

The impact on employment of the age related increases in the National Minimum Wage

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Executive Summary

In this report we examine the impact of the NMW on the labour market outcomes of young people. We exploit the fact that individuals receive a legislated increase in the NMW at age 22 of approximately 20%. We use data from the Labour Force Survey pooled over the years April 1999 to March 2009 to examine changing labour market outcomes as individuals turn 22. Our focus is on employment outcomes of low skilled individuals, but we also examine the impact on unemployment and inactivity.

Methodology

We use a regression discontinuity approach to examine the impact of this legislated wage increase. This compares labour market outcomes for those just a few months above and below age 22 years. The idea is that individuals a few months either side of this age threshold are similar in all ways, except that those older than 22 are eligible for the adult NMW and those younger are not. This provides an experimental setting whereby those over 22 years are in receipt of the treatment and those below 22 years are a control group.

Estimates are reported using both parametric and non-parametric techniques. We also report a large number of robustness checks and falsification tests. These test the sensitivity of the results to model specification, but also test for changing labour market outcomes at other age thresholds and in years prior to the introduction of the NMW.

Impact on wages

While a large number of low skilled workers are already paid the adult NMW at age 21 a sizeable proportion are paid below this. This proportion falls significantly at age 22 from about 10% of workers to 5% of workers.

Impact on employment

We find a positive and statistically significant employment effect at age 22 years for low skilled workers. The estimated effect is such that on turning 22 the employment rate increases by about 5% points, or from about 55% to 60% among this low skilled group. Results for men and women are both statistically significant with an approximate 4% point increase for men and 6% point increase for women.

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This result is robust to a number of specification checks that we carry out; changing the functional form of the regression, varying the total age range over which we analyse these labour market outcomes, excluding those exactly aged 22 and allowing the impact on employment to be different in each year.

This result is also robust to a number of falsification tests. We can find no significant employment change at ages 21 or 23 years. Nor can we find an effect at age 22 in the period prior to the introduction of the NMW (1992-1999). The non-parametric results also point to a similar conclusion but the estimated employment increases tend to be somewhat larger, and are sensitive to the extent to which we smooth the data.

Impact on Unemployment and Inactivity

Both unemployment and inactivity rates fall at age 22 among low skilled workers. The estimated effects are statistically significant and suggest that both fall by around 2.5% points. Separate results for men and women indicate a statistically significant fall in unemployment among men and a statistically significant fall in inactivity among women. The impact on unemployment is insignificant among women as is the impact on inactivity among men. In fact, the results show that the rise in employment among men can mostly be explained by a fall in unemployment, while the rise in employment among women is explained by a fall in inactivity.

Conclusion and Policy Implications

The result that the employment rate increases at age 22, mirrored by falls in unemployment and inactivity is pretty robust to a large number of tests. However, it is not entirely clear what mechanism is driving these results. A plausible explanation is that this is a labour supply effect in response to a legislated increase in the NMW. When individuals turn 22 and become eligible for the adult NMW, which is around 20% higher than the development rate, they increase their effective labour supply.

There are a number of policy implications from our results. The first is that we can find no evidence that increases in the NMW at age 22 is adversely affecting the employment probabilities of these young workers. In addition, our findings are suggestive that implementing the adult rate at age 21 years is unlikely to have any adverse employment impacts on those aged 21. Indeed, our results suggest that labour supply may well increase among this group resulting in a higher employment rate.

1. Introduction

Since the National Minimum Wage was introduced in April 1999 a substantial literature has emerged looking at its impact on the labour market. The main focus of this research has been the impact on employment from which a consensus has emerged that there appear to be no significant impacts from the National Minimum Wage (NMW) on employment. However, determining the impact of the National Minimum Wage on employment is a difficult exercise. Because the minimum wage is National and there are no sizeable groups who are excluded from coverage, finding a suitable control group with which to compare employment outcomes is difficult. The studies that exist tend to compare groups that are more or less affected by the minimum wage; i.e. by looking at employment transitions of those directly affected by increases in the minimum and comparing them with those with slightly higher wages (Linnerman, 1982, Stewart 2004), or by comparing employment rates in regions that are affected by the NMW to a greater or lesser extent (Stewart, 2002, Dickens, Riley and Wilkinson, 2009 and Dolton, Rosazza-Bondibene and Wadsworth, 2009). This general method has been termed the “differential impact” approach (Dolado et al, 1995).

Secondary to this debate about the employment effects of the NMW has been a discussion concerning the impact of the NMW on youth employment, with a particular focus on the age at which individuals should be paid the adult rate. In fact, the Low Pay Commission have for many years argued that the adult rate should start at age 21.

In this report we use a novel approach to estimate the impact on labour market outcomes among young workers. We exploit the fact that the NMW is set differently for different age groups so that individuals experience a legislated increase at age 22. Table 1 shows that the adult rate is typically about 18-20% higher than the development rate applicable to 18-21 year olds. Our focus is on what happens to employment at age 22 when individuals qualify for the adult rate. Specifically, we use a regression discontinuity approach that compares changes in employment outcomes for individuals around this age threshold. In this framework, changes in employment for individuals who are a few months younger and older than 22 years provide an estimate of the employment effect of the wage increase.

Individuals also experience a legislated increase in the NMW at age 18. However, this is co-incident with changes in the benefit system at age 18, making it difficult to interpret any change in employment around this age threshold as an impact of the NMW alone. Furthermore, there have been important changes to the benefit system’s treatment of 18 year olds over the time period of our analysis, individuals are only allowed to perform certain jobs at age 18 (i.e. serving alcohol in a bar), and there are important changes in education participation at age 18. For example, participation falls from over 60% to under 40% in the period 6 months before 18 years to 6 months after 18 years. We did estimate the employment discontinuity at age 18 but found no statistically significant effects in our main specification. For these reasons we focus on the impact of the NMW increase at age 22 years where we are fairly sure there are no other coincident changes occurring. As such, our research design is based upon a relatively “clean” experimental change in legislated wage rates.

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Our approach contrasts with the “differential impact” approach in that identification of the employment impact arises from the existence of different minimum rates for very similar individuals, those just a few months older or younger than 22 years. Identification in the “differential impact” approach tends to arise from there being different actual wages for individuals or regions, with the same minimum rate. We believe that our approach provides a relatively clean quasi-experiment where some individuals are subjected to the higher adult rate and others the lower youth rate. The allocation of individuals into these groups is essentially random, since an individual’s age is not something that they can influence.¹

We analyse the effect of this legislated wage increase on various labour market outcomes for those turning 22: employment, unemployment and inactivity. We use data from the UK Labour Force Survey (LFS) and pool together all observations from April 1999 (when the NMW was first introduced) to March 2009 in order to increase sample numbers. We focus largely on low skilled individuals since they are the group most likely to be affected by the NMW.²

We conduct a number of crucial robustness checks on our results. A concern with this type of analysis is that there is some other coincident change that may impact on labour market outcomes (e.g. benefit increases at age 22). We can find no significant changes that occur at age 22 either in policy or in the survey methodology of the LFS that should impact on individuals’ probability of being in work. Participation in full time education does change significantly in the early 20s, albeit not specifically on individuals’ 22nd birthday, but our focus on the low skilled partially overcomes this problem. Our main analysis is based on individuals who are 6 months younger or older than 22. We experiment with other age ranges and our results are robust to these. We also carry out some falsification tests by looking for a potential discontinuity in the years prior to the introduction of the NMW and at other age thresholds. We also present results using a non-parametric approach to regression discontinuity and our results are robust to utilising this less restrictive methodology.

We find a significant increase in the employment rate of low skilled workers at age 22 of about 5% points. The effect is slightly larger for low skilled women, whose employment rate appears to increase by 6% points. We can find no such increase in the years preceding the introduction of the NMW, or at age 21 or 23. We also find evidence that reductions in unemployment and inactivity account for about two and three fifths of this employment increase respectively. It is plausible that these results are reflective of a labour supply increase at age 22 among these low skilled individuals in response to a 20% increase in the wage on offer.

