# Impact of the minimum wage regime on employment and hours of young workers by sector and size of firm

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Abstract

We analyse the impact of the national minimum wage (NMW) in the UK on the employment of young workers according to size and sector of firms. Our results suggest that both may play a role in shaping the minimum wage effect on employment. In particular, we find that young workers face a rising probability of finding employment in small firms during 1-2 years before reaching the age threshold for eligibility for the adult NMW rate. This stands in contrast with the aggregate result of negative employment effect one year before the threshold. When considering sectors, we find stronger evidence of disemployment effects in the service sector than in manufacturing.

Keywords: minimum wage; employment; unemployment; young workers

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# Executive Summary

The national minimum wage (NMW) is an important yet contentious tool of economic policy. It is especially likely to affect young workers who are more prone to earn low wages. In previous research (Fidrmuc and Tena, 2011), we found evidence that young male workers face a lower probability of being employed one year before they reach the age at which they become eligible for the adult rate. We interpret this result as evidence of an anticipation effect whereby employers are less inclined to hire, or are more likely to dismiss, young workers who are one year below the age at which the adult NMW rate becomes binding.

In this report, we explore this result further by considering whether the effect of NMW rules on young workers differs across establishments of different size or sectors of employment. While our results are somewhat weak due to a low number of observations for which information on size and sector are available, they do suggest that the NMW effect is not necessarily uniform. In particular, when looking at small firms, we find the opposite of the aforementioned negative effect occurring one year before the age at which the adult rate becomes effective: young workers are more likely to be employed between three quarters and two years before reaching the adult-rate age threshold. Hence, the negative effect that we found with aggregate data is more likely to occur in large rather than small firms.

When considering sectors of employment, our results are again somewhat weak and mixed, which is largely due to the low number of observations. However, broadly, they suggest that if the NMW has an adverse effect on employment, it is more likely to be the case for workers employed in the service sector than manufacturing. This probably reflects the greater incidence of low-wage jobs in the former.

Our results thus suggest that both size of firms and sector of employment can play important roles in shaping the employment effect of the minimum wage. Findings obtained with broad aggregate data sets therefore are not necessarily representative of the full range of effects that the minimum wage has on employment.

# 1. Introduction

The minimum wage is an important tool of economic and social policy. Yet, despite its frequent application (most developed countries and many developing countries have some sort of minimum wage regulation), it remains one of the most contentious policy measures. On the one hand, it is argued that it helps reduce poverty, ensures that workers have a minimum acceptable standard of living and that they are not exploited by unscrupulous employers. On the other hand, the minimum wage is seen as causing unemployment and promoting 'migration' of jobs to cheaper countries.

The UK has had a national minimum wage (NMW) since April 1999. In the wake of its introduction, several studies have sought to assess its impact on employment (Stewart, 2004; Dickens and Draca, 2005; Dickens, Riley and Wilkinson, 2010). Most found little evidence of an adverse effect. However, more recent studies have started to undermine this consensus. Fidrmuc and Tena (2011) argue that the NMW is undermining the employment of young male workers, while Dickens, Riley and Wilkinson (2012) find that the NMW lowers job retention among female part-time workers.

The international evidence is even more mixed. Card and Krueger (1995b) and Doucouliagos and Stanley (2009) conduct meta studies of the employment effect of the minimum wage regulation. They find little evidence of adverse impact on employment. Dolado et al. (1996) consider the employment effect of minimum wage rules in France, the Netherlands, Spain and the UK. Their findings range from negative (especially for young workers) to positive. Dolton and Rosazza-Bondibene (2011) find some evidence of negative employment effects of the minimum wage during the current recessions but argue that this is not robust. In contrast, a survey by Neumark and Wascher (2007) concludes that most of the international evidence points to the minimum wage having disemployment effects.

In this contribution, we focus on the impact of the NMW on the labour-market outcomes of young workers in the UK. Previous studies offer conflicting conclusions for this segment of the labour market. Dickens, Riley and Wilkinson (2010) find no evidence of an adverse employment effect; instead, they argue that the minimum wage has a positive effect through raising labour supply. In contrast, Fidrmuc and Tena (2011) argue that the NMW, and in particular the fact that the UK NMW features separate age-specific rates for young and adult workers, depresses the employment prospects of young males. Rather than occurring at the

time when young workers become eligible for the higher adult rate, however, they find a negative effect taking place one year earlier, which they attribute to an anticipation effect on behalf of employers (such an effect can work either through higher probability of employment termination or through lower hiring probability for male workers at or around 21 years of age).

Internationally, an interesting case study presents itself in New Zealand. This country reformed its minimum wage regulation in two steps, in 2001 and 2008, largely in response to the dynamic labour market development during those years. In effect, this reform has dramatically raised the minimum wage that applies to young workers. Hyslop and Stillman (2007, 2011) argue that while these two reforms have had little immediate effect, they have led to falling employment of young workers over the next two years.

In this paper, we revisit the findings of Dickens et al. (2010) and Fidrmuc and Tena (2011). In particular, we argue that the effect of NMW on employment may differ across firms of different size or may depend on sector of employment. In particular, it is plausible that some employers seek to employ workers below the age limit for the adult NMW rate: the adult rate is approximately 20% higher than the development rate that applies to younger workers. Firms active in the service sector, in particular, may be tempted to follow this strategy: wages are often relatively low and labour costs account for a relatively high share of their overall costs.

In the next section, we discuss the data that we utilize in this study. We also briefly describe the specific institutional features of the NMW regulation in the UK. In section 3, we consider the effect of age-specific NMW rates on the employment of young workers according to size of their workplace and sector of employment. To this effect, we utilize the regression discontinuity methodology. In section 4, we complement that analysis with difference-in-difference investigation of the employment effects of regular annual NMW increases (for a broader set of workers, not only young workers). Finally, we summarize our findings and offer some conclusions in section 5.

## 2. Data and UK NMW Rules

Our analysis is based on the UK Labour Force Survey (LFS): a quarterly nationally-representative survey of households across the UK. It contains information on approximately 60 thousand households per quarter, which amounts to over 100 thousand individuals aged 16

and above. Each household is retained in the survey for five consecutive quarters, with one-fifth of households replaced in each wave. The survey features detailed demographic and socio-economic information on the respondents, including, importantly, their labour market outcomes. Since the NMW was introduced in April 1999, we use all quarterly datasets available since then: April-June 1999 to October-December 2011, pooling all available LFS waves during this period.

The LFS reports the date of birth of every respondent and also the date the survey was carried out. By comparing these two dates, we can determine the precise age of each respondent on the day of the survey.[1] We therefore know which respondents are below or above the age threshold at which they become eligible for a different NMW rate (see below). As is common in the regression-discontinuity literature, we redefine age so that it takes the value of 0 in the month when the individual reaches the threshold age.

When it was introduced in April 1999, the NMW featured two separate rates. The adult rate applied to all workers aged 22 and above while the development rate applied to young workers aged between 18 and 21. Both rates were reevaluated and increased annually every October, with the first increase taking effect in October 2000. The ratio between the two rates at their introduction was 1.2; thereafter it has fluctuated between 1.16 (as of October 2000) to 1.22 (at the time of writing, valid from October 2011). This implies that, during the period covered by our analysis, young workers on the minimum wage were entitled to a 16-22% pay rise once they reached the threshold at which the adult rate applied.

Initially, workers younger than 18 were exempt from the NMW. A separate rate for 16-17 year olds was introduced in October 2004. The ratio between this rate and the development rate started off at 1.37 and has since fluctuated between 1.35 (at the time of writing) and 1.42 (October 2005).

