

Minimum Wages and Firm Profitability

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Abstract

Although there is a large literature on the effects of minimum wages on labor market outcomes (especially wages and employment), there is much less evidence on their impact on aspects of firm performance such as profitability. Our analysis studies the profitability impact of minimum wages, exploiting the changes induced by the introduction of a national minimum wage to the UK labor market in 1999 using pre-policy information on the distribution of wages to implement a difference in differences approach. We report evidence that the introduction of the minimum wages significantly raised wages and reduced firm profitability. There is also some evidence of bigger falls in profit margins in industries with relatively high market power. Our findings are consistent with a no behavioral response model where wage gains from minimum wages map into profit reductions. There is some weak evidence that the longer-run adjustment may be through falls in net entry rates.

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I. Introduction

In debates on the economic impact of labor market regulation, much work has focused on minimum wages. Although the textbook competitive labor market model implies that wage floors raise the wages of the low paid and have a negative impact on employment (Borjas, 2004; Brown, 1999), the empirical literature is less clear-cut. Many studies have rigorously demonstrated that minimum wages significantly affect the structure of wages by increasing the relative wages of the low paid (e.g. DiNardo, Fortin and Lemieux, 1996).¹ However, in spite of the large number of studies, empirical evidence on employment effects is considerably more mixed (see the recent comprehensive review by Neumark and Wascher, 2007). Some have found the expected negative impact on employment², yet others have found no impact or sometimes even a positive effect of minimum wages on jobs.³

In the light of this, it is natural to ask how firms are able to sustain higher wage costs induced by the minimum wage. This paper explores the possibility that firm profit margins are reduced. A second possibility is that firms simply pass on higher wage costs to consumers in the form of price increases. However, there is scant evidence on this score.⁴ Indeed, even with some positive price response, part of the higher wage costs may not be fully passed on to consumers and the minimum wage could eat directly into profit margins. A third possibility is that minimum wages may “shock” firms into reducing managerial slack and improving efficiency. We examine this productivity story but do not find any evidence for it.

Given this discussion, it is surprising that there is almost a complete absence of any study directly examining the impact of minimum wages on firm profitability. This is the focus of this paper. We adopt an identification strategy using variations in wages induced by the introduction of the national minimum wage (NMW) in the UK as a quasi-experiment to examine the impact of wage floors on firm profitability. The introduction

¹ See also Lemieux (2007) for some recent evidence on the US and DiNardo and Lemieux (1997) for a comparison with Canada.

² See the discussion of time series studies in Brown, Gilroy and Kohen (1982) and Brown (1999) or the US cross-state panel evidence of Neumark and Wascher (1992) and the recent longer run analyses of Neumark and Nizalova (2007).

³ Examples here are Dickens, Manning and Machin (1999) and Card and Krueger (1994).

occurred in 1999 after the election of the Labor government that ended seventeen years of Conservative administration. To date there is evidence that the NMW increased wages for the low paid, but had little impact on employment⁵ and so this provides a ripe testing ground for looking at whether profitability changed.

Our work *does* uncover a significant negative association between the national minimum wage introduction and firm profitability. We report evidence showing wages were significantly raised, and firm profitability was significantly reduced by the minimum wage introduction. There is also some evidence of bigger falls in margins in industries with relatively high market power, but no significant effects on employment or productivity in any sector. Our findings can be interpreted as consistent with a simple no behavioral response model where wage gains from minimum wages map into profit reductions. There is a hint of a selection effect in the longer-run as net entry rates fall in the most affected industries, but although the magnitude of the effect is nontrivial it is statistically insignificant.

The rest of the paper is structured as follows. In Section II, we discuss a model of profit responsiveness to wage changes from which we derive our empirical strategy. Section III discusses the data and the characterisation of firms more likely to be affected by the minimum wage introduction. Section IV gives the main results on wage and profitability effects and tests their robustness. Section V offers some further investigations using other datasets (care homes), other outcomes and sectoral heterogeneity. Section VI concludes.

II. Motivation and Modelling Strategy

II.1. The Scope for Minimum Wages to Impact on Profitability

Following Ashenfelter and Smith (1979), consider a profit-maximizing firm employing a quantity of labor (L) at wage rate (W), using other factors at price R and selling its output at price P . Profits are maximized at $\Pi(W, R, P)$ given the values of W , R and P . The derivative of the profit function with respect to the wage rate

⁴ This was the conclusion of the survey on minimum wages and prices by Lemos (2008). For exceptions on restaurant prices see Aaronson (2001), Aaronson and French (2007) and Fougere, Gautier and le Bihan (2008). The only UK evidence to our knowledge is Wadsworth (2009) who finds limited effects on prices.

⁵ See Machin, Manning and Rahman (2003) and Stewart (2004).

is $\partial\Pi/\partial W = -L(W, R, P)$, the negative of the demand for labor. In turn, the second derivative is $\partial^2\Pi/\partial W^2 = -\partial L/\partial W$.

In this setting, the introduction of a minimum wage (M) at a level above that of the prevailing wage reduces firm profits by $\Delta\Pi = \Pi(W, R, P) - \Pi(M, R, P)$. Using a second-order Taylor series this can be approximated as:

$$\Delta\Pi \cong -L\Delta W + \frac{1}{2} \frac{\partial L}{\partial W} (\Delta W)^2 \quad (1)$$

where $\Delta W = M - W$. The terms on the right-hand side of equation (1) correspond to the “wage bill” ($-L\Delta W$) and “labor demand” ($\frac{1}{2} \frac{\partial L}{\partial W} (\Delta W)^2$) effects on profits. Note that equation (1) can be re-written as:

$$\Delta\Pi = -WL \left(\frac{\Delta W}{W} + \frac{\eta}{2} \left(\frac{\Delta W}{W} \right)^2 \right) \quad (2)$$

where $\eta = \frac{W}{L} \frac{\partial L}{\partial W} < 0$.

In a situation of “no behavioral response”, that is no impact on labor demand, the second order effect in (2), $\left(\frac{\eta}{2} \left(\frac{\Delta W}{W} \right)^2 \right)$, is zero and the fall of profits that would result from the imposition of a minimum wage M is equal to the proportionate change in the wage multiplied by the wage bill. In the case of a labor demand effect the second term can offsets this profit loss to the extent that firms can substitute away from low-wage workers into other factors (e.g. capital).

Equation (2) also serves to illustrate the inverse relationship between a firm’s initial wage and the post-policy change in its profits. It shows that, the lower the initial wage, then the greater the fall in profits associated with the imposition of a minimum wage. The difference-in-difference models we consider in our empirical modelling strategy (described below) will operationalize this idea by defining treatment groups of more affected firms, and comparison groups of less affected firms, based on their wages prior to the policy introduction.

Normalizing profits on sales revenues, S, to define a profit margin shows that, for the no behavioral response model, in a statistical regression context the coefficient on the

increase in wages caused by the minimum wage $\left(\frac{\Delta W}{W}\right)$ should simply be equal to the share of the wage bill in total revenue $\left(\frac{WL}{S}\right)$:

$$\Delta(\Pi/S) = -\theta \left(\frac{\Delta W}{W}\right) \quad (3)$$

where $\theta = \frac{WL}{S}$.

More generally, to the extent there is substitution away from labor, the coefficient on the wage increase, θ , will be less (in absolute terms) than the (initial) wage bill share of revenue. Interestingly, we will show that our empirical results cannot generally reject the simple relationship in equation (3).

It is worth noting that this is consistent with the results in the rather different context of Abowd's (1989) study of union wage increases and firm performance. Abowd estimates a version of equation (2) examining the effects of unanticipated increases in the wage bill ("union wealth") on the present discounted value of profits as reflected in changes in stock market values ("shareholder wealth"). He also finds that he cannot reject the simple model where the second order effect is zero. Abowd interprets this as evidence for strongly efficient union bargains as he focuses on a sample of unionized contracts. Strongly efficient (implicit) bargaining is also an alternative interpretation of our findings as well.⁶

It is worth focusing on some of the economic issues underlying the adjustment mechanisms implicit in the second order term of equation (1). Obviously, the magnitude of these mechanisms depend on the elasticity of the labor demand curve, η . One element of this will be the degree to which labor is substitutable for other factors. Another will be the degree to which the higher wage costs can be passed on to consumers in the form of higher prices. For example, under perfect competition price equals marginal cost so all the wage costs are reflected in higher prices for consumers. In most oligopoly models, by contrast, mark-ups will fall as some of the wage increase is born by firms (see Appendix A). Consequently, in our empirical work, we explicitly distinguish between industries

with different degrees of product market competition as we expect heterogeneity in the minimum wage effects along this dimension (i.e. a larger effect in the less competitive industries).

The model focuses on the short-run responses when the number of firms is fixed, rather than in the long-run when the number of firms varies.⁷ We believe that the short-run is still interesting as researchers cannot be sure how long is the long run (we look up to three years after the introduction of the minimum wage, so this is reasonably long run). Since firms that employ low-wage workers may well exit the market, so the relevant margin of adjustment will be more exit and less entry. We also examine this explicitly in our empirical analysis

Finally, when the product market is imperfectly competitive there may also be effects of the minimum wage on profitability in both the short-run and the long run. Appendix A in Draca et al (2008) discusses these models in some detail, but it is sufficient to note that positive price cost margins are an equilibrium phenomenon in standard industrial organization models such as Cournot or differentiated product Bertrand. For example, consider a Cournot oligopoly where firms have heterogeneous marginal costs and constant returns to scale. Introducing a minimum wage has a differential impact on the firm employing more low skilled workers causing this firm to lose market share and suffer a fall in its price cost margin. However, so long as profits do not fall below the exit threshold it will remain in the market with lower profitability.

II.2. Modelling Strategy

The approach we take to identify minimum wage effects in the context of the above theoretical discussion is in line with the existing literature that analyzes the impact of national minimum wages. Typically, we look at a group of firms that were more affected by the NMW introduction than a comparison set of firms.⁸ By “more affected”,

⁶ Although we find this explanation less plausible as the minimum wage mainly binds on those firms and sectors where unions are not present or, if they are, are very weak.