¹ A number of papers using the regression discontinuity technique exist in the literature. For example, Card, Dobkin and Mestas (2009) examine the impact on health outcomes of Medicare coverage at age 65 and Lemieux and Milligan (2008) examine the impact of welfare benefit increases at age 30.

² These are defined as individuals with no educational qualifications or with educational qualifications no higher than exams taken at minimum school leaving age (O-levels/GCSEs) or the lowest level of National Vocational Qualifications (Level 1). We also estimated impacts on all individuals but could find no significant effects on employment.

The report is organized as follows. In the next section we present the empirical methodology we use, section 3 then describes the data and presents some descriptive statistics, section 4 presents our results on wages, section 5 our main results on employment outcomes and section 6 summarises.

2. Methodology

We utilise a regression discontinuity approach to examine the impact of qualifying for the adult NMW when an individual becomes 22 years old. Typically the youth rate is some 18-20% below the adult rate (see Table 1) so when an individual turns 22 they experience a legislated pay rise of this order. We examine the impact that this increase in the NMW has on a number of labour market outcomes; probability of employment, unemployment, inactivity.

Define a dummy variable that is an indicator for whether someone has passed their 22 birthday:

$$Dum_i = \begin{cases} 1 & \text{if } age_i \geq 22 \\ 0 & \text{if } age_i < 22 \end{cases}$$

Where age_i is the individual's age measured in months. We then estimate the following reduced form regression:

$$y_i = f(age_i, \alpha) + \beta Dum_i + \delta X_i + u_i \quad (1)$$

y_i is an employment related measure for individual i (i.e. a dummy indicating employment status), $f(age_i, \alpha)$ is a flexible polynomial with parameters α , X_i is a set of covariates for individual i and u_i is an error term. We interpret β as the causal effect on employment of the increase in the NMW from the youth to the adult rate. The assumption underlying this estimation procedure is that assignment to either side of the discontinuity at the 22nd birthday is random. The approach then essentially treats those above the threshold as the treatment group and those just below as the control group; where the treatment is exposure to the adult NMW.

Since our threshold is defined by age then, as Lee and Lemieux (2009) point out, everyone will receive treatment at some point. This means one cannot interpret treatment as random as one might in the context of a random experiment. More importantly, it also means that the group of individuals to the left of the threshold may change their behaviour since they know ultimately they will also receive the treatment. Those just a few months short of 22 may turn down job offers that they would have taken in the absence of the NMW if they know they will receive a higher wage offer once they turn 22. This is akin to the Ashenfelter's dip (Ashenfelter, 1978). Ultimately there is little we can do to test this but it does seem rather implausible that, in this high turnover labour market, individuals will reject job offers when they can easily change jobs again once they turn 22.

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The estimate of the discontinuity parameter β is highly dependent on the functional form of the polynomial. In practice we estimate flexible functional forms for the age function, $f(\text{age}_i, \alpha)$, and allow for this function to have different parameters either side of the threshold. We then estimate the following regression:

$$y_i = f(\text{age}_i - c, \alpha) + Dum_i \cdot f(\text{age}_i - c, \alpha^*) + \beta Dum_i + \delta X_i + u_i \quad (2)$$

Where, as is common practice, we also define age (in months) as the age minus the cut-off point c (where c is 264, the age in months at 22 years). We present results of a test for goodness of fit proposed by Lee and Lemieux (2009). Here one compares the estimated (restricted) model with a (unrestricted) model that has a separate dummy variable for each discrete value of age. This is essentially a test of whether the discontinuity in the restricted model might result from incorrectly imposing structure on the data. It is also a test of whether there are discontinuities at other nearby age thresholds, which might cast doubt on the interpretation of β as a causal effect of the minimum wage. Since age is measured in discrete units (measured in months) we also cluster our standard errors on age in months to avoid biased standard errors (Moulton, 1986; Lee and Card, 2008).

3. The Data

We estimate this model using LFS data on individuals' labour market status around their 22nd birthday. The LFS includes just over a thousand 21 year olds each quarter, and a similar number of 22 year olds. Because the identification strategy relies on comparing individuals very close to their 22nd birthday, and because we focus on the subset of individuals that are most likely to be affected by low pay, we pool together all LFS records over the period since the introduction of the NMW; April 1999 – March 2009.³

The LFS includes information on the year, month and day an individual was born, and on the year, month and day of the survey response. From this information we can calculate an individual's age measured in days at the time the survey was recorded. If we measure age in days or weeks we have very small sample numbers in each age category and the data become very erratic. Consequently, we use age in months as our age measure for our main results. Individuals who are 264 months old are exactly 22 years old. This is the point at which individuals qualify for the adult rate. Age is measured in months distance from this cut-off. For example, the distance for individuals aged 265 months is +1 months; for those age 263 months the distance is -1 months. Of course, those who are 264 months old may be either 21 or 22. Only those who are 22 qualify for the adult NMW. We use the LFS age recorded in years to split this group accordingly. Approximately half of individuals aged 264 months are 21, and half are 22, as one would expect from a random sample. Individuals aged 264 months who are 21 are up

³ Note in our main estimation results we treat the discontinuity to be the same in each year. While the difference between the adult and youth rates do vary from years to year Table 1 shows that the difference is always in a fairly narrow range in most years. We do also allow for different impacts depending on the size of the increase at age 22.

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to half a month away from their 22nd birthday. Using the midpoint of this interval the distance measure for this group is -0.25 months. For those aged 264 months who are 22 the distance measure is +0.25 months. In a similar vein, the distance measure for other groups can be interpreted as an interval midpoint, with the distance j months referring to those who are between $j-0.5$ and $j+0.5$ months from their 22nd birthday.

The LFS has a series of questions about income and earnings from employment. There are two main measures of hourly wages. One is derived from information on pay and hours in the reference week. This has been shown to contain a significant amount of measurement error (See Dickens and Manning, 2002). In April 1999, the LFS introduced a question on hourly rates of pay. Individuals in employment are first asked whether they are paid by the hour and if they respond positively they are then asked their hourly rate. There is evidence that this variable contains much less error. However, the drawback of this measure is that we only have information on those paid by the hour. About half of all jobs are hourly paid but this increases to around 65% among 21 and 22 year olds.

In analysis using regression discontinuity it is important that there is no discontinuity in any of the potential covariates that may explain any change in the outcome variable. Table 2 shows the distribution of the covariates across age measured in months distance from the 22nd birthday. These statistics are for the low skilled, who are the focus of this paper, defined as those whose highest educational qualifications are equivalent to GCSEs (school exams obtained at minimum school leaving age of 16). This group also includes those without educational qualifications. The focus on this group is because they are more likely to be exposed to low pay and because they are less likely to be in full-time education. Table 2 also shows the distribution of the sample across sample years and months. There do not appear to be any significant changes in these covariates across the discontinuity as one would largely expect when age is the forcing variable.

4. Wages and the NMW at 22

In this section we examine what happens to hourly wages when an individual turns 22 since this is the driving mechanism by which we expect any potential employment changes. Earnings data are collected from approximately 40% of LFS respondents as income questions are only asked in waves 1 and 5, and response is typically such that we have hourly rate information for less than 20% of the LFS sample. Response rates are particularly low for younger groups; we have hourly rate information for 13% of employees age 21 or 22. Thus the data shown here is estimated on a severely restricted sample. Table 3 shows the proportion of employees age 21 and 22 who are paid less than the adult NMW. Note that quite a large proportion of 21 year olds are paid less than the adult wage. This proportion is higher for the low skilled and for females. Approximately 11% low skilled employees age 21 are paid less than the adult NMW. This drops to 6% for 22 year olds. There may be several reasons why the share paid less than the adult NMW does not drop to zero at age 22. There may be non-compliance by employers. There may also be some measurement error in the wage data which means that wages recorded below

the NMW are actually above. It is also the case that those aged 22 on a recognised apprenticeship programme are exempt from the NMW for the first 12 months of their employment.⁴ Unfortunately, it is difficult to identify these individuals in the LFS. Relatively few 21 year olds are also paid at or less than the development rate applicable to 18-21 year olds, as shown in Table 4. By age 22 virtually no one is paid this little.