As mentioned above, the early empirical literature on the NMW gave little evidence that either its introduction or its subsequent increases adversely affected employment, whether workers in general or young workers specifically. In line with this apparent consensus, the age limit for the adult rate was lowered from 22 to 21 from October 2010.[2]

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[1] The precise date of birth is not available in the publicly released LFS datasets. We are grateful to the Low Pay Commission, the Department for Business, Innovation and Skills, and the Office for National Statistics for making the restricted release of the LFS available to us.

[2] We take this change into account in our analysis.

The minimum wage regulation allows a number of specific exemptions: members of the armed forces, volunteers, students on work placements, workers living in the employers' households, and (until 2010) apprentices. A fourth rate, for apprentice workers, was introduced in October 2010 (we do not consider those subject to this rate in our analysis).

# 3. Discontinuity Analysis of Young Workers' Employment

In this section, we consider the effect of becoming eligible to the adult NMW rate on young workers' employment. Our analysis builds on and extends earlier work by Fidrmuc and Tena (2012) and Dickens, Riley and Wikinson (2010). The analysis in this section is carried out by means of the regression discontinuity design (Lee and Lemiux, 2010). The discontinuity, specifically, stems from the fact that young workers older than the threshold age must be paid at least the adult NMW rate while those before the threshold can be paid the lower development rate. This constitutes a discontinuity in the relationship between age and labour-market outcomes such as employment or the number of hours worked. Workers close to either side of the age threshold are arguably very similar in terms of productivity and employability. Yet those older than the threshold age are considerably more expensive. We want to see, therefore, whether workers whose age exceeds the threshold suffer any adverse employment effects.

The workers' age is expressed in months from discontinuity, so that a worker is assigned an age of 0 in the month when they reach the threshold age. We focus on the transition from development to adult rate (Fidrmuc and Tena, 2011, consider also the threshold at 18 years of age) because we believe that no relevant characteristics other than the NMW rate change at this age.[3] The threshold age is 22 years of age until October 2010 and 21 years thereafter. In order to maximize the number of observations that we can include in our analysis, we consider workers who are within 15 months on either side of the threshold (recall that each individual appears in the LFS for five consecutive quarters, or 15 months).

[3] This assumption clearly holds for the young workers on either side of the threshold for the adult rate (21/22 years). Turning 18, in contrast, is rather likely to affect workers' employability as they become legally adult at this age and, for instance, are allowed to sell and serve alcohol. Formal education is unlikely to play a role as most students finish their schooling at the end of the academic year and not when they reach a specific age. We are not aware of any relevant changes in, for instance, entitlement to benefits that take place at either the 21st or 22nd birthday.

Our econometric specification relates the probability of a particular labour-market outcome (such as being employed) to a polynomial in age, selected covariates, as well as the discontinuity dummy. In particular, we estimate the following equation:[4]

$$E[emp|age,dum] = F(\theta + \alpha_0 * age_i * (1 - dum) + \alpha_1 * age_i^2 * (1 - dum) + \alpha_0^* * age_i * dum + \alpha_1^* * age_i^2 * dum + \beta * dum + \gamma * change) = F(u) \quad (1)$$

where $F$ is standard normal cumulative distribution function, $age_i$ is the age in months less the threshold (i.e. age minus 264 months for 22 years or 252 for 21), *dum* is a dummy variable taking the value of 1 after the individual attains the age threshold and 0 otherwise, and *change* is a dummy variable denoting observations after October 2010 when the threshold has been lowered to 21. $\theta$ includes all additional covariates: qualifications, ethnic origin, apprenticeship, region of usual residence, being a full time student as well as the constant.

The above regression specification allows the age polynomial to have different coefficients before and after the threshold. This is a standard approach in the discontinuity literature. However, this also implies that the effect of reaching the threshold age can take two forms: a level effect, reflected in the coefficient estimated for the discontinuity dummy, and a slope effect, captured by the changed coefficients of the age polynomial. While it is standard in the discontinuity literature to consider only the former, we believe that both effects are potentially important. Several previous contributions find evidence of a dramatic slope change instead of a jump in the response function at the discontinuity. This issue is discussed in Dong (2011) at much length (see also the discussion in Fidrmuc and Tena, 2011). For example, Jacob and Lefgren (2004) study the impact of educational treatments such as grade retention or summer schools on academic performance. They find that the response variable displays a dramatic slope change instead of discontinuity at the threshold point. Card et al. (2008) show evidence that the change in the probability of retirement at 65 (Medicare eligibility) is more consistent with a change in slope than with a jump. Card et al. (2009) similarly argue there are cases in which instead of a discontinuity in the level, there is a discontinuity in the slope of the response function.

Arguably, the employment prospects of young workers before and after the threshold are affected by both effects. We argue that the estimate of the discontinuity effect needs to take this into account. Furthermore, as we estimate a non-linear (probit) model, the estimation of the interactive effects is not as straightforward as with a linear model. Norton *et al.* (2004)

[4] The following discussion builds on Fidrmuc and Tena (2011).

derive the interactive effect for the probit function and we follow their approach in our analysis:[5]

$$\frac{\Delta\frac{\Delta F(.)}{\Delta age}}{\Delta dum} = F(\theta+\beta) - F(\theta-\alpha_0^*+\alpha_1^*+\beta) - F(\theta) + F(\theta-\alpha_0+\alpha_1) \quad (2)$$

As a first step, we replicate the findings of Fidrmuc and Tena (2012) with our longer data series. This part of the analysis includes all workers, irrespective of their labour-market status (employed, unemployed, out of labour force). The results of this exercise are presented in Table 1. In part A of this table, we estimate the effect of reaching the threshold age on employment (recall that the threshold age is 22 years up to October 2010 and 21 thereafter). We estimate this for both genders together as well as for males and females separately (note that for women, we consider both a quadratic as well as a cubic polynomial of age, as the former is rejected by tests). The coefficient for 'discontinuity', as argued above, captures the combined effect of the discontinuity dummy and the changed effect of age after reaching the threshold age; the coefficient for 'dummy', on the other hand, reports on the discontinuity dummy alone. Finally, we also add a dummy variable, *change*, denoting the observations after October 2010 to take account of the lowering of the threshold age from 22 to 21. All regressions contain the full set of covariates. Parts B and C present the so-called falsification tests: effects of reaching age that is one year lower (part B) or one year higher (part C) than the threshold age. The NMW rates do not change at these ages and therefore there would seem little reason to see any effect in either case. However, Fidrmuc and Tena (2011) find a negative employment effect one year before the threshold which they attribute to employers acting in anticipation of the young workers reaching the threshold age. Note that this negative effect can come about from two kinds of actions taken by the employers (or any combination of these two actions). First, the employers can dismiss workers who are around one year short of the age threshold. Second, they can avoid hiring such workers.

The results presented in Table 1 are broadly in line with those reported by Fidrmuc and Tena (2012). The discontinuity effect at the threshold is negative for males and positive for females but it is never statistically significant. The effect of discontinuity at one year before the threshold is negative and significant for males, just as in Fidrmuc and Tena (2012): this is not surprising given that we use the same data to which we added two years' worth of

[5] In non-linear models, the marginal effect of a change in two interactive variables (age and dum) is not equal to the marginal effect of changing just the interaction term. Moreover, the sign may be different for different observations.

additional observations. In contrast, we find no discontinuity effect at one year after the threshold.

The dummy for the post-2010 observations is negative and significant: the overall probability of employment is lower after the change of threshold age. Note however that this need not necessarily mean that the change of the threshold age has worsened employment prospects of young workers. Rather, this negative effect can be attributed to the Great Recession which has had a strong adverse effect on the UK labour market since at least 2008.