⁷ Note that the short-run negative impact on profits will be larger in competitive labor markets than monopsonistic labor markets (see Card and Krueger, 1995). In the latter model, there is an offsetting positive effect on profitability when wages increase as worker turnover declines.

⁸ See, amongst others, Card’s (1992) analysis of state variations in low pay incidence to identify the employment impact of the US federal minimum wage, or Stewart’s (2002) similar analysis of regional variations in the UK NMW.

we mean where wages potentially rose by more due to the imposition of the minimum wage floor. This quasi-experimental setting enables us to compare what happened to profitability before and after NMW introduction in low wage firms as compared to what happened to profitability across the same period for a comparison group of firms whose wages were not affected as much (or at all) by the NMW introduction.

For ease of exposition, we begin our discussion of modelling by thinking in terms of a discrete treatment indicator of the minimum wage policy for a set of low wage firms with a pre-policy introduction wage, W^{pre} , beneath the minimum wage threshold M . A treatment indicator variable can be defined as $T = 1$ for below minimum wage firms (where $W^{pre} < M$) and $T = 0$ for a set of firms whose pre-policy wage exceeds the threshold.⁹

We can evaluate the impact of minimum wages on firm profitability by comparing what happens before and after minimum wage introduction across these treatment and control firms. For this procedure to be valid, we first need to establish that our choice of affected firms behave as we would expect in response to NMW introduction. The expected response would be that wages rise by more in the $T = 1$ firms before and after introduction as compared to the $T = 0$ firms.

A difference-in-difference estimate of the wage impact of the NMW is $(\bar{w}_{NMW=1}^{T=1} - \bar{w}_{NMW=0}^{T=1}) - (\bar{w}_{NMW=1}^{T=0} - \bar{w}_{NMW=0}^{T=0})$, where $w = \ln(W)$, NMW is a dummy variable equal to 1 for time periods when the NMW was in place (and 0 for pre-policy periods) and a bar denotes a mean. For example, $\bar{w}_{NMW=1}^{T=1}$ is the mean $\ln(\text{wage})$ for the treatment group in the post-policy period. This difference-in-difference estimate is just the simple difference in means unconditional on other characteristics of firms. It can easily be placed into a regression context. If $T = 1$ for firms with a pre-policy $\ln(\text{wage})$, $w_{i,t-1}$, less than the $\ln(\text{minimum wage})$, mw_t , and 0 otherwise, we can enter the indicator function $I(w_{i,t-1} < mw_t)$ into a $\ln(\text{wage})$ equation for firm i in year t as follows:

$$w_{it} = \alpha_1 + \beta_1 X_{it} + \delta_1 Y_t + \theta_1 I(w_{i,t-1} < mw_t) + \psi_1 [I(w_{i,t-1} < mw_t) * NMW_t] + \varepsilon_{it} \quad (4)$$

where X is a set of control variables, Y denotes a set of year effects (hence a linear term in NMW_t does not enter the equation since it is absorbed into the time dummies) and ε_{it}

⁹ We also consider various continuous measures of treatment intensity discussed below.

is a random error. Here the regression corrected difference-in-difference estimate of the impact of NMW introduction on the $\ln(\text{wage})$ is the estimated coefficient on the low wage treatment dummy in the periods when the NMW was in operation, ψ_1 .

After ascertaining whether the NMW impacts on wages in the expected manner we move on to consider whether profitability was affected differentially between the treatment group firms ($T = 1$) and comparison group firms ($T = 0$). We look at unconditional and conditional difference-in-difference estimates in an analogous way to the wage effects. Thus, we can estimate the unconditional difference-in-difference in profit margins, defined as the ratio of profits to sales Π/S , as

$$\left[\left(\frac{\Pi}{S} \right)_{\text{NMW}=1}^{T=1} - \left(\frac{\Pi}{S} \right)_{\text{NMW}=0}^{T=1} \right] - \left[\left(\frac{\Pi}{S} \right)_{\text{NMW}=1}^{T=0} - \left(\frac{\Pi}{S} \right)_{\text{NMW}=0}^{T=0} \right]$$

and the conditional difference-in-difference, ψ_2 , from the regression model:

$$\left(\frac{\Pi}{S} \right)_{it} = \alpha_2 + \beta_2 Z_{it} + \delta_2 Y_t + \theta_2 I(w_{i,t-1} < mw_t) + \psi_2 [I(w_{i,t-1} < mw_t) * \text{NMW}_t] + \varepsilon_{2it} \quad (5)$$

where the controls are now Z and ε_{2it} is the error term.

If we compare the econometric models (4) and (5) to the economic models of (1) through (3), we see immediately that the no behavioral response model corresponds to a restriction on the coefficients in equations (4) and (5), i.e.

$$\psi_2 = -\theta\psi_1 \quad (6)$$

We present formal tests of this restriction in the empirical section.

The main issue that arises with any non-experimental evaluation of treatment effects is, of course, whether the comparison group constitutes a valid counterfactual. The key conditions are that there are common trends and stable composition of the two groups (see Blundell, Costa-Dias, Meghir and Van Reenen, 2004). Much of our robustness analysis below focuses on whether these two conditions are met: for example, by examining pre-policy trends and carrying out pseudo-experiments (or falsification tests) in the pre-policy period.

III. Data

III.1 Basic Description of FAME Data

Accounting regulations in the UK require private firms (i.e. those unlisted on the stock market) to publicly report significantly more accounting information than their US counterparts. For example, even publicly quoted firms in the US do not have to give total employment and wage bills whereas this is required in the UK.¹⁰ Accounting information on UK companies is stored centrally in Companies House. It is organised into electronic databases and sold commercially by private sector data providers such as Bureau Van Dijk from whom we obtained the FAME (Financial Analysis Made Easy) database.¹¹

The great advantage of this data is that it covers a much wider range of companies than is standard in firm level analyses and, in particular, it includes firms who are not listed on the stock market. This means we are able to include many of the smaller and medium sized firms that may be disproportionately affected by the NMW. Furthermore, the data also covers non-manufacturing firms where many low wage workers are employed. By contrast, plant level databases in the UK and US typically cover only the manufacturing sector¹² and do not have as clear a measure of profitability as exists in the (audited) company accounts. However, UK accounting regulations do have reporting exemptions for some variables for the smaller firms so our analysis is confined to a sub-sample who do report the required information.¹³

Since FAME contains annual accounting information, we have firms reporting accounts with different year-end dates. Since the NMW was introduced on April 1st 1999, we therefore consider the sub-set of firms who report their end of year accounts on March 31st of each year (these are firms who report in the UK financial year). The accounting period for these firms will match exactly the period for which the NMW was in force.

¹⁰ The lack of publicly available information on private sector firms and on average remuneration may be a reason for the absence of US studies in this area.

¹¹ FAME is the UK part of BVD's AMADEUS dataset of European company accounts used by many authors (e.g. Bloom and Van Reenen, 2007).

¹² The Annual Business Inquiry (ABI) database does cover non-production sectors, but this database is not available until the late 1990s. The US Longitudinal Research Database (LRD) only covers manufacturing.

¹³ These firms will tend to be larger than average as the very smallest firms have the least stringent reporting requirements.

Around twenty-one percent of firms in FAME who have the accounting data we require report on this day, which corresponds to the end of the tax year in the UK.¹⁴

We use data on profits before interest, tax and depreciation from the FAME database and model profitability in terms of the profit to sales ratio. There is a long tradition in firm-level profitability studies to use this measure, as it is probably the best approximation available in firm-level accounts data to price-cost margins.¹⁵ To allow for capital intensity differences we also control for firm-specific capital to sales ratio.¹⁶

III.2. Other Data

We have also matched in industry-level variables aggregated up from the Labor Force Survey (similar to the US CPS). These are used as control variables in the analysis and include (at the three-digit industry level) the proportion of (a) part-time workers, (b) female workers and (c) union members. We also include skills proxied by the proportion of all workers who have college degrees in a particular region by two-digit industry cell. The control variables in the regression models also include a set of region, one-digit industry and time dummies. Exact variable definitions are given in the Data Appendix. Appendix Table B1 shows the characteristics of the treatment and comparison groups for each model.¹⁷

Finally, the magnitude of the minimum wage increases over our “Policy On” period should be clarified. This period lasts from April 1st 1999 until March 31st 2002 (the end of our sample). Along with the introduction of the minimum wage, there were

¹⁴ If we estimated our basic models on the whole FAME sample irrespective of reporting month we obtained very much the same pattern of results as our basic findings in Table 2 below. The estimated effects were a little smaller in magnitude, most likely because of attenuation towards zero owing to measurement error in defining treatment.

¹⁵ For example, see Machin and Van Reenen (1993) and Slade (2004). Although there are many reasons why accounting and economic profits may diverge (Fisher and McGowan, 1983), there is much evidence that they are on average highly positively correlated. The relationship between the profit-sales ratio and price-cost margins will also break down if there are not constant returns to scale. In this case, controlling for capital intensity is important in allowing for differential fixed costs across firms and that is what we do empirically in the regression-corrected difference in difference estimates.

¹⁶ We also checked that dropping the capital sales ratio did not change the results as some of the effect of the NMW may have come from firms substituting away from more expensive labor towards capital equipment.

¹⁷ Interestingly the profitability of low wage firms is higher at the median and mean than comparison group firms. This is not true for firms as a whole where there is a positive correlation between average firm wages and profits per worker (e.g. Van Reenen, 1996). It is because we are focusing on the lower part of the wage distribution that this correlation breaks down.

two upratings of the minimum during this time. The first occurred in October 2000 and saw the minimum wage rise by 10p to £3.70. The second uprating a year later was more substantial taking the minimum up to £4.10. Together these upratings constitute a 13.9% increase in the minimum between 1999 and 2002.¹⁸ Small cell sizes prevent us from estimating separate models for the 2000 and 2001 upratings.¹⁹

III.3. Defining Treatment and Comparison Groups

FAME has a total remuneration figure that can be divided by the total number of employees to calculate an average wage.²⁰ This creates a challenge in terms of defining our treatment and comparison groups since any given level of average wages is, in principle, compatible with a range of different within-firm wage distributions. This makes it hard to measure accurately how exposed each firm's cost structures are to the wage shock brought about by the minimum wage. For example, any continuous measure of treatment intensity based on the firm average wage is inevitably coarse.