The discontinuity in low pay at age 22 is quite clear in the data. Note however that in terms of the impact on employment treatment here arises from the wage on offer to individuals. We do not observe offer wages but the actual wage when an individual enters work. If there is selection into work at different wages then we may not observe a sharp discontinuity in wages at age 22; firms may be reluctant to hire those over 22 on the adult rate or those aged 21 may not enter at the lower offer wage. Figure 1 reports the proportion of low skilled employees paid below the adult NMW at each month from 21 to 23 years. This figure shows us that there is a significant degree of sampling variability from month to month due to the small sample sizes. However, there does appear to be a clear drop in the proportion paid below the adult NMW after age 22.

5. Results

5.1 Impact on Employment

In this section we present our results on employment. We restrict our analysis on low skilled individuals since these are most likely to be affected by the increase to the adult NMW. Furthermore, we focus on those aged six months either side of the age 22 threshold. As such, our estimates span individuals who are aged between 21 years and 6 months and 22 years and 6 months. We also present estimates below using a 12 month window either side of 22. However, we believe that the 6 month windows provide the most robust estimates since many other influences on labour market behaviour start to creep in with the wider age ranges.

Table 5 presents our results from estimating equation (2) above with a piecewise quadratic in age. We estimate a probit regression where the dependent variable is a dummy indicating whether the individual is in employment or not. The reported coefficients are marginal effects. Different specifications are reported with and without other control variables. The first column reports the results for all unskilled workers with no controls. The results are rather striking. We find a positive discontinuity coefficient β that is strongly significant at the 1% level. The estimated coefficient implies that on turning 22 the probability of employment increases by about 5% points on average for this group of workers. This

⁴ Note that there are a number of potential reasons why individuals can legally be paid below the NMW. For example, those living in employer provided accommodation can be paid with an accommodation offset.

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result is robust to the inclusion of controls in column 2 where the estimated discontinuity coefficient remains strongly significant at the 1% level.⁵ Note that if we have a true discontinuity then the inclusion of controls should not affect the point estimate of the discontinuity parameter but can help improve the precision of the estimates (See Lee and Lemieux, 2009).

The choice of the polynomial in age $f(\text{age}_i, \alpha)$ is crucial for robust estimation using a regression discontinuity approach. We follow Lee and Lemieux (2009) and test our specification. The final row of the Table reports a chi squared test of the piecewise quadratic specification against a specification with a full set of age dummies. We cannot reject the piecewise quadratic specification against this much more general specification that allows for a different employment rate at each month around 22 years.

It is common practice when using the regression discontinuity approach to present results graphically, since one would like to be able to observe any discontinuity in the data. Figure 2 presents the employment rate for each month six months above and below age 22. These are the average employment rates for each discrete value of age measured in months. Also presented on the figure is the predicted employment rate from equation (2) above using the results from column 2 of Table 5. These solid lines represent the piecewise quadratics, including controls, with the jump at age 22 being the estimated discontinuity parameter β . While there is some variation from month to month due to sample sizes one can clearly see a jump in the employment rate at age 22. The estimated jump at the threshold is approximately 5% points, taking the employment rate from just under 56% to over 60%.

The rest of the columns of Table 5 present results separately for men and women. Figures 3 and 4 present the actual and predicted employment rates for men and women. We find slightly different results for the two sexes. The estimated discontinuity coefficient for men is lower at around 4% but is statistically significant at the 5% level when one includes controls. The results for women suggest a 6% point increase in the employment rate for this group, which is again significant at the 5% level. The results are also robust to the inclusion of controls, which raises the estimated increase in employment to 6.5% points. The quadratic specification is rejected by the data for females (at the 10% level in the model without controls; at the 5% level in the model with controls). We discuss a cubic specification of the age function in the next section.

Our results suggest that when a low skilled individual turns 22 years of age and they become eligible for the adult NMW their employment rate increases. This is at odds with the standard neoclassical model of the labour market, in which any binding minimum wage will result in employment losses. One interpretation of our results is that labour supply increases among low skilled workers, who now find work more attractive. Another possibility is that demand for workers is changing at age 22, perhaps if firms now treat those over 22 as adult workers. We will attempt to investigate this issue further.

The estimated impact is non-trivial. . With an approximate wage rise of 20% we find that the employment rate increases by about 5% points. This corresponds to a 2.5% point increase in

⁵ See notes to Table 5 for a list of control variables.

employment resulting from a 10% increase in the minimum wage. We will spend the rest of this section looking at various robustness checks in order to test the reliability of our main findings.

5.2 Falsification tests

If the National Minimum Wage is the driving force behind our results, then one would expect to find no employment discontinuity at age 22 years in those years prior to the introduction of the NMW. We take the same LFS data for the period March 1992-March 1999 and estimate our discontinuity model once again. The results are presented in Table 6. The results are strikingly different from those presented above. In no specification can we find a statistically significant discontinuity parameter. For example, the estimated parameter for females with controls in column 4 is 0.028, with an estimated standard error of 0.023. These results suggest that the employment discontinuity at age 22 was not apparent prior to the introduction of the NMW.⁶

We also estimated this as a difference in difference to see if the gap was statistically significant. We find positive employment effects now only significant at the 10% level for men and 'all' group when we include controls. There is an issue here as to whether we are comparing like with like in the pre and post NMW periods since our definition of low skilled is an absolute one. Consequently, the pre-NMW sample is much larger as there were many more low skilled individuals.

Another worry is that we have just picked up a spurious effect related to becoming a year older. In order to check this we estimate the same discontinuity model, but instead look for the discontinuity at different ages. In Tables 7 and 8 we present results based on a discontinuity at age 21 and age 23 respectively. The results are once again reassuring. At age 21 we can find no evidence of a significant discontinuity in employment among any of our estimated specifications for all individuals and women. The estimated coefficients are all low with relatively large standard errors. For men with controls we do find a positive coefficient of 0.041 that is significant at the 10% level. The results at age 23 also show no significant employment changes for any of our groups or specifications. These results confirm that the discontinuity only exists at age 22, but there is very little evidence that employment changes at other age thresholds in the early 20s.

⁶ Sample sizes for the period prior to the introduction of the NMW are larger than for the period after because in the 1990s LFS sample sizes were larger and because there were more low skilled people in this age group. Note that participation in higher education has risen sharply since the 1990s. We have re-run our results for a lower skilled group that is constructed to cover the 18% lowest skilled in each period – i.e. before and after the introduction of the NMW. Doing this we reach the same conclusions, finding a significant positive discontinuity in employment at the 22nd birthday in the period after the introduction of the NMW and none in the period before.

In terms of other changes at age 22 it is difficult to think of any changes in policy or legislation that occur at that time and that might explain this employment jump. The main changes in the benefit system happen to individuals at age 18 and then 25. Of course there are significant changes in education participation around the early 20s. However, we have focussed on low skilled workers who are less likely to be in education. In addition, our results are robust to including a control for whether the individual is still in full time education or not.

5.3 Specification checks

The quadratic specification for the age function that we use, with different parameters either side of the age threshold, is rather a flexible functional form. This ensures that the estimated discontinuity parameter does not simply result from too strict a structure on the data. However, as discussed above, for females the piecewise quadratic is rejected against the very general specification that allows for different employment rates at each discrete age point. In Table 9 we specify a piecewise cubic for the age function. The size of the coefficients in all columns remains similar to those obtained with the piecewise quadratic (reported in Table 5) and the results for all low skilled individuals are statistically significant at the 1% level. For men the estimated coefficient is similar in value but the standard error increases so that the results are no longer statistically significant. The size of the estimated coefficient increases for low skilled women to around 0.083 and this remains statistically significant. However, the evidence of mis-specification with the more flexible piecewise cubic is stronger than for the piecewise quadratic. This suggests to us that the test statistic is detecting the erratic nature of the data, resulting from small sample sizes.