Our results thus confirm the finding of Fidrmuc and Tena (2012) that young male workers experience a significantly lower employment probability one year before reaching the threshold for the adult NMW rate. A possible explanation is that employers avoid hiring workers who are within one year of the threshold age, or dismiss such workers, rather than take such actions at the threshold age.[6]

It is possible that the size of firm matters in this context: either small or large firms may find it more attractive, or cheaper, to monitor the age of young workers and avoid employing those eligible for the adult rate. Ideally, we would like to use the number of workers per firm. However, the LFS only reports the number of workers per workplace. In many cases, this is the same as firm size but it may differ in cases of employers with multiple workplaces. Most notably, shops, supermarkets and catering establishments are typically relatively small but often belong to chains with dozens or hundreds of workplaces. In Table 2, we split the data according to size of workplace. The regression specifications are the same as in Table 1. Note, however, that we now have substantially fewer observations as the information about size of workplace is missing for many workers. For that reason, we are unable to present results with covariates as we simply do not have enough observations.

We consider three categories, workplaces with fewer than 25, fewer than 50 (which includes also firms with fewer than 25 employees) and more than 50 employees. Besides considering the discontinuity effects at the threshold age, one year earlier and one year after the threshold, we also look at two years before the threshold and each quarter during the year before the threshold. In part A, we consider only workers for whom we have information on size of workplace in the current quarter. In part B, we also add workers for whom such information is missing in the current quarter but is available in at least one of the preceding four quarters, which increases the number of observations several fold.

[6] We can only speculate about the potential motives for this, such as seeking to avoid litigation due to age discrimination.

Given the low numbers of observations, it is not surprising that few of the discontinuity effects in part A are significant. Nevertheless, being between three quarters and two years younger than the threshold age while working in a workplace with fewer than 25 employees appears to have significant and positive effect on employment, although the magnitude is rather small. The results for firms with fewer than 50 employees are similar: we observe a positive and significant effect two years and again three quarters before the threshold; the effect one year before is also positive but not significant. The remaining coefficients are all insignificant.

When we add the young workers for whom we have information on workplace size in preceding quarters, the pattern for small firms becomes more complicated and generally mixed: the discontinuity appears to have a negative effect on employment two years before as well as one to three quarters before the threshold while the effect turns out positive in the remaining cases. We also observe a negative effect for large firms one year before the threshold. However, it is difficult to put much weight on these results, given that the information on size of workplace may refer to past rather than contemporaneous employment.

In summary, we can conclude that among the workers for whom information on workplace size is available, the different age-specific NMW rates do not appear to have a negative effect on employment. On the contrary, the effect may be significantly positive for small firms (workplaces).

Next, we consider whether the effect of reaching the threshold for the adult NMW rate depends on the sector in which the workers are employed. The LFS contains detailed information on the respondents' sector of employment. However, this is again only available for those respondents who are employed at the time of survey or who report the sector of their previous employment. In order to have enough observations to be able to run our analysis, we have to aggregate the young workers into three relatively broad sectors: services (the largest category), manufacturing and construction (henceforth referred to as manufacturing), and other. As additional tests, we also consider private versus public firms to see if the NMW effect depends on ownership, and low-pay versus high-pay workers to investigate if the effect of age-specific NMW rates is different for low pay workers.

We again proceed using the regression discontinuity design. The analysis is more complex, however, as we have to account for the fact that we have more than two possible labour-market states. In particular, workers who are employed in a particular sector before reaching the age threshold may end up staying in the same sector afterwards, go to a different

sector or become unemployed. Similarly, those who are in that sector after having attained the age threshold may have stayed there or transferred from a different sector. The results are summarized in Table 3: part A considers services while part B reports on manufacturing.

In the upper panel of Table 3A, we consider the probability of staying in the service sector against the probability of moving to unemployment. In the lower panel, we consider the probability of moving to the service sector from another sector versus moving from another sector to unemployment. Note that there is a third possible transition pertaining to those working in the service sector, namely moving from the service sector to another sector: this is captured when looking at the other sectors (in particular manufacturing in part B, as we do not have enough observations to consider the remaining 'other' category). Table 3B is constructed analogously for manufacturing. Again, we present regression results for a number of alternative thresholds in addition to the age at which young workers become eligible for the adult NMW rate.

The results are interesting. When considering the probability of staying in the service sector versus becoming unemployed, we observe a negative though insignificant effect on the probability of staying one year before the age threshold and again at the threshold age. A similar negative effect is observed for those moving to the service sector from other sectors: this time the effect is close to being significant at the 5% level at one year before the threshold. Hence, the negative effect at one year before the age threshold that we observe in Table 1 may apply mainly to those who change sectors rather than to those who stay in the service sector. However, the opposite seems to hold in manufacturing: here, it is the stayers who experience a negative effect both at one year before reaching the age threshold and at the discontinuity, with the former being both stronger and more precisely estimated. The discontinuity effects thus differ across these two sectors quite considerably. Approaching one year before the threshold and reaching the threshold age seems to lowers the employment prospects of those moving into services from elsewhere and of those staying in manufacturing. Interestingly, these effects can only be found at these two time points: none of the discontinuity effects at one to three quarters before the threshold are similar.

As a further check, we split the data on young workers based on whether firms employing them are private or public. The results for both sectors, however, are generally similar, suggesting that ownership does not shape the effect of age-specific NMW rates on employment. In particular, we find that workers in both the private and public sector are more likely to stay employed in the same sector, and correspondingly less likely to change sectors,

at one year before the threshold age and at the threshold age. The only difference appears at one year after the threshold age when they display a higher probability of staying in the public sector and lower probability of staying in the private sector.

The results distinguishing low-pay workers from the rest, similarly, offer few interesting insights. For this part of our analysis, we define low-pay workers as those earning their age-specific NMW rate or up to 1+*c* multiple of this rate, with *c* set as either 0.1 or 0.3. However, most of the effects are insignificant and those that are significant do not submit themselves to a clear-cut interpretation. Both the result for the public versus private sector and for the low-pay versus high-pay workers are not reported here for the sake of brevity but can be obtained from the authors on request.

In Table 4, finally, we consider the discontinuity effect on the hours worked (both in the main and, if applicable, second job, also including overtime). In this analysis we only consider employed individuals in order to answer the question of whether there is a significant change in their labour input in response to becoming eligible for the higher adult rate of the NMW. Although the regression analysis in this case is linear, due to the fact that slope parameters in the age function change after the threshold in this case we again consider the whole discontinuity effect produced by the different specification of the linear function. The discontinuity effect on the number of hours, however, is very marginal and never statistically significant.

# 4. Difference-in-difference Analysis

We complement the preceding discontinuity discussion with difference-in-difference analysis of the employment effect of the minimum wage rate increases. The difference-in-difference methodology involves comparing the employment outcomes of two groups that should be a-priori similar: treatment and control groups. The treatment group comprises workers whose wages have to go up in the wake of an annual NMW increase because the new NMW rate is higher than their current wage. The wages of those in the control group should be close to just above the new rate so as not to have to change. Any difference in the employment probabilities between the two groups can be interpreted as the labour-market effect of the minimum wage.

In order to have sufficient number of observations, we depart from considering only young workers and instead include all individuals aged between 16 and 40. Furthermore, we

do not analyse the effects of differences between different age-specific NMW rates but instead consider the regular annual increases that apply to all rates.

