)	(0.012)	(0.012)
Year FE	x	x	x	x
1-Digit Industry * Year FE	x	x	x	x
Match FE	x	x	x	x
Sample Size	197,748	106,932	197,748	160,509

Notes: The dependent variable is the log of hourly wages. The table reports the comparison between employer contributions post- and pre-closure for exposed DB members and all other workers, as defined in the main text. All regressions include age, age squared and tenure. Standard errors are clustered at the firm-level. ***, **, and * indicate significance at the 1%, 5% and 10% level respectively.

TABLE 6. PENSION SCHEME MEMBERSHIP AND WORKER MOBILITY

A) All Workers in ASHE	
DB Member	0.199
Not a DB Member	0.245
Sample Size	1,041,537
B) Workers in Sample Firms	
DB Member	0.177
Not a DB Member	0.269
Sample Size	233,362

Notes: This table reports the probabilities of worker exit based on DB pension membership status. The results are based on a probit regression of a 0/1 indicator of whether the worker leaves the firm in the next period on a scheme membership indicator, as well as controls for age, age squared, gender, tenure, tenure squared, year, and 2-digit industry.

TABLE 7. PENSION SCHEME CLOSURE AND WORKER MOBILITY

	(1) Pr(Exit | Scheme Open)	(2) Pr(Exit | Scheme Closes)	(2) - (1) Effect of Scheme Closure on Pr(Exit)
A) All Workers in Sample Firms			
(a) DB Member	0.188***	0.391***	0.202***
	(0.002)	(0.022)	(0.022)
(b) Not a DB Member	0.278***	0.348***	0.070***
	(0.002)	(0.007)	(0.007)
Difference-in-Difference (a-b)			0.132***
			(0.023)
B) Workers in Sample Firms by Position in the Wage Distribution			
(i) Workers with Wage ≤ Median			
(a) DB Member	0.208***	0.340***	0.132***
	(0.004)	(0.032)	(0.032)
(b) Not a DB Member	0.276***	0.347***	0.070***
	(0.002)	(0.008)	(0.008)
Difference-in-Difference (a-b)			0.061*
			(0.033)
(ii) Workers with Wage > Median			
(a) DB Member	0.179***	0.426***	0.247***
	(0.003)	(0.029)	(0.029)
(b) Not a DB Member	0.284***	0.353***	0.069***
	(0.003)	(0.015)	(0.015)
Difference-in-Difference (a-b)			0.178***
			(0.033)

Notes: This table reports the marginal effect of DB scheme closure on worker exit based on DB pension membership status. Column (1) shows the results from a probit regression of a 0/1 indicator of whether the worker leaves the firm in the next period on scheme membership and scheme closure indicators and their interaction, as well as controls for age, age squared, gender, tenure, tenure squared, year, and 2-digit industry. Low-wage workers are defined as those who are, on average, below or at the median of the annual wage distribution in ASHE, while high-wage workers are those who are on average above the median. Predicted exit probabilities and marginal effects are calculated at the means of all regressors. Sample size is 173,449. Deferred members and post-closure periods are excluded from the sample. ***, **, and * indicate significance at the 1%, 5% and 10% level respectively.

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