All the results so far are using data that covers a 6 month window either side of 22 years. We also experimented with different windows. Table 10 presents the results taking a 12 month window either side of 22 (i.e. from age 21 to 23 years). This reduces the estimated discontinuity to 4% points for all low skilled individuals, and the results are strongly significant at the 1% level. The estimated parameter for females drops to 4% points and is now not statistically significant. For men we find a similar 4% point discontinuity in the employment rate at the 22nd birthday, which is statistically significant. This further supports the evidence of an increase in employment amongst low skilled individuals when they become eligible for the adult NMW.

There are fewer observations either side of the threshold, where we observe individuals within 2 weeks of their 22nd birthday. This makes the data more erratic at the discontinuity. For this reason we re-estimate our main model, excluding individuals who are exactly 22. The results are reported in table 11. The estimated discontinuity in employment is smaller than in our main specification, but not very different in the models with controls. Standard errors are increased, because of the notable reduction in sample size around the threshold in this model. The estimated parameter for all low skilled individuals,

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with controls, implies an increase in the employment rate of 3.7% points that is statistically significant at the 5% level. For males and females the estimated parameters fall and become statistically insignificant.

The discontinuity results presented so far constrain the impact of the NMW increase at age 22 to be the same across all years. However, we saw in Table 1 that the wage jump at age 22 ranges from about 16% to 20% depending on the year we are looking at. Therefore it is feasible that the impacts of the discontinuity are different in years with larger and smaller wage increases. In Table 12 we report the discontinuity results when we interact the discontinuity dummy with the magnitude of the wage increase at age 22. Comparing these results to those in Table 5 shows that little changes. The impact of the wage rise at age 22 are now somewhat lower across the different groups but the results remain statistically significant.

5.4 Impacts on unemployment and inactivity

The results above appear to show that the employment rate increases at age 22 as young workers become eligible for the adult minimum wage. These results hold up pretty well to a number of robustness and falsification tests. However, if employment is rising then one or both of the other labour market states must also be changing. Here we examine what happens to unemployment and inactivity at the age 22 threshold. Table 13 presents the results from the discontinuity regression in equation (2) above where the dependent variable is now an indicator dummy specifying if the individual is unemployed or not. For all low skilled individuals we find a negative discontinuity parameter that is significant at the 1% level. The unemployment rate falls by 2.4% points among this group of low skilled workers. This result is robust to the inclusion of other controls in the second column. When we look at men and women separately we find contrasting results. The effect for women is essentially zero. However, for men we find a significant negative impact that suggests the unemployment rate falls by 3.8% points at age 22. The rise in employment among men appears to be a result of falling unemployment.

Table 14 presents the same exercise but with inactivity as the dependent variable. Here we find evidence that inactivity falls at age 22. For all low skilled workers, the inactivity rate declines by 2.7% points. This is only significant at the 10% level. The inclusion of controls increases the point estimate to 3.8% points and this is now significant at the 5% level. As with unemployment, we find contrasting results for men and women. For men the impact on inactivity is small and not significantly different from zero. However, the results for women show a 5.5% point fall in the inactivity rate which is significant at the 5% level. This is robust to the inclusion of controls.

Overall these results tie in quite nicely with our results on employment presented above. There we found an employment increase of approximately 5% points among the low skilled. The results here suggest that about two fifths of that increase is coming from reductions in unemployment and three

fifths from inactivity. The evidence also suggests that increases in employment for men are as a result of declining unemployment, whereas increases for women are coming about through declines in inactivity.

5.5 Non-parametric estimates

All of our results presented so far are dependent on a specific functional form for the employment rate either side of the discontinuity. We have experimented with a piecewise quadratic and cubic specification. These may be unduly restrictive, although our model specification tests against the flexible dummy model generally suggest not. In this section we utilise non-parametric regression discontinuity techniques to check the robustness of our results. This imposes fewer restrictions on the functional form of the data. This essentially estimates local linear (or polynomial) regressions in intervals either side of the discontinuity. The procedure smooths the outcome variable across different data points. We now measure age in days to allow more flexibility in this smoothing process. The size of the interval (bandwidth) can be crucial to the estimates so we experiment with a number of different bandwidths (as suggested by Lee and Lemieux, 2009). We allow bandwidths of 14, 28 and 56 days. Note that smaller bandwidths result in greater sampling variability since the number of data points used in the local regression estimation is reduced (the larger the bandwidth, the more we are smoothing the data). We utilise the RD programme written in Stata (See Nichols, 2007).

The results are presented in Table 15. Here we report the estimated discontinuity parameter for low skilled individuals and men and women separately. We report estimates using 14, 28 and 56 day bandwidths. The results are somewhat sensitive to the chosen bandwidth. However, for all low skilled individuals we always find a positive and statistically significant discontinuity parameter. The implied employment increase at age 22 ranges from about 7% points to 11% points. The size of the effects seems to increase as the bandwidth is reduced. In addition, the precision of the estimates declines as the bandwidth is reduced. This can be seen more clearly in Figures 5-7. These report the predicted employment rate at each age in days around the discontinuity for bandwidths 14, 28 and 56 respectively. It is clear from these figures that the prediction is more volatile for the bandwidth of 14 days and smoothest for 56 days. This is because the latter is smoothing over more data points. There is a trade off here in that the spirit of the discontinuity approach is to take a small group either side of the discontinuity, but this is at the expense of loss of precision.

Columns 2 and 3 of Table 15 report the non-parametric results for women and men. Splitting the sample results in lower precision. The results for women suggest a 8-10% point increase in employment but this is only significant when a bandwidth of 56 days is used. For men, we find statistically significant positive results for all bandwidths, implying a 9%-15% point increase in the employment rate. Once again the estimated size of the impact is larger at the lower bandwidths. The analogous figures to Figure 5-7 for males and females (not reported) show more volatility in predicted employment at lower bandwidths.

These non-parametric results are broadly supportive of our parametric findings. It doesn't appear to be the case that the statistically significant positive effects found in the parametric results above are being driven by an overly restrictive functional form. The non-parametric results themselves imply somewhat larger impacts on employment rates. However, these are sensitive to the choice of bandwidth.

5.6 Potential explanations

Our results using this discontinuity approach suggest that when a low skilled worker turns 22 and they qualify for the adult NMW their probability of being in employment increases. This is largely driven by a fall in unemployment for men and a fall in inactivity for women. These results are robust to a large number of specification and falsification tests. But the question as to what is the mechanism driving these results remains. One possibility is that as the legislated wage is increased at age 22, wages on offer to low skilled workers increase. For a group of individuals, the range of jobs offering wages larger than their reservation wage increases, and they either enter the labour market, increase their job search efforts, or accept job offers more readily. Essentially, the effective labour supply increases in response to an increase in the NMW. We know from the data that a large number of 21 year olds are paid the adult NMW already. If this is the case then why aren't those who increase their labour supply at 22 prepared to supply their labour while 21? It may well be that at the margin offer wages do increase. We presented some evidence of increasing wages at age 22. Or it could be that the perceived wage on offer increases, since the rates at which the NMW change are widely publicised.

An alternative explanation is that firms who want to hire adult workers choose an arbitrary age at which they consider a worker to become an adult. Anecdotal evidence from the Low Pay Commission and IDS (2002) suggests that before the introduction of the NMW firms treated workers aged 21 as adults, paying them a higher wage rate at this point or at an even earlier age. It is possible that with the introduction of the NMW this age has shifted to 22 years so that labour demand increases at this point.⁷ One way to test this hypothesis is to see if employment increased at age 21 in the pre-NMW period, the age at which many employers would consider an individual to be an adult. Table 16 presents the results from this analysis using our parametric regression discontinuity approach. We can find no evidence of a discontinuity in employment at age 21 in the period before the NMW. It seems that any labour demand effect that did exist prior to the introduction of the NMW was not large enough to show up in the data.

⁷ Following the introduction of the NMW some employers increased the adult rate to 22 (IDS, 2004).