We estimate the following equation:

$$P(e_{it+1}=0|e_{it}=1) = \alpha*treat+\beta*treat*gap_{it}+\gamma*X \quad (3)$$

where the dependent variable is the probability that the worker is unemployed conditional on being employed in the preceding quarter. The treatment group is defined as the workers whose wages are due to increase following the NMW uprating, i.e. those whose wages meet the following condition:

Treatment group: $nmw_t \leq w_{it} < nmw_{t+1}$

where $nmw_t$ is the (age-dependent) NMW rate in effect at time $t$ while $w_{it}$ is the worker's wage. The control group is defined as the workers whose wage before the increase is greater than the new NMW rate but lower than some upper bound to ensure that we only consider low-wage workers who are more likely to possess similar characteristics as those earning the minimum wage. In particular, we set the upper bound as $c$ percent above the new rate:

Control group: $nmw_{t+1} \leq w_{it} < nmw_{t+1}*(1+c)$

Finally, $gap_{it}$ is the difference between the worker's wage and the new NMW rate for the workers in the treatment group and zero for those in the control group:

$gap_{it} = nmw_{t+1} - w_{it}$ (for the treatment group only, 0 for the control group)

Besides looking at the effect of NMW increases on job loss, we also consider job-market entry: the probability of holding a job, conditional on being unemployed in the preceding quarter:

$$P(e_{it+1}=1|e_{it}=0) = \alpha*treat + \gamma*X \quad (4)$$

In this case, the regression equation contains no interaction term with the wage gap (since workers entering the sector from unemployment have no past wages to report), and the treatment and control groups are defined, slightly differently, as follows:

Treatment group: $w_{it+1} \leq nmw_{t+1}$

Control group: $nmw_{t+1} < w_{it} < nmw_{t+1}*(1+c)$

We thus specifically focus on labour-market flows rather than consider those whose labour-market status does not change. We consider three alternative values for $c$: 10%, 30% and 50%, for both job entry and exit (it is questionable whether workers earning 50% above

the minimum wage constitute a valid control group and therefore those results should be taken with a grain of salt). The LFS contains two alternative variables reporting the respondents' hourly wage: *hrrate* and *hourpay*. The former is a response to an explicit question on the workers' hourly wage while the latter is derived from information on their weekly (or annual) earnings and their reported hours worked (since many respondents report their weekly or annual salary only). As such, the latter measure is more likely to be affected by measurement error and therefore is less reliable (see Dickens and Manning, 2004, and Dickens and Draca, 2005). On the other hand, the reported hourly rate (*hrrate*) can similarly suffer from a reporting bias as workers are likely to report a round figure rather than their actual hourly wage.

In Table 5, we report the results obtained with all workers aged 18-40, regardless of their sector or size of workplace. We consider all annual NMW increases since 1999 rather than the age-specific NMW rates. As such, this part of our analysis essentially replicates the difference-in-difference result of Fidrmuc and Tena (2011) with additional data. Not surprisingly, our findings are in line with those in that study: annual NMW increases are associated with greater probability of job loss but also with more job entry. In other words, some workers lose their jobs after their wage has gone up but others enter the sector, possibly attracted by the prospect of higher pay. The net effect therefore can be either positive or negative. The size of the coefficient estimated for job entry exceeds that of job loss, which would suggest that the former effect is stronger. Nevertheless, as the pool of employed workers is much larger than the pool of the unemployed, the impact on absolute flows is indeterminate. Interestingly, the interaction between the treatment dummy and the wage gap is never significant. When using *hourpay* to determine workers hourly wage, the positive effect of the wage gap is nonetheless close to being significant, indicating that the probability of losing one's job increases with the size of the gap between the existing wage and the new relevant minimum wage rate.

Next, we consider services and manufacturing (there is an insufficient number of observations for the remaining workers in the 'other' category), and also distinguish between workers in the private and public sector. The results for services, in the upper half of Table 6A, are similar to the preceding findings obtained with all workers: there is a positive effect of annual NMW increases on both job entry and job loss. No such effect is observed in manufacturing, however, either with respect to job entry or job loss. The effect of the wage gap is only significant in the service sector and only when the hourly wage is measured with

*hourpay*: in this case, the probability of job loss again increases with the wage gap. Hence, it appears that the NMW increases affect employment in the service sector only.

Looking at the effect of NMW increases on hours worked, we see little difference across sectors. However, the interaction between the treatment dummy and the wage gap appears positive and significant in the service sector when we measure hourly wage with *hrrate*. It appears therefore that while NMW increases may have implications for employment, they do not affect the number of hours worked much, with the possible exception in the service sector where those whose wages have to increase more also work more hours.

Finally, we compare the response of employment to NMW increases in the private and public sectors (Table 8). There are relatively few low-wage workers in the public sector so that those results are not very precisely estimated. Nevertheless, the effects that we do observe are interesting. In particular, NMW increases encourage job loss only in the private sector while the positive effect on job entry can be found in both sectors. Moreover, the effect on job entry in the public sector exceeds that in the private sector. Hence, the public sector is more likely to absorb new workers in the wake of NMW increases than the private sector.

In summary, this analysis indicates that NMW increases may affect employment both by causing employment losses and by encouraging new entrants to the labour market. The net effect therefore can be either positive or negative. When considering individual sectors of employment, the aforementioned pattern is observed in the service sector only. This is likely a reflection of the greater competitive pressure and the relative importance of wage costs in that sector. The annual NMW increases, on the other hand, seem to have little effect on employment in the manufacturing sector.

# 5. Conclusions

In this report, we revisit the effect of age-specific rates on the national minimum wage (NMW) in the UK on the employment of young workers. Using regression discontinuity design, we replicate the earlier result of Fidrmuc and Tena (2011) indicating that young workers experience a lower probability of being employed one year before reaching the age at which they become eligible for the adult NMW rate. We then explore this result further by considering whether the effect depends on the size of firm or sector of employment. Our results, although plagued by the low number of observations due to missing information on the size of workplace and employment, are interesting. First, we find little evidence of a

negative employment effect when considering firm size. Instead, it appears that the probability of employment in small firms increases as workers grow older and approach the age threshold for the adult rate: the effects are significant one to two years before the threshold but not at the threshold age. However, these results do not appear very robust and therefore should be taken as an indication of a possible pattern associated with firm size rather than as firm evidence.

Considering the sector of employment, our findings are again somewhat mixed. Nevertheless, when we consider employment flows among the sectors, we can again observe a negative effect at one year before the age threshold for the adult rate. This effect appears for young workers staying in manufacturing and construction and among those who were initially in other sectors and transferred to services.

When we complement the regression discontinuity analysis with a difference-in-difference investigation of employment effects of annual NMW upratings, we find stronger employment effects in the service sector rather than in manufacturing. In particular, the annual upratings encourage both job loss as well as job entry, in the service sector. The net effect is thus ambiguous.

While we also consider NMW effects on hours worked, we find little evidence of any effect, possibly again because of missing information.

In summary, our research suggests that both size of firms and sector of employment may play a role in shaping the effect on minimum wage regulation on employment. The adverse employment effect, if any, is more likely in larger firms and in the service sector.