We have used information from FAME, the Labor Force Survey (LFS) and the Workplace Employment Relations (WERS) to both construct and validate our treatment group indicators. Specifically, the main results use average firm wages from FAME to define our treatment and comparison groups, but we also use LFS information for the industry level analysis of entry and exit. We use within-establishment information from matched worker-establishment data in WERS to consider the association between low pay incidence and average wages to assess the effectiveness of this empirical strategy.²¹

To investigate the impact of the minimum wage we have defined our treatment group, T, based upon average remuneration information from FAME. For our main initial analysis we define $T = 1$ for firms with average remuneration of less than £12,000 in the accounting year prior to minimum wage introduction ("low wage firm").²² Average

¹⁸ By contrast, the consumer price index grew by 6.3% over the same period.

¹⁹ For example, less than 9% of firms report annually on September 30th (i.e. the 12 months immediately before the October upratings).

²⁰ In almost all firms in the data we use, employment refers to average employment over the accounting period. Firms can report employment at the accounting year or the average over the year, but the overwhelming number of our firms report averaged employment.

²¹ Unfortunately, direct linking of data of WERS and FAME is not possible due to confidentiality restrictions.

²² In earlier versions of this paper we also combined the low wage firm information with industry-region "cell" data on the proportion of workers beneath the minimum wage in the year before it came in. Using

remuneration in the treatment group for this threshold is £8,400 which, after allowing for a deduction for non-wage costs (such as employers' payroll tax, pension contributions, etc), is equivalent to a £3.90 hourly wage for a full-time worker and is close to the NMW (introduced at £3.60 per hour). For our research purposes, the key issue is that the wages of firms beneath the threshold we choose have a significant wage boost from the NMW relative to higher wage firms and we consider this in detail in our analysis. One aspect of this is that we have extensively experimented with the threshold cut-off and we discuss this in detail below. In the analysis presented below, we also look at associations with the pre-policy average wage in the firm. This gives a continuous indicator that we can use to compare with the binary treatment variables based upon being beneath a particular wage threshold.

III.4 The Usefulness of Average Wages to Define Treatment

How accurate are these treatment group definitions at identifying firms most affected firms by the minimum wage regulation? This hinges on how segregated low-wage workers are between firms. Our threshold-based definition will be more effective if sub-minimum wage employees are concentrated in particular firms at the lower end of the wage distribution.

To assess the usefulness of the approach we adopt we look at segregation and wages in the 1998 cross-section of the British Workplace Employment Relations Survey (WERS)²³. This contains matched worker and establishment data that allows us to look at within-workplace wage distributions and explore the association between average wages and the intensity of low-wage workers. For 26,509 workers in 1,782 WERS workplaces we computed the proportion of workers paid less than £3.60 per hour (the value of the minimum wage when introduced in 1999) and the average hourly wage in the workplace. There is a strong, negative association between the two variables (a correlation coefficient of -0.61, p-value < 0.001). In Figure 1 we plot the proportion of workers paid

LFS data, we defined a low wage industry-region cell if more than 10% of workers in the given firm's two-digit industry by region cell in the pre-policy period are paid below the minimum wage. In practice this made little difference to the overall pattern of results and so we do not report this material (see Draca et al, 2008, for all the results).

at or below the minimum wage against the establishment's average annual wage. This proportion of minimum wage workers tapers off rapidly after an average annual wage of £10,000, supporting the idea that exposure to the minimum wage can be proxied by using an average wage threshold that is around this level. Workplaces with average annual wages of £12,000 or less (our main threshold defining the treatment group) contain 87% of all minimum wage workers. These patterns give some support to our idea that "at risk" group of minimum wage workers are concentrated in firms that pay low average wages.

IV. Main Results

IV.1. Changes in Wages Before and After the Introduction of the National Minimum Wage

It is important to see whether we are able to observe a clear change or "twist" in the firm average wage distribution as the minimum wage was introduced. To consider this, we started our analysis by calculating the change in average wages in the year immediately before and immediately after NMW introduction for every firm at each percentile of the pre-policy firm wage distribution. If the firms in the FAME data exhibit some of the low pay patterns outlined above for WERS, the minimum wage introduction should raise average firm wages by more in low wage firms. Thus, we would expect there to be larger changes in firm wages for the lowest percentiles of the distribution.

The results given in Figure 2 very clearly confirm this hypothesis. In the post-NMW introduction year from April 1 1999 to March 31 2000 (labelled "1999-2000 Change", and denoted by the solid line), the wage change tapers off steadily beyond the lowest decile of the firm average wage distribution. After the 13th percentile, firms appear to have had a similar increase in nominal wages of around 5.6%. Importantly, there is no evidence of much faster wage growth for the bottom decile in the pre-policy year (labelled "1998-1999 Change", and denoted by the dotted line). In fact, wage growth in the bottom thirteen percentiles was on average 2.6% in the 1998-1999 financial year compared to 9.9% in the following year. A spike is seen for the bottom few percentiles of the wage distribution in both years, which is consistent with the notion of some transitory

²³ WERS is a stratified random sample of British establishments and has been conducted in several waves since 1980. It has been extensively used by economists and industrial relations experts to study a range of issues. Culley et al. (1999) give details of the survey

measurement error at the low end of the wage distribution generating mean reversion in both periods. Reassuringly, the general picture follows a similar pattern to that found for individual-level wage data (Dickens and Manning, 2004) and again provides encouraging evidence that our definition of the treatment group is useful.

It is critical that we identify wage effects from the treatment group definitions, so that our analysis of profitability consequences is validated by the minimum wage introduction having a bigger ‘bite’ on low wage firms. To make this a tighter definition we have also defined the comparison group to be those firms with average wages above the £12,000 treatment threshold, but less than £20,000 (the median firm wage) by removing any firms with above £20,000 average wages from the main analysis. We do so since these firms are quite different in terms of their characteristics and therefore subject to different unobservable trends from the treatment group. We are careful to test for the sensitivity of the results to definitions of these thresholds.

IV.2. Firm-Level Estimates: Wages and Profitability

The upper panel of Table 1 presents unconditional difference-in-differences in the mean $\ln(\text{wage})$ for the discrete categorization of treatment and comparison groups, for the three years before and after NMW introduction.²⁴ It is evident that wages rose significantly faster amongst the low wage firms when the minimum wage became operational. Wage growth across the pre- and post-NMW three year time period was higher at 22.9 log points in the low initial wage group ($T = 1$) as compared to wage growth of 11.8 log points in the higher initial wage group ($T = 0$). The difference-in-difference of 11 percent is strongly significant in statistical terms. This is consistent with the hypothesis that the NMW significantly increased wages for low wage firms.

An analogous set of descriptive results is presented for firm profitability in Panel B of Table 1. It is clear that, whilst profit margins fell by 0.039 between the pre- and post-NMW periods in the pre-NMW low wage firms, they only fell by 0.012 in the pre-NMW higher wage firms. Thus, there is a negative difference-in-difference of -0.027.

²⁴ Note that we are looking across the six financial years from April 1 1996 to March 31 2002 (three years before the policy and three years afterwards). In Figure 2, we simply looked one year before and after the policy introduction.

This difference is statistically significant and is preliminary evidence that profit margins were squeezed in firms that were “at risk” from the introduction of the minimum wage.

Comparing these results with the simple models in Section II, we find that no behavioral response model does surprisingly well. Using the average wage bill to sales ratio of 0.27 (see Table B1), the implied change of profit margins using the estimated wage gains in Table 1 and equation (3) is -0.030 ($= -0.111 \times 0.27$). This is only slightly above the empirically estimated profitability reduction of -0.027 in Table 1, suggesting only minor offsetting adjustments (the second-order term in equation (2)). Below, we will see that this conclusion broadly holds up to more rigorous econometric testing.

Table 2 reports results from statistical difference-in-difference wage and profitability regressions that additionally control for firm and industry characteristics. The upper panel (A) of the Table shows results for the binary low wage firm indicator, whilst the lower panel (B) uses a continuous measure, the negative of the pre-policy average wage (reporting the negative so as to have signs on coefficients that are consistently defined with the low wage dummy). The basic pattern of results from the unconditional models of Table 1 are confirmed in these conditional specifications. For the binary indicator in the upper panel, the estimated effects show a 9.4 percentage point increase in wages and a 2.9 percentage point decrease in profitability (similar to Table 1). The same pattern of results is observed for the (negative of the) continuous pre-NMW wage, reported in panel B. There is a significant positive connection between wage growth and the negative of the pre-NMW wage and a significant negative association with profitability. When compared to average profits in the low-wage firms in the pre-policy period, the results for the binary low-wage firm model imply a sizable 22.7 per cent ($-0.029/0.128$) fall in profit margins. The P-values from F-tests of the no behavioral response model are at the bottom of each panel and again indicate that we cannot reject the simple model underlying equation (3).

IV.3. Further Probing of the Baseline Results

There are many reasons to probe these baseline results more deeply. The first, and obvious, reason is to judge the sensitivity of our definition of pre-policy low wages. Because we do not have data on the individual workers within our FAME firms, we rely

on pre-policy low wage status as being a function of the average wage in the firm. This is less than ideal, even though we have (at least partially) validated its use above with the WERS data, and it is important to study whether the results are robust to alternative ways of defining the threshold between treatment and comparison groups.

We therefore re-estimated the models in Table 2 for a range of different wage thresholds, running from an average wage of £10,000 at £1,000 intervals up to £15,000. The results are reassuring in that they all establish a significant NMW effect of reducing profit margins, with magnitude of the impact varying and becoming slightly larger (in absolute terms) for lower thresholds as we would expect (so there is a bigger impact on the very low wage firms).²⁵

A second possible concern is that our results are simply picking up a relationship between changes in profit margins and initial low wage status that exists, but has nothing to do with the NMW introduction. We have thus looked at estimates, structured in the same way, from periods *before* the NMW was introduced. One such ‘pseudo experiment’ or falsification test are reported in Table 3 where we examine an imaginary introduction of the NMW on April 1st 1996 (instead of April 1999) and repeat our analysis of wage and profitability changes. Table 3 very much reinforces the results reported to date, as we are unable to find any difference in margins between low and high wage firms in the period when the policy was not in place. This is consistent with the NMW introduction being the factor that caused margins to fall in low wage firms.