6. Conclusions

In this report we utilise the legislated increase in the NMW at age 22 to identify employment effects of the minimum wage. We use a regression discontinuity approach that compares changes in employment outcomes around this age threshold. The assumption behind this approach is that being just a few weeks older or younger than 22 is random. We then compare employment outcomes considering those above the age threshold as a treatment group and those just below as a control group. We find a significant positive effect on employment. Our results suggest that on turning 22, the employment rate among low skilled individuals increases by about 5% points. This finding is robust to a large number of specification and falsification tests. Furthermore, we find evidence that reductions in unemployment and inactivity account for about 40% and 60% of this employment increase respectively.

These findings are consistent with an increase in labour supply, whereby young workers respond to this legislated pay increase of approximately 20% by entering work more readily. This seems plausible among this low skilled group whose initial wages are very low. However, there are other competing explanations such as an increase in labour demand as firms treat individuals as adults at age 22

While these results cannot be generalised to the wider labour market they do offer some insight into the mechanisms impacting upon employment among these young workers. The government has on a number of occasions resisted calls to reduce the age at which the adult rate becomes applicable. The evidence here suggests there would be little harm in legislating the adult rate at age 21. There is unlikely to be a deterioration in employment opportunities of low skilled individuals and it is possible that employment rates may increase as these young workers face increased incentives to enter the labour market.

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The impact on employment of the age related increases in the National Minimum Wage

Figure 1: Share of Low Skilled Employees Paid Less than the Adult NMW

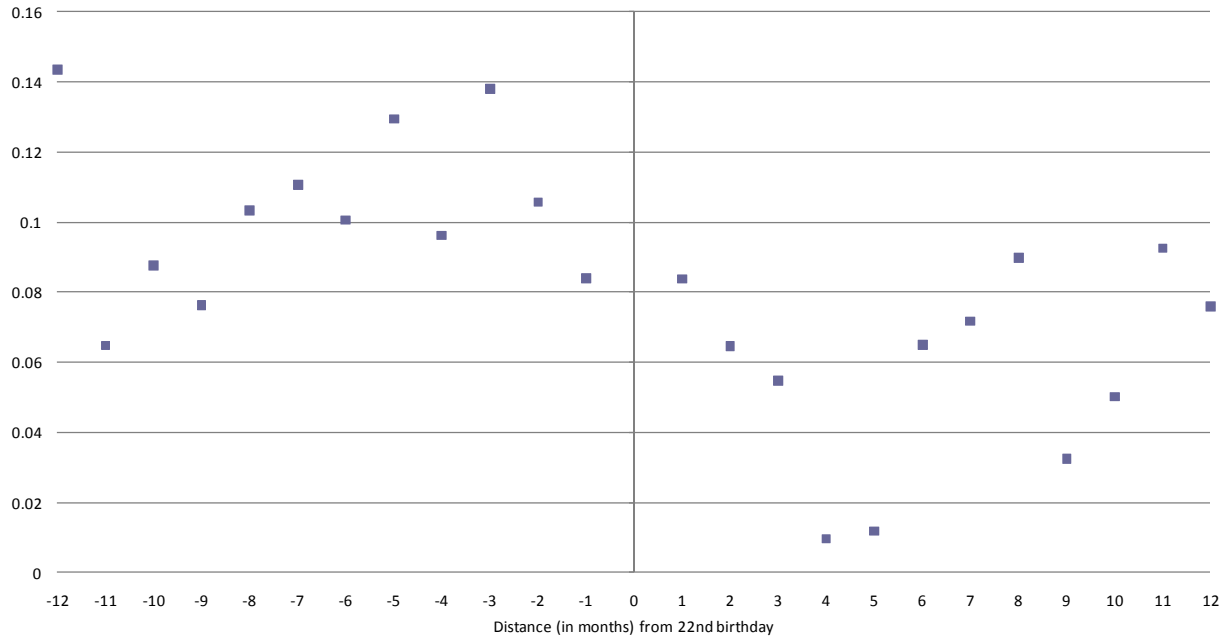
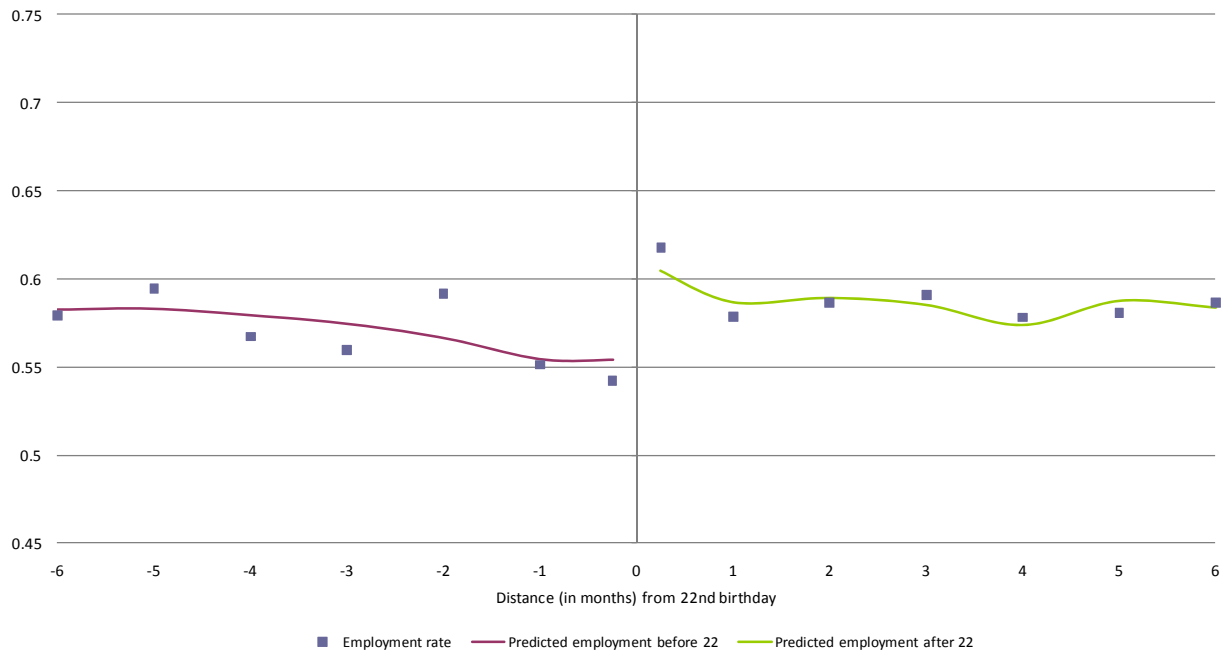


Figure 2: Employment Rate by Age in Months for All Low Skilled Individuals



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Figure 3: Employment Rate by Age in Months for Low Skilled Females