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**Table 1A**
**Discontinuity Effect on Employment at Threshold Age.**

| | All | Males | Females | |
|---|---|---|---|---|
| | | | Quadratic | Cubic |
| Change | -.0415763<br>(.00657) (**) | -.0490936<br>(.00905) (**) | -.0376992<br>(.0095) (**) | -.0474583<br>(.00967)(**) |
| Discontinuity[(1)] | .00083169<br>(.0023366) | -.0027762<br>(.0031882) | .003681<br>(.0033716) | .0018661<br>(.0087473) |
| Dum[(2)] | .0045759<br>(.00767) | .0051875<br>(.01058) | .0063258<br>(.01105) | -.0067565<br>(.01584) |
| No. observations | 151106 | 73775 | 77331 | 77331 |
| Chi-statistic for Whole regression | 29405.79 | 17321.72 | 14242.04 | 14244.76 |
| Pr>Chi | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1523 | 0.1917 | 0.1397 | 0.1397 |
| Chi-statistic for quadratic | 3.55 | 5.92 | 48.57 | 34.46 |
| Pr>Chi | 1.0000 | 1.0000 | 0.0032 | 0.0588 |

Notes: (1) estimated discontinuity effect taking into account the impact of age and the threshold dummy variable; (2) estimated impact of the threshold dummy variable. Significance levels denoted as * 5% and ** 1%. Marginal effects at mean values and standard deviations between brackets. All estimations include covariates. Source: Labour Force Survey.

**Table 1B**

**Discontinuity Effect on Employment 1 Year before the Threshold Age.**

| | All | Males | Females | |
|---|---|---|---|---|
| | | | Quadratic | Cubic |
| Change | -.0536314<br>(.00676) (**) | -.0626858<br>(.00944) (**) | -.0474194<br>(.00967) (**) | -.0474583<br>(.00967) (**) |
| Discontinuity[(1)] | -.0051477<br>(.002318)(**) | -.0085247<br>(.0031884) (**) | .00199333<br>(.003342) | |
| Dum[(2)] | -.0066742<br>(.00794) | -.008423<br>(.0111) | -.0053245<br>(.01134) | -.0067565<br>(.01584) |
| No. observations | 153646 | 75779 | 77867 | 77867 |
| Chi-statistic for Whole regression | 30863.56 | 19095.28 | 13337.86 | 13338.12 |
| Pr>Chi | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1519 | 0.1948 | 0.1273 | 0.1273 |
| Chi-statistic for quadratic | 12.71 | 7.22 | 34.72 | |
| Pr>Chi | 1.0000 | 1.0000 | 0.0933 | |

Notes: (1) estimated discontinuity effect taking into account the impact of age and the threshold dummy variable; (2) estimated impact of the threshold dummy variable. Significance levels denoted as * 5% and ** 1%. Marginal effects at mean values and standard deviations between brackets. All estimations include covariates. Source: Labour Force Survey.

**Table 1C**
**Discontinuity Effect on Employment 1 Year after the Threshold Age.**

| | All | Males | Females | |
|---|---|---|---|---|
| | | | Quadratic | Cubic |
| Change | -.0314672<br>(.00621) (**) | -.0380074<br>(.0083) (**) | -.0279216<br>(.00916) (**) | -.027919<br>(.00916) (**) |
| Discontinuity[(1)] | -.0000484<br>(.0022101) | .0014764<br>(.0029919) | -.0015362<br>(.0032195) | -.00441148<br>(.0082993) |
| Dum[(2)] | -.0009441<br>(.0074) | | -.0136487<br>(.01087) | .0055547<br>(.01523) |
| No. observations | 150478 | 72362 | 78116 | 78116 |
| Chi-statistic for Whole regression | 28311.33 | 15112.36 | 15716.50 | 15720.06 |
| Pr>Chi | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1557 | 0.1877 | 0.1580 | 0.1580 |
| Chi-statistic for quadratic | 12.64 | 10.60 | 26.01 | 22.45 |
| Pr>Chi | 0.9806 | 0.9947 | 0.4070 | 0.4933 |

Notes: (1) estimated discontinuity effect taking into account the impact of age and the threshold dummy variable; (2) estimated impact of the threshold dummy variable. Significance levels denoted as * 5% and ** 1%. Marginal effects at mean values and standard deviations between brackets. All estimations include covariates. Source: Labour Force Survey.

**Table 2A Discontinuity Effect on Employment by Firm Size, without Covariates, size contemporaneous(*)**

| **Firms with fewer than 25 workers** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -.0005265 (.00185) | Omitted | Omitted | Omitted | -.0016445 (.00138) | -.0005461 (.00165) | .0049904 (.00273) |
| Discontinuity | .0007856 (.000277) (**) | .00083843 (.00031766) (**) | .0006112 (.000264) (**) | -.000877 (.0015021) | -.0026449 (.002442) | -.00180503 (.00230764) | -.00148527 (.0017756) |
| N. Observations | 10462 | 10322 | 10286 | 10519 | 11564 | 11552 | 11407 |
| Chi(5) | 18.84 | 7.70 | 7.06 (5) | 13.97 (5) | 8.61 | 5.92 | 9.34 |
| Pr>Chi(5) | 0.0044 | 0.1736 | 0.2159 | 0.0158 | 0.1965 | 0.4318 | 0.1555 |
| R2 | 0.0366 | 0.0173 | 0.0144 | 0.0266 | 0.0158 | 0.0114 | 0.0168 |
| Dum | .0017186 (.00389) | -.003797 (.00451) | .0034304 (.00526) | .0378556 (.03349) | .0001782 (.00298) | -.0046128 (.00351) | -.0039843 (.00351 ) |
| **Firms with fewer than 50 workers** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | .0003311 (.00194) | -.0054939 (.00431) | -.0021449 (.00091) (*) | -.001743 (.00077) (*) | -.0009155 (.00133) | -.0001011 (.00152) | .0034686 (.00218) |
| Discontinuity | .0008016 (.000222) (**) | .00039747 (.000438) | .0005457 (.000175) (**) | -.0007748 (.001188) | -.002674 (.002113) | -.00163136 (0.0019084) | -.00285396 (.00229933) |
| N. Observations | 13370 | 14458 | 14451 | 14806 | 14872 | 14861 | 14591 |
| Chi(5) | 15.40 | 9.04 | 9.05 | 17.87 | 9.14 | 7.13 | 9.30 |
| Pr>Chi(5) | 0.0174 | 0.1714 | 0.1709 | 0.0066 | 0.1659 | 0.3087 | 0.1574 |
| R2 | 0.0251 | 0.0168 | 0.0154 | 0.0292 | 0.0141 | 0.0112 | 0.0139 |
| Dum | .0012292 (.00318) | -.0018269 (.00089) (*) | .0015072 (.00361) | .0259684 (.02065) | .0009623 (.00254) | -.0050478 (.0032) | -.0012064 (.00252) |
| **Firms with more than 50 workers** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year late |
| Change | -.0007843 (.00267) | .0010288 (.00247) | .0007988 (.00237) | -.0007748 (.00119) | .0002344 (.00218) | .0004173 (.00215) | .000083 (.002) |
| Discontinuity | .000142 (.000906) | -.00202245 (.00257299) | -.0012452 (.001985) | .0005731 (.00039) | .0004477 (.000305) | .00031343 (.00057854) | -.00032588 (.00135446) |
| N. Observations | 8118 | 9152 | 9111 | 9285 | 9337 | 9312 | 9356 |
| Chi(5) | 10.43 | 2.05 | 2.08 | 2.58 | 2.46 | 3.00 | 4.30 |
| Pr>Chi(5) | 0.1077 | 0.9151 | 0.9119 | 0.8598 | 0.8732 | 0.8086 | 0.6357 |
| R2 | 0.0256 | 0.0064 | 0.0063 | 0.0077 | 0.0067 | 0.0087 | 0.0116 |
| Dum | .0041742 (.00477) | .000016 (.00275) | .0010303 (.00309) | -.0019616 (.00394) | .0019279 (.00402) | -.0027222 (.00392) | -.0076667 (.00582) |

Notes: (*) Size of workplace refers to current quarter only.