A related issue is the possibility of pre-sample trends (possibly due to mean reversion) in the wage model. If initially low wage firms had lower than average profitability growth even in the absence of the policy this would be conflated with the causal effect of the NMW impact on profits. The evidence from Table 3 suggested that there is no trend for wages or profitability in the pre-policy period. Nevertheless, we investigated this issue in more detail by estimating the profits model of Table 2 with a rolling threshold from £10,000 to £15,000 for both the policy and pseudo-experiment periods. That is, we estimate the model for thresholds at each £100 interval in this range and plot the coefficients (see Figure 3). In the policy-on period there is a consistently

²⁵ The profitability impacts for the different $T = 1$ thresholds were: -0.029 (0.014) for £10,000; -0.027 (0.013) for £11,000 ; -0.029 (0.012) for £12,000 ; -0.024 (0.010) for £13,000; and -0.014 (0.009) for £14,000.

negative effect of around 2-3% no matter how we draw the exact profit threshold. By contrast, in the pre-policy period there is essentially a zero effect with the point estimates actually positive and around 1%.

Draca et al (2008) report a number of further robustness tests. First, a statistical matching technique by trimming the sample according to the propensity scores of the treatment and comparison groups did not affect the pattern of results.²⁶ As discussed earlier our sample seems well chosen with relatively few observations needing to be trimmed to ensure common support. More importantly, the estimated effect of the policy on wages and profitability are significant and similar to those in the baseline Low Wage Firm specification.²⁷ Second, we included a full set of three-digit industry time trends. Although this is a strong test, the profitability effect was almost identical when these industry time trends were included with an estimate of -0.032 (0.015).

V. Further Investigation of the Minimum Wage Effect

The baseline results of Section IV show very clearly that low wage firms in the FAME data experienced faster wage growth coupled with falling profit margins before and after the introduction of the UK National Minimum Wage. The results also seem consistent with the no behavioral response theoretical model introduced in Section II above. The model has a number of other salient features that we explore more fully in this Section, in an attempt to understand the effect of minimum wages on firm profitability and mechanisms that underpin the negative effect our baseline results have uncovered.

²⁶ The basic method used is that of Heckman, Ichimura and Todd (1997) where propensity scores are estimated and the sample then trimmed to exclude poorly matched observations without common support. To generate the propensity scores, we used a probit model that included all the control variables used in Table 2. We trimmed at the 1st percentile of the treatment group and the 99th percentile.

²⁷ Few observations are lost under propensity score matching because the comparison group is already chosen to be of relatively low wage firms (under £20,000 average annual wages). If we had used the entire FAME sample (including firms with average wages of over £20,000) we would have had to lose the vast majority of the sample to ensure that the comparison group had common support with the treatment group. Results are not presented for the pre-policy average wage since that is a continuous variable. If, however, the specification including that variable was estimated on the trimmed sample from columns (2) or (3) this produced very similar results to the baseline estimates of Table 2.

V.1. Minimum Wages and Profitability in UK Residential Care Homes

In this sub-section we look at the wage and profitability effects of the minimum wage in a rather different context, UK residential care homes.²⁸ There are three reasons to focus on care homes to juxtapose with the FAME results. First, it is a very low wage sector so offers a good testing ground for studying minimum wage effects on profitability and other economic outcomes.²⁹ Second, the sector is price regulated so one of the margins of adjustment (passing on higher wage costs in higher prices) is constrained. Finally, we have individual level data so can observe the entire within-firm wage distribution in this exercise, something we could not do in the FAME dataset.

The more sophisticated definition of treatment we are able to use is the initial firm wage gap relative to the minimum, namely the proportional increase in a firm's wage bill required to bring all of its workers up to the minimum wage. This variable, *GAP*, is defined as:

$$GAP_i = \frac{\sum_j h_{ji} \max(W_{ji}^{\min} - W_{ji})}{\sum_j h_{ji} W_{ji}} \quad (7)$$

where h_{ji} is the weekly hours worked by worker j in firm i , W_{ji} is the hourly wage of worker j in firm i , and W_{ji}^{\min} is the minimum wage relevant for worker j in firm i .

For care homes, we do not have accounting data and so the profit variable we study is a derived one based on total revenues less total costs. Total revenue of each home is measured directly as the product of the number of beds, the home-specific average price of beds and the home occupancy rate. Total costs are calculated by dividing the total firm wage bill by the share of labor in total costs.³⁰ Home profitability is then defined as the ratio of profits to revenue.

²⁸ To date these data have mostly been used for studies of minimum wage effects on wages and jobs (e.g. Machin, Manning and Rahman, 2003), but see also Machin and Manning's (2004) test of competitive labor market theory.

²⁹ Prior to the minimum wage introduction in April 1999 average hourly wages were very low in the sector (at around £4 per hour). On average, 32.2% of workers were paid below the incoming minimum wage with this figure falling to 0.4% after the introduction of the policy.

³⁰ Total sales and profits are not reported directly in the care homes data. We calculated them from the underlying home-specific components. Sales (S) is calculated as Occupancy Proportion * Number of Beds * Average Price (all reported in the survey). The wage bill (WB) and the share of labor in total costs ($SHARE$) are also reported directly in the data. We can then calculate total costs (TC) as the ratio of the wage bill to

We therefore estimate the following care homes specification:

$$\Delta\left(\frac{\Pi}{S}\right)_{it} = \eta_0 + \eta_1 \text{GAP}_{i,t-1} + \eta_2 Z_{i,t-1} + \xi_{it} \quad (8)$$

where ξ_{it} is the equation error. Under the no behavioral response model the coefficient on GAP (η_1) should be equal to the wage bill share of revenues.

Table 4 presents estimates of home-level wage change and profitability change equations for the period surrounding NMW introduction (1998-99). The upper panel (A) focuses on wages, and presents results showing that wages clearly rose by more in homes with a larger pre-NMW wage gap. The lower panel (B) shows profitability estimates, where the coefficient on the pre-NMW wage gap variable is estimated to be negative and significant. In the column (2) specification with controls the coefficient is -0.492. Thus there is clear evidence of profitability falls in homes that were more affected by the minimum wage introduction. This very much corroborates the FAME findings of the previous section.

There was also some evidence that wages rose more in the pre-policy period (1992-93) in homes with a bigger initial wage gap.³¹ Nevertheless, the relationship is much weaker in the earlier period so the trend-adjusted estimate is statistically significant and large in magnitude (at 0.678). Under the no behavioral response model, the coefficient on the initial wage gap measure should equal the share of the wage bill in sales. The (trend adjusted) point estimate on the wage gap term in the profitability equation turns out to be -0.396 for the model with controls (and -0.343 for the no controls specification), which in absolute terms is very close to the wage bill to sales ratio in our sample of care homes (0.398). Hence, like the FAME results the magnitude of the estimated impact in care homes is very much in line with what we would expect from the simple no behavioral response model.

the labor share ($WB/SHARE$). Profits are then simply sales less total costs ($S - TC$). Profitability is the ratio of profits to sales, $(S - TC)/S$.

³¹ We define a counterfactual minimum wage at the same percentile of the wage distribution as the real 1999 minimum, so we can compute a *GAP* measure for the earlier pre-policy time period. Note that this is the only previous wage change information that exists, as the data was not collected in other (non-election) years.

V.2. Sectoral Heterogeneity: Industries With High and Low Market Power

As noted in Section II, a condition for the existence of long-run effects of minimum wages on profitability is that there is some degree of imperfect competition in the product market. To examine this idea in Table 5 we split industries into “high” and “low” competition industries based on a proxy for the Lerner Index (constructed as in Aghion et al, 2005). Consistent with the idea of imperfect competition, the effects of the NMW policy on profitability were stronger in the less competitive sectors (defined as those with above the median value of three-digit industry Lerner index). Table 5 shows that the impact of the policy on wages was not so different (10.9% vs. 8.1%). By contrast, the effect of the minimum wage on profitability was almost two and a half times as large in the less competitive industries as in the more competitive sectors (as well as being significant only in the more competitive sectors).

Under perfect competition, an industry facing a common increase in marginal costs will pass on the higher wage costs in the form of higher prices to consumers. In less competitive sectors, however, firms will generally adjust by reducing their profit margins, rather than just through prices. Therefore, the evidence in Table 5 is consistent with the idea that the strongest effects of the NMW on profitability will be in the less competitive sectors.

V.3. Effects of Minimum Wage on Other Outcomes: Employment, Productivity, Exit and Entry

We also examined the effect of the NMW policy on other firm outcomes in the lower part of Table 5, again split by high and low market power sectors. We do not find any significant negative effects on employment, consistent with some of the minimum wage literature (e.g. Card and Krueger, 1994). The presence of no significant employment effect is also consistent with our tests of the no behavioral response model. Similarly, there does not appear to be any effect of the policy introduction on labor productivity (as predicted by the "shock" theory).

The FAME database identifies four categories of inactive firms, namely firms that are dissolved, liquidated, in receivership or currently non-trading.³² Hence, we have defined all firms in these categories as “exiting” firms. We examine three year death rates for a cohort alive April 1st 1999 (i.e. did they exit by March 31st 2002) compared to a cohort alive on April 1st 1996 (i.e. did they exit by 1999). In the final row of Table 5 there is no evidence of any faster increase in exit rates in initially low wage firms following the minimum wage introduction either in the whole sample or in sub-sectors. The same is true in models of the probability of closure of care homes (see Machin and Wilson, 2004).