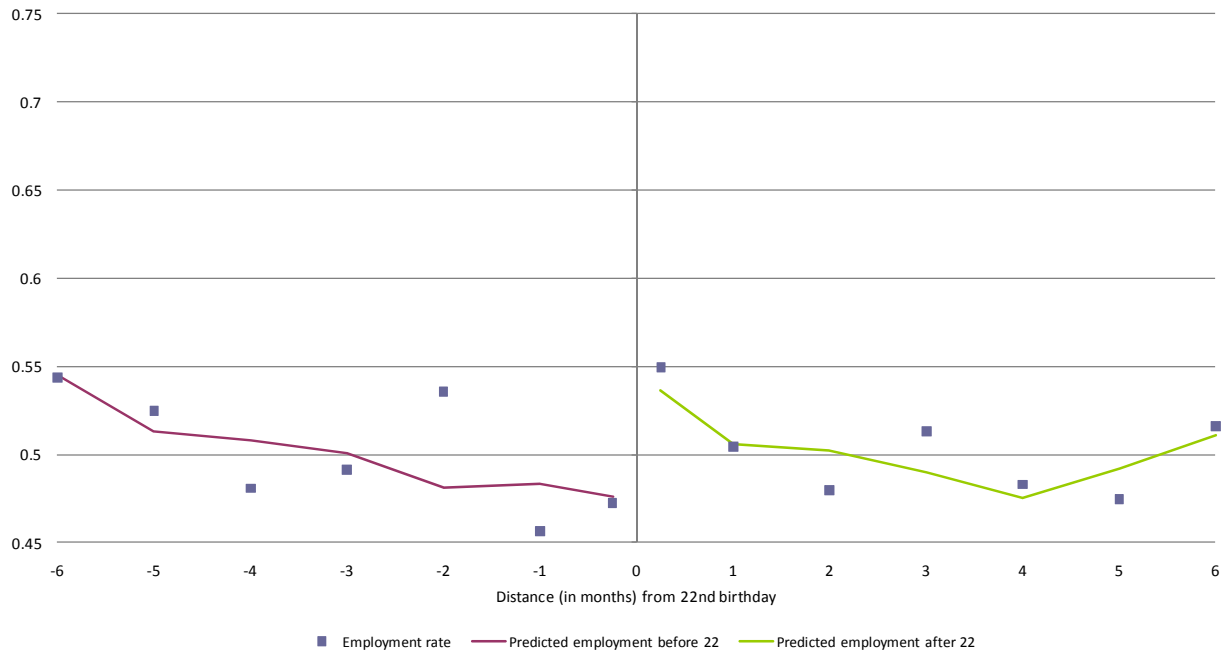
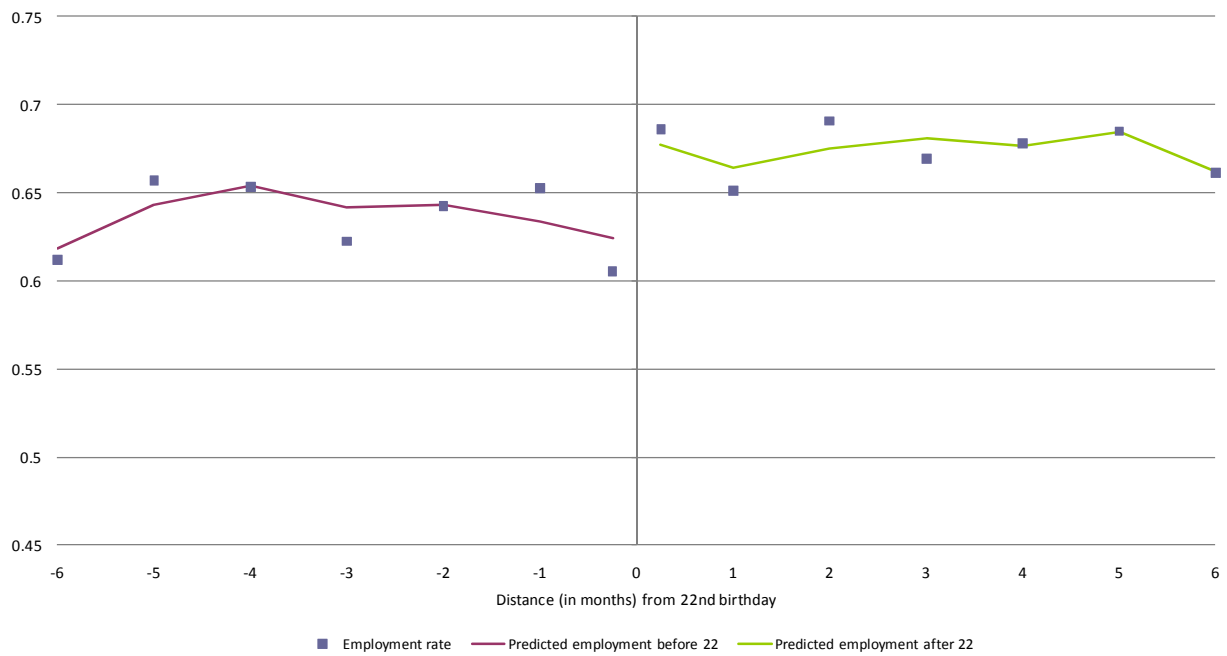
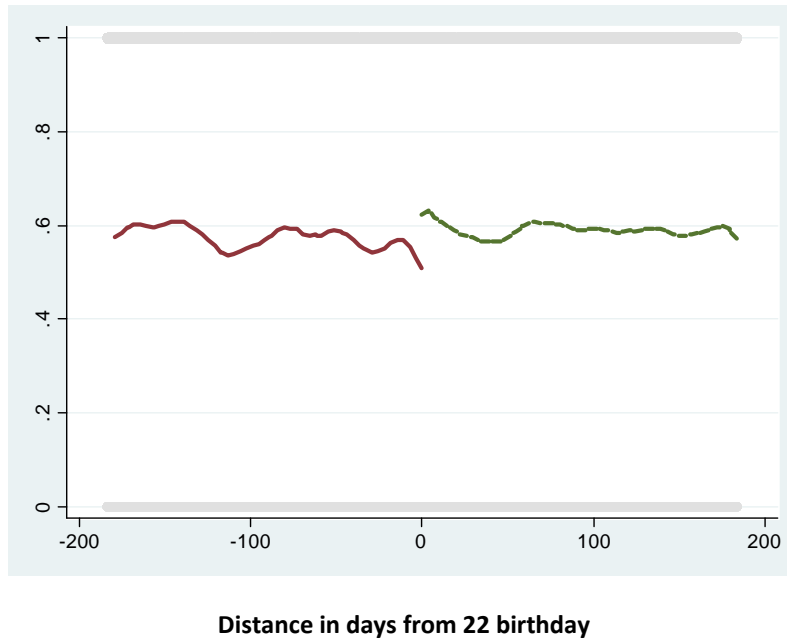


Figure 4: Employment Rate by Age in Months for Low Skilled Males

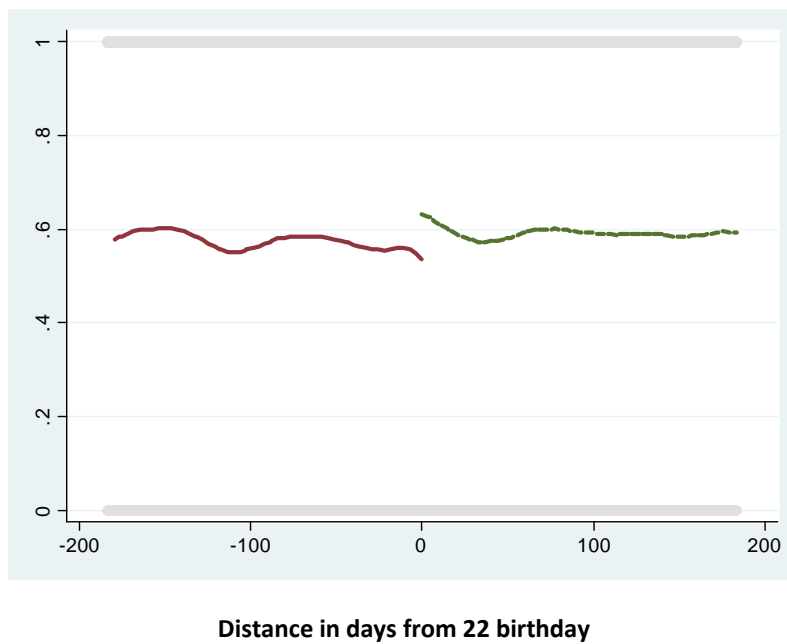


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**Figure 5: Employment Rate from Non-Parametric Model by Age for Low Skilled Individuals
Bandwidth 14 days**