**Table 2B Discontinuity Effect on Employment by Firm Size, without Covariates, size contemporaneous or past(**)**

| **Firms with fewer than 50 workers** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | .0203286 (.00167) (**) | -.0185113 (.0018) (**) | .0211389 (.00177) (**) | .0222223 (.00176) (**) | .0207641 (.00189) (**) | -.0219661 (.00189) (**) | -.0196117 (.00231) (**) |
| Discontinuity | -.0077419 (.001715) (**) | .0047422 (.001483) (**) | -.0067365 (.0013622) (**) | -.0078411 (.0012405) (**) | -.006538 (.00137) (**) | .0074411 (.0013723) (**) | .0065348 (.0019411) (**) |
| N. Observations | 68138 | 62974 | 60166 | 59583 | 57686 | 55913 | 48610 |
| Chi(5) | 649.36 | 628.76 | 645.23 | 676.18 | 650.16 | 750.44 | 752.28 |
| Pr>Chi(5) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0285 | 0.0296 | 0.0313 | 0.0325 | 0.0319 | 0.0370 | 0.0388 |
| Dum | -.0105257 (.00407) (*) | .0077726 (.00421) | -.0065863 (.00448) | -.0188985 (.0046) (**) | -.0120931 (.00464) (**) | .0061952 (.00461) | .0180903 (.00532) (**) |
| **Firms with more than 50 workers** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | .1513167 (.00479) (**) | -.1320695 (.00472) (**) | .1278204 (.00477) (**) | .1256368 (.00475) (**) | .1242207 (.00476 ) | -.1202643 (.00476) (**) | -.1055437 (.00467) (**) |
| Discontinuity | -.0033392 (.002263) | -.0051332 (.0022282) (*) | -.0034538 (.002271) | -.0023173 (.002241) | -.0021435 (.002266) | .0018058 (.0022446) | -.0007581 (.0021369) |
| N. Observations | 160298 | 156994 | 153513 | 155315 | 154799 | 154434 | 153818 |
| Chi(5) | 1162.36 | 1096.49 | 1091.24 | 1580.78 | 1273.37 | 1397.08 | 1519.55 |
| Pr>Chi(5) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0054 | 0.0052 | 0.0054 | 0.0058 | 0.0063 | 0.0070 | 0.0081 |
| Dum | -.004504 (.00752) | -.0027578 (.00758) | -.0014564 (.00776) | -.0139418 (.00755) | -.0106339 (.0075) | .0035712 (.00737) | -.0053704 (.0072) |

Notes: (**) Size of workplace refers to current quarter or any of the previous four quarters, if not available in the current quarter.

## Table 3A Discontinuity Effect on Employment, Services, with Covariates

| **Services: stayers in the sector vs movers to unemployment** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -.0135181 | -.023165 | -.0037558 | -.000712 | .0050952 | .0002726 | -.0053307 |
| | (.00903) | (.0506372) | (.00779) | (.00763) | (.00714) | (.00715) | (.00633) |
| Discontinuity | .005275 | -.0023393 | -.0002365 | .0040963 | -.0005028 | -.0010774 | .0017745 |
| | (.003205) | (.0024676) | (.002956) | (.003159) | (.00287) | (.0012952) | (.0023745) |
| N. Observations | 47618 | 46017 | 45223 | 46166 | 46534 | 46992 | 49367 |
| Chi(128) | 2517.81 | 1823.29 | 1708.99 | 1821.04 | 1896.65 | 1903.03 | 1779.52 |
| Pr>Chi(128) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0731 | 0.0635 | 0.0629 | 0.0665 | 0.0701 | 0.0715 | 0.0744 |
| Dum | .0015992 | .001683 | .0032566 | .0165426 | .0122149 | .0017209 | .0077286 |
| | (.00821) | (.00783) | (.00819) | (.00794) (*) | (.0078) | (.00713) | (.00627) |
| **Services: movers from a different sector vs movers to unemployment** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -.2164248 | -.2506347 | -.2478708 | -.2507319 | -.2605835 | -.1997678 | -.2129765 |
| | (.06556) (**) | (.07287) (**) | (.08218) (**) | (.07496) (**) | (.07747) (**) | (.08147) (**) | (.08428) (**) |
| Discontinuity | .01283 | -.0390015 | .0272119 | .0402669 | -.0085804 | -.0264204 | -.0155719 |
| | (.022396) | (.0232924) | (.025293) | (.023587) | (.02543) | (.0246552) | (.0250589) |
| N. Observations | 2160 | 2051 | 1949 | 1955 | 1899 | 1882 | 1838 |
| Chi(62) | 309.58 | 271.53 | 267.33 | 278.11 | 245.81 | 239.63 | 325.69 |
| Pr>Chi(62) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1043 | 0.0960 | 0.0993 | 0.1029 | 0.0937 | 0.0921 | 0.1280 |
| Dum | -.0844734 | -.1277293 | -.1152877 | .0628624 | .013429 | .0110346 | .0265604 |
| | (.07039) | (.06968) | (.07492) | (.07332) | (.07354) | (.07377) | (.07579) |

Notes: The upper panel is a probit regression of the probability of staying in the service sector vs moving from services to unemployment. The lower panel considers the probability of moving to the service sector from a different sector vs moving from a different sector to unemployment.

## Table 3B Discontinuity Effect on Employment, Manufacturing, with Covariates

**Manufacturing: stayers in the sector vs movers to unemployment**

| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
|---|---|---|---|---|---|---|---|
| Change | .0002833 | .0280488 | .0277628 | .0300744 | .0308092 | .0320817 | .0250027 |
| | (.01583 ) | (.01086) (**) | (.02718) | (.02417) | (.00841) (**) | (.00811) (**) | (.00774) (**) |
| Discontinuity | .0001731 | -.0108695 | .0029915 | .0132981 | .0048579 | -.0083075 | -.000075 |
| | (.005095) | (.0036623) (**) | (.005947) | (.010175) | (.00582) | (.003555) (*) | (.0041252) |
| N. Observations | 10843 | 11284 | 11220 | 11589 | 11859 | 12119 | 13065 |
| Chi(*) | 1150.27 (63) | 773.98 (63) | 658.29 (62) | 732.79 (62) | 696.37 (62) | 635.40 (63) | 561.68 (62) |
| Pr>Chi(*) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1664 | 0.1155 | 0.1039 | 0.1146 | 0.1103 | 0.1008 | 0.0952 |
| Dum | -.0153622 | -.0144699 | -.01598 | -.0063705 | .0062666 | .0076526 | .0025019 |
| | (.01346) | (.01404) | (.01915) | (.01333) | (.01317) | (.01322) | (.01123) |

**Manufacturing: movers from a different sector vs movers to unemployment**

| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
|---|---|---|---|---|---|---|---|
| Change | -.0014438 | -.0583395 | -.0735249 | -.0732105 | Estimation not | -.0725154 | -.0892552 |
| | (.02178) | (.08506) (**) | (.12142) | (.02871) (*) | possible due to | (.02331) (**) | (.02494) (**) |
| Discontinuity | .0108111 | .0141409 | .0056134 | .0051719 | low number of | -.0026375 | -.0111839 |
| | (.016666) | (.0224418) | (.012185) | (.008633) | observations | (.0105666) | (.012812) |
| N. Observations | 6625 | 5298 | 4941 | 4997 | | 4872 | 4254 |
| Chi(*) | 1079.28 (62) | 825.68 (62) | 758.16 (61) | 746.13 (62) | | 702.86 (63) | 651.07 (64) |
| Pr>Chi(*) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 |
| R2 | 0.2033 | 0.1764 | 0.1679 | 0.1635 | | 0.1487 | 0.1467 |
| Dum | .0278651 | .0506135 | .0093558 | .0226107 | | .0142322 | .0200958 |
| | (.04339) | (.06897) | (.03292) | (.02876) | | (.03053) | (.03349) |

Notes: The upper panel is a probit regression of the probability of staying in the manufacturing sector vs moving from manufacturing to unemployment. The lower panel considers the probability of moving to the manufacturing sector from a different sector vs moving from a different sector to unemployment.