There are two possible problems with this firm-level analysis of exit. First, we ignore the possible entry-detering effect of the minimum wage may, and second, there may be pre-policy trends.³³ Table 6 takes both of these into account. Obviously, we cannot implement this at the firm level, as entrants do not have a pre-policy wage for the entrants. However, we can examine an alternative dataset containing all entrants and exits in each three-digit sector (from the Department of Trade and Industry’s VAT Registration Database).³⁴

The three Panels of Table 6 show one-year entry rates, one-year exit rates and the difference between the two (“net entry”) three-digit industries. Column (1) shows estimated coefficients on a pre-NMW low pay proportion in the period surrounding NMW introduction. Column (2) does the equivalent experiment for an imaginary policy (as in Table 3) introduced in 1996 and column (3) presents the trend-adjusted difference in differences. Although the first row shows that entry rates appear to perversely increase for low wage firms after the minimum wage, there does appear to be some positive pre-policy trend in column (2) suggesting a negative trend-adjusted effect of the NMW policy on entry. Similarly, trend adjusted exit rates in Panel B are 1.5 percentage points higher after the minimum wage was introduced. The final row shows that trend-adjusted net entry rates had fallen by about 5.1 percentage points in the low wage industries after the

³² So exits by takeover are *not* coded to be unity in this definition as takeovers may be regarded as a sign of success rather than failure. Re-defining the dependent variable to be unity if the exit is to a takeover does not change the qualitative nature of the results.

³³ Running the pseudo-policy experiment of Table 3 gave a coefficient on the policy variable of 0.021 with a standard error of 0.106 for employment and 0.077 with a standard error of (0.053) for productivity.

NMW introduction This effect is large in magnitude, but not statistically significant. These results do hint that in the long-run a margin of adjustment may be in the dimension of lower rates of net entry into the sectors most affected by the NMW.³⁵ There is little within firm change, but the margin of adjustment may be through the long-run number of firms.

VI. Conclusions

This paper considers a very under-studied research question on the economic impact of minimum wages by looking at empirical connections between minimum wage legislation and firm profitability. Using the quasi-experiment of the introduction of a national minimum wage to the UK labor market in 1999, we utilise pre-policy information on the distribution of wages to construct treatment and comparison groups and implement a difference in differences approach. We report evidence showing wages were significantly raised, and firm profitability was significantly reduced by the minimum wage introduction. There is also some evidence of bigger falls in margins in industries with relatively high market power, but no effects on firm employment or productivity. Somewhat surprisingly, our findings are consistent with a simple "no behavioral response" model where wage gains from minimum wages map into profit reductions. There is a hint that the long-run adjustment may be through lower rates of net entry.

There are, of course, a number of caveats to our results. It would have been useful to have data on prices and quality to see if these may also have adjusted in response to minimum wages.³⁶ It would also be useful to have more information on the within firm distribution of workers in other sectors besides care homes. A fuller integration of theory and empirical work in the context of imperfect competition in both product and labor markets is another fruitful research area for the future. Overall, though given the total sparsity of evidence of the impact of minimum wage floors on firm profitability, we

³⁴ Unlike the firm data, we cannot distinguish between exit due to takeover and exit due to bankruptcy (the focus of Table 7). Appendix table B2 describes some key features of these data.

³⁵ Our further indications indicated that there were minimal differences in entry and exit rates between high and low market power industries. For example, when split by market power the corresponding estimates for column (1), Panel (A) in Table 6 were 0.025 (0.022) for high and 0.019 (0.020) for low.

believe this study is an important contribution looking at the impact of labor market regulation on *firms* as well as the more developed and extensive evidence base that exists studying the impact on individuals.

³⁶ Although there is no evidence for these effects in the care homes sector, as it is heavily regulated (see Machin, Manning and Rahman, 2003).

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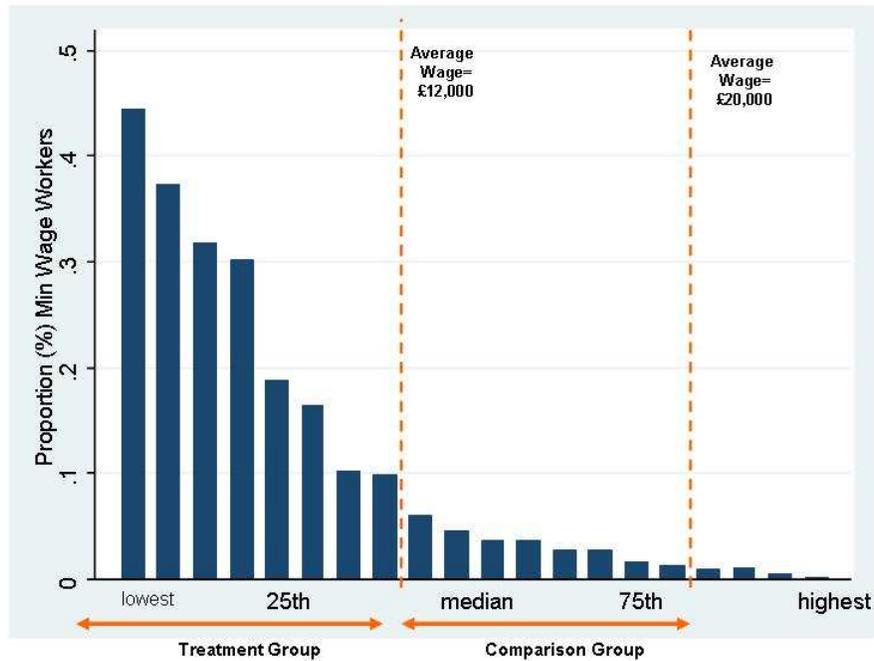
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**FIGURE 1: VALIDATION OF AVERAGE WAGE DATA
(COMPARISON OF PROPORTION OF LOW WAGE WORKERS AND
ESTABLISHMENT AVERAGE WAGES, WERS 1998)**

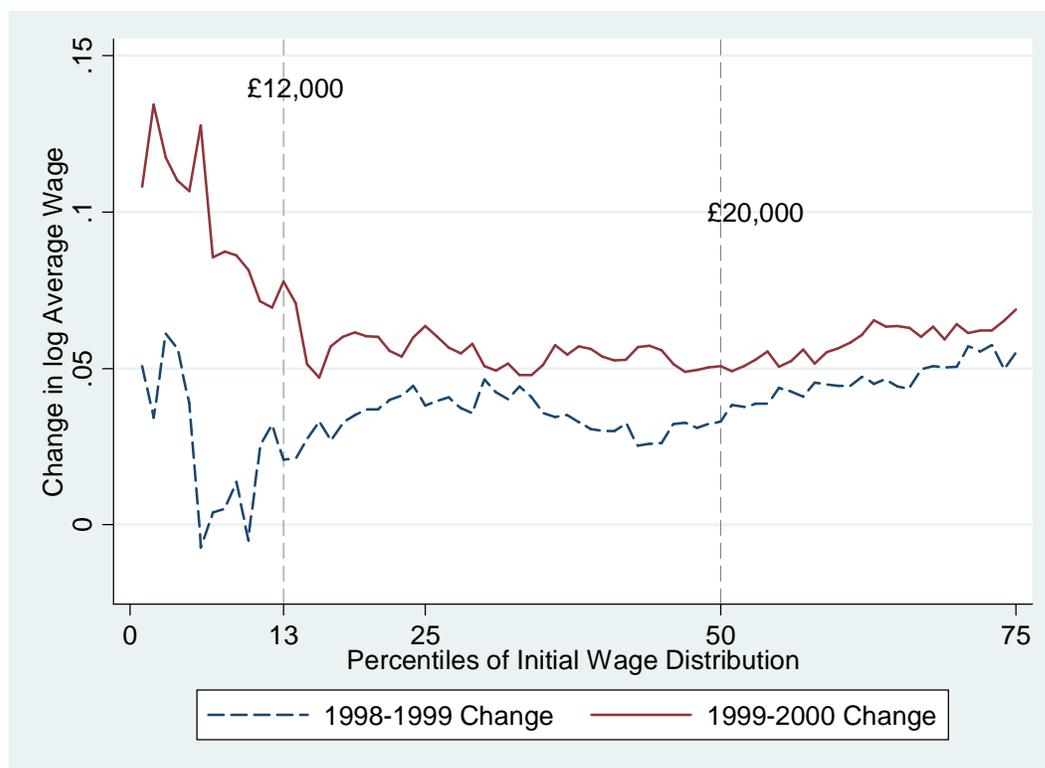


Source: Workplace Employee Relations Dataset 1998 (Worker-level Survey)

Notes:-

- 1). These figures are derived from the worker-establishment data (23,319 workers in 1,782 workplaces) from the 1998 Workplace Employee Relations Survey (WERS). The y-axis shows the proportion of workers paid below the minimum wage (£3.60 per hour) in the establishment. The x-axis shows the average annual wage at the workplace. This is divided into bins for of five percentiles from lowest (left) to highest (right) - a total of twenty bins.
- 2). We mark the relevant thresholds for our analysis with vertical lines. The £12,000 line represents the main treatment group threshold used in our analysis of the FAME data. The £20,000 line is the cut-off for the upper bound of the comparison group used in the FAME analysis.