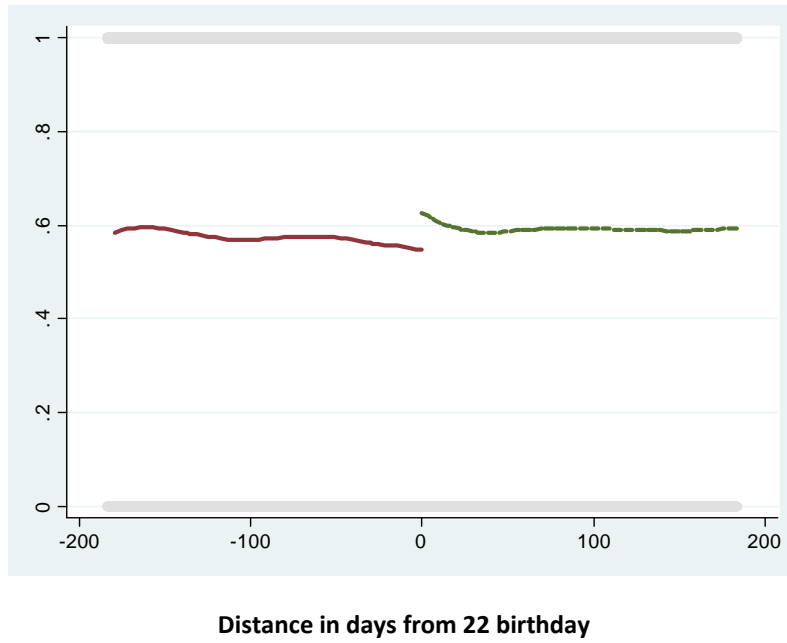


**Figure 6: Employment Rate from Non-Parametric Model by Age for Low Skilled Individuals
Bandwidth 28 days**



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**Figure 7: Employment Rate from Non-Parametric Model by Age for Low Skilled Individuals
Bandwidth 56 days**



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	Adult rate	Development rate	NMW increase at age 22
	£	£	%
Apr-99	3.60	3.00	20.0
Oct-00	3.70	3.20	15.6
Oct-01	4.10	3.50	17.1
Oct-02	4.20	3.60	16.7
Oct-03	4.50	3.80	18.4
Oct-04	4.85	4.10	18.3
Oct-05	5.05	4.25	18.8
Oct-06	5.35	4.45	20.2
Oct-07	5.52	4.60	20.0
Oct-08	5.73	4.77	20.1

Notes: Adult rate applies to employees age 22 and above; Development rate applies to 18-21 year old employees.

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Table 2: Descriptive Statistics (Low Skilled)

	Months from 22nd birthday													
	-6	-5	-4	-3	-2	-1	-0.25	0.25	1	2	3	4	5	6
Male	0.525	0.526	0.501	0.523	0.521	0.485	0.525	0.496	0.502	0.506	0.496	0.489	0.504	0.486
White	0.872	0.857	0.876	0.865	0.866	0.866	0.882	0.871	0.858	0.864	0.878	0.865	0.855	0.862
Full-time education	0.046	0.055	0.056	0.064	0.064	0.058	0.053	0.052	0.055	0.061	0.043	0.052	0.048	0.050
No qualifications	0.234	0.242	0.239	0.226	0.241	0.229	0.236	0.216	0.257	0.223	0.239	0.258	0.211	0.238
Proxy	0.457	0.465	0.436	0.451	0.441	0.429	0.466	0.437	0.460	0.436	0.451	0.434	0.410	0.398
Copy	0.114	0.121	0.131	0.122	0.139	0.114	0.111	0.133	0.130	0.118	0.126	0.118	0.131	0.120
Apprentice	0.018	0.012	0.015	0.014	0.016	0.012	0.014	0.021	0.021	0.012	0.014	0.022	0.010	0.015
1999	0.068	0.071	0.071	0.071	0.066	0.068	0.059	0.056	0.072	0.064	0.061	0.071	0.059	0.061
2000	0.092	0.094	0.085	0.091	0.095	0.094	0.101	0.087	0.092	0.095	0.097	0.092	0.094	0.094
2001	0.104	0.098	0.090	0.107	0.095	0.084	0.103	0.101	0.109	0.080	0.098	0.105	0.089	0.105
2002	0.093	0.094	0.095	0.100	0.092	0.098	0.105	0.101	0.097	0.086	0.112	0.105	0.092	0.107
2003	0.097	0.087	0.094	0.083	0.092	0.097	0.086	0.093	0.085	0.107	0.098	0.092	0.107	0.102
2004	0.090	0.084	0.090	0.093	0.097	0.091	0.085	0.090	0.095	0.108	0.076	0.085	0.107	0.089
2005	0.096	0.110	0.094	0.087	0.095	0.114	0.078	0.088	0.089	0.095	0.076	0.101	0.105	0.079
2006	0.103	0.097	0.126	0.102	0.127	0.110	0.124	0.100	0.115	0.102	0.118	0.111	0.106	0.109
2007	0.118	0.121	0.127	0.117	0.106	0.115	0.110	0.128	0.117	0.124	0.107	0.103	0.117	0.117
2008	0.106	0.110	0.098	0.119	0.111	0.115	0.119	0.128	0.098	0.114	0.118	0.108	0.106	0.116
2009	0.033	0.033	0.030	0.030	0.025	0.015	0.030	0.028	0.029	0.024	0.038	0.028	0.017	0.022
January	0.086	0.089	0.079	0.074	0.099	0.072	0.089	0.108	0.086	0.081	0.086	0.083	0.096	0.084
February	0.083	0.083	0.083	0.073	0.062	0.082	0.077	0.065	0.079	0.084	0.080	0.083	0.077	0.066
March	0.077	0.072	0.064	0.078	0.063	0.057	0.077	0.077	0.063	0.069	0.080	0.057	0.063	0.075
April	0.082	0.077	0.092	0.079	0.093	0.086	0.091	0.074	0.103	0.068	0.102	0.086	0.085	0.096
May	0.068	0.081	0.093	0.086	0.085	0.082	0.080	0.083	0.069	0.084	0.073	0.091	0.086	0.080
June	0.092	0.086	0.081	0.088	0.087	0.080	0.090	0.079	0.087	0.085	0.080	0.074	0.079	0.073
July	0.106	0.095	0.079	0.097	0.096	0.105	0.090	0.084	0.098	0.098	0.078	0.101	0.076	0.096
August	0.078	0.097	0.088	0.077	0.079	0.098	0.094	0.084	0.086	0.082	0.095	0.077	0.089	0.074
September	0.081	0.073	0.089	0.092	0.079	0.087	0.078	0.092	0.085	0.077	0.090	0.093	0.084	0.087
October	0.075	0.098	0.078	0.101	0.087	0.084	0.084	0.090	0.084	0.091	0.081	0.088	0.095	0.084
November	0.084	0.070	0.089	0.073	0.086	0.082	0.070	0.084	0.083	0.096	0.075	0.092	0.086	0.088
December	0.090	0.080	0.083	0.081	0.083	0.085	0.081	0.081	0.075	0.086	0.079	0.075	0.085	0.099
Population	809037	853643	816585	827156	855871	816313	398108	433025	829920	848640	792487	842974	808714	783603

Source: Labour Force Survey

Notes: Calculations take into account survey weights; Low skilled are individuals with highest educational qualification equivalent to GCSE (minimum school leaving age exams); Average April 1999-March 2009.

The impact on employment of the age related increases in the National Minimum Wage

Table 3: Share of Employees Paid Less than the Adult NMW at age 21 and 22

Skill	All		Females		Males	
	High	Low	High	Low	High	Low
Age 21	0.096 (0.006)	0.107 (0.009)	0.120 (0.009)	0.115 (0.014)	0.071 (0.008)	0.101 (0.013)
Age 22	0.044 (0.004)	0.057 (0.007)	0.051 (0.006)	0.078 (0.012)	0.037 (0.006)	0.040 (0.009)

Source: Labour Force Survey

Notes: Standard errors in parentheses take into account survey weights; Low skilled are individuals with highest educational qualification equivalent to GCSE (minimum school leaving age exams); Average April 1999-March 2009.

Table 4: Share of Employees Paid at or below the Development NMW at age 21 and 22

Skill	All		Females		Males	
	High	Low	High	Low	High	Low
Age 21	0.021 (0.003)	0.020 (0.004)	0.024 (0.004)	0.022 (0.006)	0.017 (0.004)	0.019 (0.006)
Age 22	0.007 (0.002)	0.006 (0.002)	0.007 (0.002)	0.007 (0.004)	0.006 (0.002)	0.005 (0.003)

Source: Labour Force Survey

Notes: Standard errors in parentheses take into account survey weights; Low skilled are individuals with highest educational qualification equivalent to GCSE (minimum school leaving age exams); Average April 1999-March 2009.