**Table 4 Discontinuity Effect on Hours Worked by Sector, with Covariates**

| **Services** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -2.862728 (.2472122) (**) | -1.970718 (.2399313) (**) | -1.700986 (.2411342) (**) | -1.609509 (.239184) | -1.559439 (.2392889) | -1.343421 (.2360555) (**) | -1.240611 (.2272804) |
| Discontinuity | .0253336 (.078906) | .0265163 (.0799008) | -.0618374 (.081861) | -.0135297 (.079765) | .0174739 (.080704) | .0676376 (.0794197) | .0456474 (.0775371) |
| N. Observations | 66935 | 66928 | 66152 | 67606 | 68285 | 69155 | 73271 |
| F statistic | 492.65 | 401.46 | 369.07 | 353.19 | 327.89 | 303.27 | 199.58 |
| Pr>F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Dum | .3402591 (.2659219) | .341873 (.269379) | .2387723 (.2799328) | -.0902716 ( .273790) | -.3077056 (.2730844) | -.0613463 (.2680172) | -.2376413 (.261136) |
| **Manufacturing** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -1.066707 (.5013487)(*) | -1.520327 (.4626541)(**) | -1.514079 (.4608631) (**) | -1.876551 (.4542732) (**) | -1.638878 (.4414436) (**) | -1.79922 (.4302562) (**) | -1.713343 (.3975179) (**) |
| Discontinuity | .2101271 (.135783) | .1911718 (.134502) | .1008757 (.137392) | -.145728 (.132826) | -.1503307 (.13232) | -.1187144 (.128808) | .2066375 (.1205809) |
| N. Observations | 15677 | 16645 | 16709 | 17274 | 17635 | 18020 | 19526 |
| F statistics | 23.66 | 20.12 | 19.44 | 19.69 | 19.07 | 17.80 | 15.77 |
| Pr>F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Dum | .5337583 (.4581718) | -.1848043 (.4531447) | -.0516286 (.4676974) | .1302288 (.4568225) | -.229092 (.449568) | -.0508432 (.4332034) | -.0670719 (.4045398) |
| **Other** | | | | | | | |
| | 2 years before | 1 year before | 3 quarters before | 2 quarters before | 1 quarter before | Threshold | 1 year later |
| Change | -3.188982 (2.146201) | -.9966339 (2.163475) | .0818793 (2.333057) | -.6201781 (2.181599) | -.9576385 (2.088559) | -1.212122 (1.846843) | -3.280686 (1.718302) |
| Discontinuity | -.7002096 (.625312) | .1485395 (.6068605) | .5620505 (.656901) | -.5988625 (.635954) | -.3749416 (.631992) | -.5171937 (.5793492) | .0621634 (.5756006) |
| N. Observations | 1673 | 1832 | 1629 | 1679 | 1732 | 2008 | 2255 |
| Chi(12) | 5.58 | 5.76 | 5.03 | 5.01 | 5.19 | 5.50 | 5.41 |
| Pr>Chi(12) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Dum | -4.203097 (2.085453) (*) | -.0927502 (2.034677) | 2.222897 (2.229913) | -.1548837 (2.206665) | -.5352369 (2.180652) | 3.284653 (1.93048) | 2.9896 1.926149 |

**Table 5**

**Difference-in-difference Analysis of Job Entry and Exit, All Sectors**

| **A. Job Loss** | | | | | | |
|---|---|---|---|---|---|---|
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (82) | 178.66 | 412.13 | 608.32 | 242.21 | 486.19 | 750.38 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0338 | 0.0377 | 0.0436 | 0.0440 | 0.0397 | 0.0430 |
| Number of obs | 7503 | 16347 | 22264 | 8078 | 19645 | 30808 |
| Treatment | .027446 (.01002)(**) | .0331557 (.0095) (**) | .0389015 (.00919) (**) | .00779 (.00929) | .0207685 (.00861) (**) | .0288542 (.00826) (**) |
| Interaction | .0063497 (.04072) | .0133747 (.03703) | .0058529 (.03387) | .057904 (.03382) | .0343566 (.02913) | .0272185 (.02563) |
| Change | .0538315 (.02898) | .0458487 (.01979) (*) | .0338971 (.01694) (**) | .0882271 (.01219) (**) | .0586122 (.01215) (**) | .0478516 (.00954) (**) |
| **B. Job Entry** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (81) | 265.11 | 817.44 | 1232.43 | 531.82 | 1009.51 | 1626.89 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0410 | 0.0611 | 0.0700 | 0.0533 | 0.0596 | 0.0715 |
| Number of obs | 6783 | 15178 | 21578 | 11687 | 21481 | 31475 |
| Treatment | .0520269 (.00996)(**) | .081079 (.00894) (**) | .0955042 (.00867) (**) | .0018416 (.00673) | .0254317 (.00491) (**) | .0396129 (.00447) (**) |
| Change | .0031454 (.05202) | .0215798 (.03936) | .0362146 (.03379) | -.0220743 (.03447) | .0252586 (.02976) | .0210698 (.02345) |