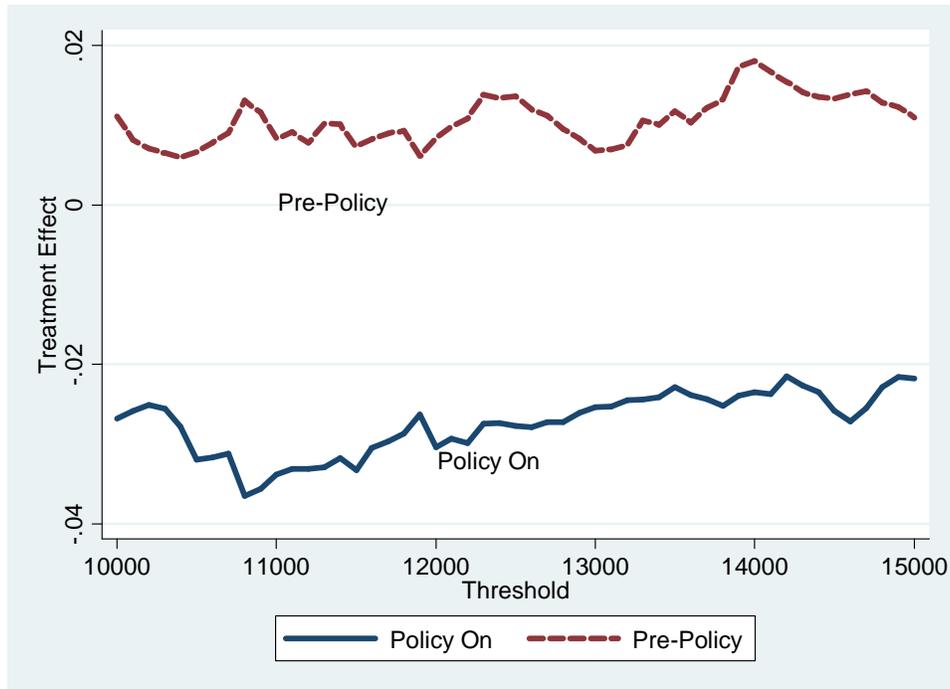
FIGURE 2: CHANGE IN LN(AVERAGE WAGE) BY PERCENTILE IN THE FINANCIAL YEAR BEFORE AND AFTER NMW INTRODUCTION



Notes:-

- 1). The data is taken from the FAME database of company accounts. The horizontal axis indicates the percentile in the firm wage distribution for a given firm in the initial period, the pre-policy financial year up to March 31st 1999. The vertical axis shows the proportionate change in average firm wages (between the pre-policy financial year and the post policy financial year) for each firm ranked by where it began in the wage distribution.
- 2). Pre-Policy is defined as the financial year April 1st 1998 to March 31st 1999; Policy On is defined as the financial year April 1st 1999 to March 31st 2000.
- 3) We show the threshold for the treatment groups by hatched vertical lines. In the baseline specifications firms with average wages below £12,000 (the 13th percentile) are in the treatment group and firms with average wages between £20,000 (the median) and £12,000 are in the control group.

FIGURE 3 VARYING TREATMENT EFFECT COEFFICIENTS IN FAME DIFFERENCE-IN-DIFFERENCE PROFITABILITY MODELS



Notes:-

- 1). Data taken from is the FAME database of company accounts. The baseline models are as per Pre-NMW Low Wage Model in Tables 2 (Policy On period) and Table 3 (Pre-Policy period). .
- 2). The vertical axis shows the estimated treatment effects. The horizontal axis shows thresholds are shifted in units of £100 to define treatment group (T=1) as firms with pre-policy wages of under the threshold and comparison group with firms with average wages over the threshold and under £20,000. The baseline model is then re-defined and re-estimated using 50 successive treatment group wage thresholds between £10,000 and £15,000.
- 3). The Policy On sample period covers the six financial years from April 1st 1996 to March 31st 2002, NMW introduction on April 1st 1999. The Pre-Policy (pseudo-experiment) period covers the six financial years April 1st 1993 to March 31st 1999, with an 'imaginary' NMW introduction on April 1st 1996.

TABLE 1: CHANGES IN FIRM AVERAGE WAGES AND PROFITABILITY BEFORE AND AFTER THE INTRODUCTION OF THE NATIONAL MINIMUM WAGE

	(1)	(2)	(3)
	Pre-NMW Introduction	Post-NMW Introduction	Difference
A. ln(Average Wage), lnW			
Pre-NMW Low Wage Firm, T=1	2.149	2.378	0.229
Pre-NMW Not Low Wage Firm, T=0	2.775	2.893	0.118
Difference-in-Difference			0.111*** (0.029)
B. Profit Margin, Π/S			
Pre-NMW Low Wage Firm, T=1	0.128	0.089	-0.039
Pre-NMW Not Low Wage Firm, T=0	0.070	0.058	-0.012
Difference-in-Difference			-0.027** (0.014)

Notes:-

1). Pre-NMW corresponds to the three financial years April 1st 1996-March 31st 1999 and Post-NMW to the three financial years April 1st 1999-March 31st 2002.

2). T = 1 indicates the treatment Group and T= 0 indicates the comparison group. Pre-NMW Low Wage Firm – the treatment group is defined as firms with an average wage equal to or below £12,000 per annum in the pre-policy financial year up to March 31st 1999; the comparison group is defined as firms with average wages between £12,000 and £20,000 in the pre-policy financial year up to March 31st 1999.

3). Standard errors in parentheses are clustered by firm and sample size is 4,112 (there are 951 firms).

TABLE 2: WAGES AND PROFITABILITY BEFORE AND AFTER INTRODUCTION OF THE NATIONAL MINIMUM WAGE (NMW), 1997-2002

Period Before and After NMW Introduction, 1997-2002, (N = 4,112)		
	<i>Change in ln(Average Wage), $\Delta \ln W$</i>	<i>Change in Gross Profit Margin, $\Delta(\Pi/S)$</i>
A. Treatment = Low Wage Firm		
Pre-NMW Low Wage Firm	0.090*** (0.026)	-0.029** (0.012)
Test of no behavioral response	P-value = 0.663	
B. Treatment = - Pre-Policy ln(W)		
- Pre-NMW ln(W)	0.188*** (0.033)	-0.032** (0.015)
Test of no behavioral response	P-value = 0.144	

Notes:-

- 1). Coefficients estimated by Ordinary Least Squares and standard errors in parentheses below are clustered by firm (there are 951 firms).
- 2). The Pre-NMW period covers the three pre-policy financial years April 1st 1996-March 31st 1999 and the Post-NMW period the three financial years April 1st 1999-March 31st 2002. Low Wage Firm Pre-NMW - treatment group is defined as firms with an average wage equal to or below £12,000 per annum in the pre-policy financial year up to March 31st 1999; the comparison group is defined as firms with average wages between £12,000 and £20,000. Pre-NMW ln(W) - indicates that we use a continuous measure of the wage (in the pre-policy year up to March 31st 1999) is used for treatment intensity.
- 3). Controls include two digit industry dummies; 18 regional dummies; the proportion of workers who are graduates (by region and two-digit industry); and union membership, part-time work and female employment rates (by three-digit industry classification).
- 4). "Test of no behavioral response" implements equation (3) in the text.

TABLE 3: WAGES AND PROFITABILITY BEFORE AND AFTER INTRODUCTION OF AN 'IMAGINARY' NATIONAL MINIMUM WAGE (NMW), 1993-1999

Period Before and After 'Imaginary NMW' Introduction, 1993-99, (N = 4,550)		
	<i>Change in ln(Average Wage), $\Delta \ln W$</i>	<i>Change in Gross Profit Margin, $\Delta(\Pi/S)$</i>
A. Treatment = Low Wage Firm		
Pre-'Imaginary NMW' Low Wage Firm	0.033 (0.028)	0.015 (0.011)
B. Treatment = - Pre-Policy ln(W)		
- Pre-'Imaginary NMW' ln(W)	0.079 (0.106)	0.012 (0.029)

Notes:-

- 1). Coefficients estimated by Ordinary Least Squares and standard errors in parentheses below are clustered by firm (there are 1,047 firms).
- 2). The Pre-'Imaginary NMW' period covers the three financial years April 1st 1993 – March 31st 1996 and the Post-'Imaginary NMW' period covers the three financial years April 1st 1996 and March 31st 1999. Low Wage Firm Pre-'Imaginary NMW' - treatment group is defined as firms with an average wage equal to or below £12,000 per annum in the pre-policy financial year up to March 31st 1996; the comparison group is defined as firms with average wages between £12,000 and £20,000. Pre-'Imaginary NMW' ln(W) - indicates that we use a continuous measure of the wage (in the Pre-'Imaginary NMW' year up to March 31st 1996) is used for treatment intensity.
- 3). Controls include two digit industry dummies; 18 regional dummies, the proportion of workers who are graduates (by region and two-digit industry); and union membership, part-time work and female employment rates (by three-digit industry classification).

**TABLE 4: NATIONAL MINIMUM WAGE INTRODUCTION AND
WAGES AND PROFITABILITY IN CARE HOMES, 1998-1999.**

Period Before and After NMW Introduction, 1998-99, (N = 908)		
A. Wages	<i>Change in ln(Average Wage), $\Delta \ln W$</i>	
Pre-NMW Wage Gap	0.861*** (0.045)	0.886*** (0.052)
Controls	No	Yes
B. Profitability	$\Delta(\Pi/S)$, <i>Change in Profit Margin</i>	
Pre-NMW Wage Gap	-0.433*** (0.173)	-0.492*** (0.202)
Controls	No	Yes

Notes:-

- 1). Coefficients estimated by Ordinary Least Squares. Robust standard errors in parentheses under coefficients.
- 2). Sample covers 454 nursing homes in 1998 and 1999.
- 3). Initial pre-minimum wage period (t-1) controls include workforce characteristics (proportion female, mean worker age, proportion with nursing qualifications), the proportion of residents paid for by the government ("DSS"), region dummies and month dummies.

TABLE 5: SPLITTING INTO HIGH AND LOW MARKET POWER INDUSTRIES

Outcome	High Market Power Industries	Low Market Power industries
A. Wages		
Treatment = Low Wage Firm N = 1,943 (High); N =2,169 (Low)	0.109*** (0.035)	0.081** (0.038)
B. Profits		
Treatment = Low Wage Firm N = 1,943 (High); N =2,169 (Low)	-0.037** (0.018)	-0.014 (0.014)
Test of no behavioral response	P-value = 0.646	P-value = 0.531
C. Employment		
Treatment = Low Wage Firm N = 1,943 (High); N =2,169 (Low)	0.104 (0.142)	-0.012 (0.121)
D. Labor Productivity		
Treatment = Low Wage Firm N = 1,943 (High); N =2,169 (Low)	0.075 (0.066)	0.113 (0.090)
E. Exit		
Treatment = Low Wage Firm N=1,150 (High); N= 1,206 (Low)	-0.023 (0.023)	-0.002 (0.027)

Notes:-

- 1). This table shows the results from a series of separate regressions for the Low Wage Firm models. The dependent variable is indicated in the first column, Column (1) is on the sub-sample of firms in high market power industries and column (2) is the sub-sample of firms in the low market power industries
- 2). High market power industries are defined as those with higher than the median value of the industry-level Lerner Index in the firm's three-digit industry. Low market power industries are defined as those with below the median value of the industry-level Lerner Index in the firm's three-digit industry.
- 3). Coefficients estimated by Ordinary Least Squares and standard errors in parentheses below are clustered by firm.
- 4). Employment is total number of workers in the firm. Labor productivity is $\ln(\text{sales}/\text{employment})$. "Exit" is defined for two cohorts in 1996 (pre-NMW) and 1999 post NMW and indicates whether the firm ceased to exist in the subsequent 3 years (see text)
- 5). Controls include two digit industry dummies; 18 regional dummies, the proportion of workers who are graduates (by region and two-digit industry); and union membership, part-time work and female employment rates (by three-digit industry classification).