**Table 6**

**Difference-in-difference Analysis of Job Entry and Exit by Sectors**

| **A. Services: Job Loss** | | | | | | |
|---|---|---|---|---|---|---|
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (82) | 181.96 | 405.08 | 563.93 | 226.77 | 472.21 | 723.41 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0437 | 0.0451 | 0.0497 | 0.0541 | 0.0494 | 0.0529 |
| Number of obs | 6393 | 13030 | 17360 | 6035 | 14934 | 23272 |
| Treatment | .034648 (.01262)(**) | .0377229 (.0124) (**) | .0446268 (.01224) (**) | .0025378 (.01268) | .0122892 (.01174) | .0197034 (.01125) |
| Interaction | -.0396316 (.0656) | .0069969 (.06107) | .0036916 (.05681) | .1706862 (.07363) (**) | .1711834 (.066) (**) | .1573478 (.05903) (**) |
| Change | -.0782923 (.01979)(**) | -.0633281 (.01736) (**) | -.0515398 (.01546) (**) | NA | -.0730278 (.0095) (**) | -.0606653 (.00792) (**) |
| **B. Services: Job Entry** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (81) | 250.72 | 686.51 | 1005.48 | 448.63 | 818.86 | 1303.58 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0445 | 0.0594 | 0.0673 | 0.0525 | 0.0574 | 0.0687 |
| Number of obs | 5734 | 12578 | 17385 | 9639 | 17245 | 24751 |
| Treatment | .0543373 (.0111) (**) | .0833234 (.01002) (**) | .099057 (.00975) (**) | .0014547 (.00764) | .0250789 (.00564) (**) | .0396354 (.00515) (**) |
| Change | .0041642 (.05715) | .0137439 (.04307) | .0291517 (.03785) | -.027755 (.03862) | .0092441 (.03254) | .0007191 (.02529) |
| **C. Manufacturing: Job Loss** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (82) | 111.27 (79) | 110.43 (81) | 144.02 (81) | 107.93 (80) | 116.51 (82) | 138.42 (82) |
| Prob > chi2 | 0.0098 | 0.0166 | 0.0000 | 0.0204 | 0.0074 | 0.0001 |
| R2 | 0.2164 | 0.0835 | 0.0743 | 0.1564 | 0.0661 | 0.0496 |
| Number of obs | 633 | 1857 | 3095 | 922 | 2692 | 4702 |
| Treatment | .0244248 (.05457) | .0376378 (.04033) | .0451479 (.03788) | -.0256947 (.02917) | .0025293 (.02903) | .0068569 (.027) |
| Interaction | -.1089734 (.27093) | -.1712337 (.20854) | -.1149357 (.17801) | .0540852 (.19217) | .0625183 (.1802) | .1027381 (.15988) |
| Change | .4193524 (.45746) | -.0329656 (.07255) | -.0119785 (.05549) | .037552 (.15586) | .0338109 (.07538) | .0103994 (.048) |
| **D. Manufacturing: Job Entry** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (81) | 84.36 (75) | 195.13 (79) | 239.15 (81) | 146.44 (78) | 234.16 (79) | 344.58 (81) |
| Prob > chi2 | 0.2152 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.1692 | 0.1639 | 0.1313 | 0.1552 | 0.1299 | 0.1328 |
| Number of obs | 530 | 1532 | 2668 | 1143 | 2532 | 4219 |
| Treatment | .0115911 (.04365) | .0588301 (.21876) | .0811143 (.02769) (**) | .0150046 (.04136) | .0382892 (.01404) (**) | .0520566 (.01274) (**) |
| Change | -.0094338 | .0474959 | .0486183 | -.0207072 | .0471793 | .0682155 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (.18861) | (.21095) | (.08709) | (.09178) | (.07806) | (.06523) |
| | | | | | | |

Notes: NA indicates that the variables had to be omitted due to low number of observations. Blanc column indicates that the estimation could not be completed with the observations available.

**Table 7**

**Difference-in-difference Analysis of Hours Worked by Sectors**

| **A. Services** | | | | | | |
|---|---|---|---|---|---|---|
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| F statistics | 1.70 | 2.36 | 2.33 | 1.40 | 1.69 | 1.90 |
| Prob > F | 0.0001 | 0.0008 | 0.0000 | 0.0108 | 0.0000 | 0.0000 |
| Number of obs | 5288 | 11911 | 16073 | 5558 | 13877 | 21913 |
| Treatment | -.5704092 (.6377727) | -.1180996 (.6196674) | -.0881018 (.6307182) | -.6248723 (.700957) | -.6651379 (.7004094) | -.4932619 (.7005349) |
| Interaction | 6.62823 (3.507073) | 6.925631 (3.512844) (*) | 7.346286 (3.592906) (*) | 4.831901 (4.315783) | 6.014302 (4.46006) | 6.165968 (4.488789) |
| Change | 2.152688 (2.376916) | -1.282223 (1.800601) | -.645541 (1.595172) | 2.029165 (2.530589) | .0578514 (1.646363) | .4267339 (1.332028) |
| **B. Manufacturing** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| F statistics | 0.97 | 1.30 | 1.19 | 1.28 | 1.14 | 1.09 |
| Prob > F | 0.5546 | 0.0387 | 0.1182 | 0.0555 | 0.1885 | 0.2735 |
| Number of obs | 673 | 1958 | 3238 | 962 | 2778 | 4850 |
| Treatment | .7245068 (2.153382) | .3799507 (1.986982) | .5571325 (2.017131) | -1.192861 (1.779025) | -1.54099 (1.686452) | -1.536763 (1.712921) |
| Interaction | .3182945 (11.87131) | 3.243255 (11.30618) | -.6266733 (11.53736) | .3236925 (10.86512) | 2.732709 (10.7453) | 4.241845 (10.99391) |
| Change | -15.97181 (10.1976) | -6.691124 (5.415807) | -7.761904 (4.164241) | -2.600574 (6.759643) | -4.385659 (3.783811) | -4.684654 (3.1004) |

**Table 8**

**Difference-in-difference Analysis of Job Entry and Exit: Private vs Public Sector**

| **E. Private Sector: Job Loss** | | | | | | |
|---|---|---|---|---|---|---|
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (82) | | 336.03 (82) | 486.59 (51) | | 388.30 (82) | 602.39 (82) |
| Prob > chi2 | | 0.0361 | 0.0530 | | 0.0000 | 0.0000 |
| R2 | | 0.0361 | 0.0413 | | 0.0386 | 0.0420 |
| Number of obs | | 13109 | 17640 | | 15183 | 23450 |
| Treatment | | .0294207 (.01219) (*) | .0362108 (.01185) (**) | | .0044065 (.01157) | .0116359 (.01104) |
| Interaction | | -.0103363 (.06304) | -.0076234 (.05809) | | .1671098 (.0681) (*) | .1563176 (.0615) (*) |
| Change | | -.0706207 (.01814) (**) | -.0552518 (.01636) (**) | | -.0713538 (.01246) (**) | -.0648031 (.00896) (**) |
| **F. Private Sector: Job Entry** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (81) | 248.75 | 770.34 | 1096.81 | 464.93 | 892.64 | 1389.32 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R2 | 0.0433 | 0.0682 | 0.0756 | 0.0569 | 0.0657 | 0.0774 |
| Number of obs | 6045 | 12701 | 17436 | 9561 | 17112 | 24520 |
| Treatment | .0524376 (.01047) (**) | .0825756 (.0095) (**) | .0946801 (.00922) (**) | .0009335 (.00743) | .0244467 (.00546) (**) | .0383331 .00497 (**) |
| Change | .027909 (.05817) | .0363436 (.04291) | .0456397 (.03745) | -.0039464 (.03944) | .030587 (.03252) | .0283604 (.02611) |
| **G. Public Sector: Job Loss** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (82) | | 114.66 (80) | 177.58 (81) | | 163.16 (81) | 210.33 (82) |
| Prob > chi2 | | 0.0067 | 0.0000 | | 0.0000 | 0.0000 |
| R2 | | 0.1072 | 0.1079 | | 0.1082 | 0.0872 |
| Number of obs | | 2025 | 3214 | | 2939 | 5359 |
| Treatment | | .1201354 (.07539) | .1202169 (.09617) | | .0315625 (.02969) | .0446815 (.03444) |
| Interaction | | -.1684396 (.18923) | -.1510269 (.20234) | | .083673 (.13772) | .0611178 (.12393) |
| Change | | .2495595 (.20874) | .1247748 (.13179) | | .0063108 (.05014) | .0342339 (.0478) |
| **H. Public Sector: Job Entry** | | | | | | |
| | hrrate | | | hourpay | | |
| | c=0.1 | c=0.3 | c=0.5 | c=0.1 | c=0.3 | c=0.5 |
| LR Chi2 (81) | 89.69 (76) | 184.78 (79) | 279.57 (80) | | 259.55 (80) | 421.77 (80) |
| Prob > chi2 | 0.1349 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 |
| R2 | 0.1740 | 0.1097 | 0.1080 | | 0.0908 | 0.1002 |
| Number of obs | 446 | 1706 | 3010 | | 3253 | 5321 |
| Treatment | .0320887 (.09156) | .1391261 (.04472) (**) | .1673468 (.04183) (**) | | .0276112 (.01473) | .0483306 (.01299) (**) |
| Change | NA | NA | -.0213319 (.09735) | | -.0112721 (.09078) | -.0378636 (.05564) |