TABLE 6: FIRM ENTRY AND EXIT (BY THREE-DIGIT INDUSTRY).

	Period Before and After NMW Introduction, 1996- 2001, (N = 1,020)	Period Before and After 'Imaginary NMW' Introduction, 1994-98, (N = 850)	Difference
A. Change in Industry Entry Rates			
Pre-NMW Low Pay Proportion	0.021 (0.015)	0.057* (0.032)	-0.036 (0.038)
B. Change in Industry Exit Rates			
Pre-NMW Low Pay Proportion	-0.013 (0.016)	-0.028 (0.018)	0.015 (0.024)
C. Change in Industry Net Entry Rates			
Pre-NMW Low Pay Proportion	0.034 (0.025)	0.085** (0.027)	-0.051 (0.037)

Notes:-

1). Data taken from Value-Added Tax (VAT) Registrations and Deregistration Data, Department of Trade and Industry (DTI). Entry rate is the proportion of firms who are newly registered in a year in a three-digit industry. Exit rate is the proportion of firms who are deregistered in the year. Net entry is entry rate – exit rate. Standard errors (in parentheses) are clustered by three-digit industry.

2). Pre-NMW low pay proportion is the proportion of workers with an hourly wage less than £3.60 in the three-digit industry in real terms over the pre-policy period (the minimum wage threshold of £3.60 is deflated by the retail price index for the years 1994-1998).

3). All specifications include controls for two digit industry dummies, time dummies, and the proportion of employees in the three-digit industry that are female, part-time and the proportion of employees in the three-digit industry that are female, part-time and unionized.

Appendices

[Note that these are for referees only and not intended for publication unless specifically requested. They are available on-line as NBER Working Paper 13996]

Appendix A: Theoretical Models of Profitability and Minimum Wages

A1. Introduction

In order to obtain a long-run effect of the minimum wage on profitability we need to have some degree of imperfect competition in the product market. We therefore consider several industrial organization models. Aaronson and French (2007) consider in detail the effects on the minimum wage on prices and costs in a competitive and monopsonistic labor market model. However, in these models firms do not have positive price-cost margins so profits remain zero by assumption, regardless of the minimum wage.

We separate our analysis into the short-run and long-run, where we define the short run as the period where all variables are able to change (*including* capital, labor, prices, etc) but the number of firms is held fixed. In the long-run entry and exit can occur and the number of firms can change. Our analysis of exit and entry is directly applicable to the long-run results.

A2. Imperfect Competition in the Product market

Short-run effects with symmetric and asymmetric costs

Consider a two-stage game where firms pay a sunk entry cost (K) and, conditional on entering engage in competition with other firms (total number of firms in market is denoted N). The instruments of competition can be price or quantity.

We begin with the workhorse industrial organization model of an asymmetric Cournot model³⁷ where firms have heterogeneous marginal costs. Below we discuss alternative imperfect competition models that lead to similar qualitative results.

The non-cooperative Nash equilibrium in quantities gives a well-know expression for the price-cost margin:

$$\frac{p - c_i(q_i)}{p} = \frac{MS_i}{\eta} \quad (\text{A1})$$

Where η is the (absolute value of the) price elasticity of product demand, p is output price, c_i is marginal cost of firm i , q_i is firm output and MS_i is the market share

³⁷ Cournot competition can be considered the reduced form of a two-stage game where firms set capacities in the first stage and then compete in prices in the first stage (Kreps and Scheinkman, 1983).

$(MS_i = \frac{S_i}{\sum_i S_i})$ with S_i denoting firm sales. Note that equation (A1) nests the special cases of monopoly ($N = 1$). If we assume constant returns then marginal costs do not depend on output ($c_i = c_i'(q_i)$) so the price-cost margin can be characterised by the ratio of profit (Π) to sales (S):

$$\left(\frac{\Pi}{S}\right)_i = \frac{MS_i}{\eta} \quad (\text{A2})$$

Firm i 's market share will depend on its marginal costs relative to the marginal costs of other firm's in the industry. If firm i 's marginal costs rise relative to those of other firms it will lose market share (see Tirole, 1989, Chapter 5 for example).

Consider the effect of an increase in the minimum wage. If we assume that demand is iso-elastic (we will relax this below) then the impact of the minimum wage on the firm's price-cost margins will be reflected in its market share. If a firm employs a greater proportion of minimum wage workers, it will face a larger increase in marginal costs and therefore a larger fall of its price-cost margins.

This is our key comparative static result: the introduction of a minimum wage will reduce the profitability of firms who are more "at risk" because they employ a higher share of minimum wage workers.

If we also relax the assumption the demand elasticity is constant, there will also likely be a fall in profitability. To see this clearly assume that firms are symmetric so that they all face identical marginal costs. In this case, the equilibrium condition of (A1) simplifies to

$$\frac{\Pi}{S} = \frac{1}{N} \frac{1}{\eta} \quad (\text{A3})$$

It is clear from equation (A3) that the impact of the minimum wage will on profitability $(\frac{\Pi}{S})$ will depend on its impact on the demand elasticity (η). In particular if demand becomes more elastic, profitability will fall. For most commonly used demand curves, a minimum wage will make the demand curve more elastic because price has risen. For example, consider the case of linear industry demand (Q) for where $Q = A - bp$, $b > 0$, $A > 0$. In this case, $\eta = b \frac{P}{Q}$. Following the introduction of a minimum wage prices will be

higher and quantity sold lower unless demand is perfectly elastic. The elasticity of demand is therefore higher and profitability will fall. This will reinforce the effects on market share discussed in the more general model with asymmetric firms.³⁸

³⁸ We cannot rule out the possibility that the aggregate demand curve may become more elastic as wages rise even if the labor market is perfectly competitive. Micro-economic theory places few restrictions on

Under differentiated products Bertrand equation (A3) should be interpreted as a firm-specific elasticity.

This result differs from Aaronson and French (2006) who consider a model of monopolistic competition. This generates an equilibrium condition like (A3). The minimum wage has no effect on price cost margins in their model because they assume that the elasticity of demand is constant. This guarantees no effect of the minimum wage on price-cost margins as all costs are passed through completely to the consumer. Additionally, the “large number of firms” assumption underlying monopolistic competition rules out strategic interactions that generate the market share effects in equation (A3)

Long-run effects

After the minimum wage is imposed, absolute profits in the industry will be lower. This will mean that there is less of an incentive to enter the industry. Consequently, we might expect to see fewer firms in the industry (from exit and/or less entry) in the long run. The short run fall in profits for the incumbent firms in the industry will therefore be greater than the long-run change as N will fall (e.g. see equation (A3)).

An important caveat to this is that the number of firms in the industry may not fall due to an “integer” effect. Since there will always be an integer number of firms in the industry all firms will usually earn some economic profit. Firms will enter and pay the sunk cost up until the point that a marginal firm entering the industry would not make a profit net of the sunk cost. For example, consider a symmetric duopoly in long-run equilibrium. If a third firm entered the industry a firm’s profits (net of the sunk cost, K) would be negative i.e. $\Pi^{*(3)} - K \leq 0 \leq \Pi^{*(2)} - K$, where $\Pi^{*(3)}$ is equilibrium profits with three firms and $\Pi^{*(2)}$ equilibrium profits with two firms.

Now, except in the special case when profits in the market exactly covers the sunk cost ($\Pi^{*(3)} - K < 0$ and $\Pi^{*(2)} - K = 0$) the minimum wage could reduce $\Pi^{*(2)}$, but not by so much that $\Pi^{*(2)} - K < 0$ and one firm was forced to exit the industry. Consequently, for small increases in the minimum wage firms could have lower profits without a change in the equilibrium number of firms.

This caveat aside, in a dynamic setting we would expect that a minimum wage would increase exit and reduce the entry rate.

A3. Perfect Competition in the Product Market

industry demand curve aggregated from consumer preferences (e.g. see Varian, 1984, chapter 3.16). Thus, it is still ultimately an empirical issue whether profitability rises or falls after the minimum wage.

Now consider the case of perfectly competitive product markets. Comparative statics of prices and factor demands following a minimum wage increase have been comprehensively analyzed by Aaronson and French (2007). Here, we will briefly contrast the usual case of perfect competition in the labor market with some alternative models. It worth emphasizing two preliminary points. First, as we discussed above that these are in the short-run as in the long run firms earn zero profits by assumption. Second, the short-run effect of the introduction of a minimum wage will be *larger* in the competitive model than in the monopsony model.

Perfect competition in the labor market

If labor markets are perfectly competitive, the short run effects of the minimum wage on profits are composed of two components (see Ashenfelter and Smith, 1979, and the main text). First, there is fall in profits due to the increased wage for the current number of workers paid below the minimum wage. This fall in profits is offset by a second effect to the degree that firms can substitute minimum wage workers for other factors of production (including non minimum wage workers). In the limiting case of perfect substitutability of minimum wage workers there will be *no effect* on profits.

Of course these are only short-run effects as there can be no economic profits under perfect competition and in equilibrium industry prices will rise and quantity will fall (so there will either be fewer firms or the average firm size will shrink).

Imperfect Competition in the labor market

There have been a variety of models proposed in recent years where firms have some power to set wages because of efficiency wages, monopsony, search or other reasons. In these models, over a certain range of values a binding minimum wage can increase employment.

Considering profits, we would expect the negative short-run effects of a minimum wage on profitability to be muted in such models. This is because, unlike the competitive model the first order effect on profits is zero as an increase in the wage has a beneficial effect on profits through making it easier to recruit, retain and/or motivate workers. There will be a second effect because the firm is being shifted away from its optimal level of the wage so overall we would still expect a decline in profits. However, this is likely to be much less severe than in the competitive model.

To see this consider a simple representation of the monopsony model. We model the firm's wage setting power in a reduced form way (following Card and Krueger, 1995) and assume that the production function, $F(W, L)$, is increasing in the wage as well as labor, L . The firm chooses wages and labor to maximize profits

$$\Pi = \max_{w,L} pF(W, L) - WL$$

Which lead to the standard first order condition:

$$p \frac{\partial F(W, L)}{\partial L} = W^*$$

where an asterix denotes the optimized value. We also have an additional non-standard condition from optimizing wages of:

$$p \frac{\partial F(W, L)}{\partial W} = L^* \tag{A4}$$

If we consider the effect of a small increase in wages on profits in the neighbourhood of the optimized level of wages and employment (W^*, L^*) this is given by:

$$\frac{d\Pi}{dW} = p \frac{\partial F(W^*, L^*)}{\partial W} - L^*$$

Note that this is equal to zero by the first order condition with respect to wages, equation (A4).

Long-run effects

In this setting, there are no long-run effects on profits.

Considering exit, unlike the model with imperfect competition firm size is not tied down.

In the competitive model, prices will be higher and output lower. In our constant returns set-up a zero profit equilibrium can be restored either by all firms becoming smaller or by some firms exiting.

A4. Summary

In models of imperfect product market competition, we would generally expect to observe negative effects on the profitability of firms where the minimum wage bites, even after firms have adjusted all factors of production. In such models, some of the increase in costs is borne by shareholders rather than just consumers and unemployed low-wage workers as in the standard competitive model.

It is worth emphasizing that employment will still fall in these models. So oligopoly could explain only why employment responses could be more muted than one would expect from a competitive model. Of course, employment changes can be positive if firms with market power in the product market also have market power in the labor market.

The final section (A4) showed a very simple model that assumes no change in sales or jobs following a minimum wage hike. This model does surprisingly well in rationalizing the results.

Additional References

Aaronson, Daniel and French, Eric (2006) “Product Market Evidence on the Employment Effects of the Minimum Wage” Federal Reserve Bank of Chicago Working Paper No. 21

Kreps, David and Scheinkman, J. (1983) “Quantity Precommitment and Bertrand competition yield Cournot outcomes” Bell Journal of Economics, 14, 326-227

Tirole, Jean (1989) The Theory of Industrial Organization, Cambridge: MIT Press

Varian, Hal (1986) Microeconomic Analysis, Second Edition New York: Norton

Appendix B: Data

FAME Data

The FAME (Financial Analysis Made Easy) dataset contains information on firm company accounts of publicly listed and private firms in the UK economy. It is supplied under licence as part of the AMADEUS database from BVD (Bureau Van Dijk). Our sample begins with data on all firms in the six financial years from April 1st 1996 to March 31st 2002 including those who had entered and exited. We select firms who report on the 31st March. We drop firms with missing data on our key variables (profits, wages, sales, employment, industry, and region). We use information on consolidated accounts at the lowest level that exists (i.e. we use subsidiary level information if this exists). We drop information for all observations where the profit-sales ratio is greater than 1 in absolute value.

In the main results, we condition on the cohort of firms who were alive on March 31st 1999 when the minimum wage introduced and had an average wage between £4000-£20,000. We also present results where we examine the impact of including firms who entered after this date (and exited before this date) including a dummy variables for entrant and exiting firms (and interactions of these dummies with the NMW policy period).

Profits/Sales: Gross profits (prior to deductions for tax, interest and dividends) over turnover (sales).

Average Wages: Total remuneration divided by total number of employees

Capital / Sales: Tangible assets over turnover (sales).

Sales / Employment: Total turnover (sales) over the number of employees.

Labor Force Survey

The Labor Force Survey (LFS) is a large-scale household interview-based survey of individuals in the UK that has been carried out on varying bases since 1975.³⁹ Around 60,000 households have been interviewed per survey since 1984. Annual proportions calculated relative to firm reporting year rather than calendar year (i.e. April 1998 – March 1999).

Union membership: Defined at the three-digit UKSIC industry level, annual values 1993-2002.

³⁹ Between 1975 and 1983, the survey was conducted every two years. From 1984 until 1991, it was conducted annually. Since 1992, the Labor Force Survey has been conducted every three months in a five-quarter rolling panel format.

Part-Time Work: Proportion of employed workforce classified as part-time, annual values 1993-2002. Defined at the three-digit industry level.

Female Workforce: Female workers as a proportion of total employed workforce, annual values 1993-2002. Defined at the three-digit industry level.

Graduate Qualifications: Proportion of graduate qualified workers per region and two-digit industry cell.

Region: Government Office Region of Workplace (“gorwk”). These include Tyne and Wear, Rest of the North East, Greater Manchester, Merseyside, Rest of the North West, South Yorkshire, West Yorkshire, Rest of Yorkshire and Humberside, West Midlands and Met Country, Rest of West Midlands, Eastern, Inner London, Outer London, South East, South West, Wales, Rest of Scotland, Northern Ireland.

Care Homes Data

The UK care homes data was collected in surveys conducted in 1992 (prior to the general election in that year) and 1993 for homes on the South Coast of England; in 1998 (before the introduction of the NMW) and in 1999 (after the introduction of the NMW in April) for all homes across the country. Finally, there was some more data collected in 2000 and 2001 for South Coast homes only. The data is in the form of an unbalanced panel so that the same homes are followed over time. The sector was chosen because it is characterized by a large concentration of non-unionized, low wage employees working in small firms with an average employment level of fifteen to twenty. There was also product market regulation in this sector insofar that an important fraction of home residents had their care paid for by the government through the Department of Social Security (DSS).⁴⁰ The Department of Social Security paid a capped price for beds, which were not increased when the minimum was introduced. As a result, many homes had a limited scope to increase prices in response to the minimum thereby leaving more room for employment or profitability effects to manifest themselves. A more comprehensive account of features of the data is given in Machin, Manning and Rahman (2003).

Business Registration and De-registration Database

The UK Department of Trade and Industry (DTI) publish data on births and deaths of companies at the three-digit level on a consistent basis from 1994 (see <http://stats.berr.gov.uk/ed/vat/>). These are based on Value Added Tax (VAT) Registration numbers that every incorporated firm in Britain is legally obliged to have. (This is the same as the aggregated FAME date).

We used this data to calculate for each three-digit sector the proportion of firms who entered in a year (entry rate). Entry rates calculated as the number of new VAT (Value-Added Tax) registrations as a proportion of the beginning of year stock. Exit rate

⁴⁰ The average percentage of such residents was 52.7% before the minimum wage introduction and 57.6% after. We always condition on this variable in the regressions.

calculated as the number of VAT deregistrations over the beginning-of-year stock. Net entry calculated as entry rate minus exit rate. We also calculated the net entry rate as the difference between the entry and exit rates.

We then matched information from the LFS at the same level of aggregation to calculate the proportion of workers in each industry paid below the minimum wage in the pre-policy period.

TABLE B1:
CHARACTERISTICS OF TREATMENT AND COMPARISON GROUPS

	Treatment Group T=1	Comparison Group T=0	All
Average Wage (£000s)	10.53	17.38	15.76
Profit/Sales	0.108	0.064	0.074
Capital/Sales	0.297	0.237	0.248
Wagebill/Sales	0.289	0.261	0.268
Employment (mean)	2,704	1,004	1,407
Employment (median)	273	170	187
Productivity (=Sales/Employee) (£000s)	71.4	110.2	101.0
Exit Rate	0.050	0.053	0.051
Proportion part-time employees	0.295	0.158	0.190
Proportion female employees	0.535	0.378	0.415
Proportion union members	0.186	0.213	0.207
Proportion Firms in:			
Manufacturing	0.165	0.372	0.323
Wholesale	0.081	0.172	0.150
Retail	0.098	0.038	0.052
Hospitality	0.163	0.015	0.050
Business Services	0.133	0.083	0.095
Number of Observations	974	3,138	4,112

NOTES:- T= 0: Comparison group; T = 1: Treatment Group; Part-time and female employees based on Labor Force Survey (LFS) and calculated as proportion of total workers per two-digit industry by regional cell. *Low Wage Firm* - treatment group is defined as firms with an average wage equal to or below £12,000 per annum in the pseudo pre-policy financial year up to March 31st 1996; the comparison group is defined as firms with average wages between £12,000 and £20,000. Sample for exit represents 1999 cohort of firms, with total N = 1,066 (N=319 for treatment group and N=747 for comparison group).

**TABLE B2: FIRM ENTRY AND EXIT RATES BY THREE-DIGIT INDUSTRY,
1996-2001 (DTI VAT REGISTRATIONS AND DEREGISTRATIONS).**

	(1) All Industries	(2) Low Wage industries (below median Lowpay)	(3) High Wage Industries (above median Lowpay)
Entry Rate	0.089	0.087	0.091
Exit Rate	0.082	0.083	0.081
Net Entry	0.007	0.003	0.011
Lowpay	0.126	0.051	0.201
Union	0.287	0.350	0.189
Female	0.343	0.274	0.411
Part-time	0.143	0.076	0.209
No. of Industries	170	85	85
No. of Observations	1,020	510	510

NOTES: Entry rates calculated as the number of new VAT (Value-Added Tax) registrations as a proportion of the beginning of year stock. Exit rate calculated as the number of VAT deregistrations over the beginning-of-year stock. Net entry calculated as entry rate minus the exit rate. The variables lowpay, union, female, part-time are all sourced from the UK Labor Force survey (LFS). The “Lowpay” variable is defined as the proportion of workers with hourly wage below £3.60 in the pre-minimum wage period (1994-1998). “Below Median Lowpay” indicates all those industries where the proportion of lowpay workers ranges from 0 to 0.092. “Above Median Lowpay” indicates all of those industries where the proportion of lowpay industries ranges from 0.095 to 0.557.