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Table 5: Employment Outcomes for the Low Skilled at age 22

	All		Females		Males	
Discontinuity	0.049*** (0.017)	0.059*** (0.015)	0.058** (0.026)	0.065** (0.030)	0.041* (0.023)	0.049** (0.020)
Observations	18524	18321	9436	9336	9088	8985
Rsquared	0.000380	0.102	0.00105	0.0862	0.00143	0.0966
Chisq(8)	8.90	9.48	14.77	20.11	6.78	6.22
Pr>Chisq(8)	0.35	0.30	0.06	0.01	0.56	0.62
Controls	N	Y	N	Y	N	Y

Notes: Statistical significance of the discontinuity indicated: * 10, ** 5, and *** 1 per cent level; Robust standard errors in parentheses corrected for clustering on age measured in months; Sample of those 6 months either side of 22 birthday April 1999-March 2009; Piecewise quadratic in age included in all specifications; Controls include: Dummies for education level, white, apprentice, region of residence, in full time education, year and month of interview; Low skilled are individuals with highest educational qualification equivalent to GCSE (minimum school leaving age exams); Chi-squared test statistic from likelihood ratio test of the estimated model against a model with dummy variables for age measured in months.

Table 6: Employment Outcomes for the Low Skilled at age 22 - Before NMW

	All		Females		Males	
Discontinuity	0.018 (0.020)	0.023 (0.017)	0.021 (0.025)	0.028 (0.023)	0.013 (0.019)	0.017 (0.016)
Observations	22903	22883	12679	12673	10224	10210
Rsquared	0.000277	0.0784	0.000300	0.0997	0.000416	0.0663
Chisq(8)	16.59	14.69	7.66	7.16	19.14	16.15
Pr>Chisq(8)	0.03	0.07	0.47	0.52	0.01	0.04
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Period before NMW includes March 1992 - March 1999.

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Table 7: Employment Outcomes for the Low Skilled at age 21

	All		Females		Males	
Discontinuity	0.017 (0.017)	0.022 (0.018)	-0.002 (0.016)	-0.001 (0.019)	0.034 (0.022)	0.041* (0.021)
Observations	18820	18652	9092	9014	9728	9638
Rsquared	9.79e-05	0.0950	0.000452	0.103	0.000518	0.0872
Chisq(8)	8.47	9.75	11.75	12.65	8.18	8.37
Pr>Chisq(8)	0.39	0.28	0.16	0.12	0.42	0.40
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Sample of those 6 months either side of 21 birthday April 1999-March 2009.

Table 8: Employment Outcomes for the Low Skilled at age 23

	All		Females		Males	
Discontinuity	-0.007 (0.012)	-0.005 (0.015)	-0.035 (0.025)	-0.023 (0.022)	0.023 (0.018)	0.010 (0.022)
Observations	18036	17841	9417	9333	8619	8508
Rsquared	0.000191	0.101	0.000760	0.0922	0.000309	0.0782
Chisq(8)	8.09	11.19	11.80	6.63	8.12	12.14
Pr>Chisq(8)	0.42	0.19	0.16	0.58	0.42	0.15
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Sample of those 6 months either side of 23 birthday April 1999-March 2009.

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Table 9: Employment Outcomes for the Low Skilled at age 22 - Cubic Specification

	All		Females		Males	
Discontinuity	0.059*** (0.021)	0.068*** (0.018)	0.083** (0.033)	0.091*** (0.031)	0.037 (0.032)	0.039 (0.030)
Observations	18524	18321	9436	9336	9088	8985
Rsquared	0.000394	0.102	0.00117	0.0864	0.00147	0.0966
Chisq(6)	8.56	9.16	13.14	18.23	6.26	5.88
Pr>Chisq(6)	0.20	0.16	0.04	0.01	0.39	0.44
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Piecewise cubic in age included in all specifications.

Table 10: Employment Outcomes for the Low Skilled at age 22 - Bandwidth 12

	All		Females		Males	
Discontinuity	0.037*** (0.014)	0.039*** (0.015)	0.040 (0.024)	0.037 (0.029)	0.035** (0.016)	0.039** (0.016)
Observations	35567	35192	17999	17815	17568	17377
Rsquared	0.000219	0.100	0.000680	0.0890	0.00117	0.0870
Chisq(20)	20.80	24.97	39.70	42.64	13.60	15.63
Pr>Chisq(20)	0.41	0.20	0.01	0.00	0.85	0.74
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Sample of those 12 months either side of 22 birthday April 1999-March 2009.

The impact on employment of the age related increases in the National Minimum Wage

Table 11: Employment Outcomes for the Low Skilled at age 22 - Excl. birthday month

	All		Females		Males	
Discontinuity	0.025 (0.016)	0.037** (0.018)	0.035 (0.038)	0.049 (0.049)	0.009 (0.021)	0.026 (0.022)
Observations	17084	16891	8709	8617	8375	8274
Rsquared	0.000164	0.103	0.000833	0.0858	0.00127	0.0980
Chisq(6)	6.09	7.70	13.07	19.31	4.67	5.05
Pr>Chisq(6)	0.41	0.26	0.04	0.00	0.59	0.54
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Individuals surveyed 2 weeks either side of their 22nd birthday excluded from the sample.

Table 12: Employment Outcomes for the Low Skilled at age 22: Allowing for different increases in each year

	All		Females		Males	
Discontinuity	0.040*** (0.014)	0.049*** (0.013)	0.047** (0.023)	0.053** (0.025)	0.033* (0.020)	0.041** (0.017)
Observations	18524	18321	9436	9336	9088	8985
Rsquared	0.000365	0.102	0.00102	0.0862	0.00141	0.0966
Chisq(8)	11.71	10.97	16.89	21.58	9.27	6.44
Pr>Chisq(8)	0.16	0.20	0.03	0.01	0.32	0.60
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Discontinuity interacted with the age 22 increase in each year

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Table 13: Unemployment Outcomes for the Low Skilled at age 22

	All		Females		Males	
Discontinuity	-0.024*** (0.005)	-0.023*** (0.004)	-0.009 (0.011)	-0.008 (0.011)	-0.038*** (0.012)	-0.039*** (0.011)
Observations	18524	18321	9436	9308	9088	8985
Rsquared	0.00113	0.0457	0.000602	0.0174	0.00231	0.0539
Chisq(8)	3.83	4.04	6.65	7.05	4.82	4.97
Pr>Chisq(8)	0.87	0.85	0.57	0.53	0.78	0.76
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; ILO definition of unemployment.

Table 14: Economic Inactivity Outcomes for the Low Skilled at age 22

	All		Females		Males	
Discontinuity	-0.027* (0.016)	-0.033** (0.016)	-0.055** (0.024)	-0.062** (0.030)	-0.001 (0.014)	-0.005 (0.010)
Observations	18524	18321	9436	9336	9088	8985
Rsquared	0.000297	0.187	0.000860	0.0896	0.000916	0.183
Chisq(8)	15.80	19.31	17.03	23.75	6.86	6.55
Pr>Chisq(8)	0.05	0.01	0.03	0.00	0.55	0.59
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Economic inactivity includes all individuals outside employment and unemployment.

The impact on employment of the age related increases in the National Minimum Wage

Table 15: Non-Parametric Estimates of Employment Outcomes for the Low Skilled at age 22

	All	Females	Males
Bandwidth			
14 days	0.113** (0.056)	0.098 (0.076)	0.147** (0.075)
28 days	0.098*** (0.035)	0.096 (0.060)	0.121** (0.054)
56 days	0.078*** (0.025)	0.082** (0.039)	0.092** (0.043)

Notes: Statistical significance of the discontinuity indicated: * 10, ** 5, and *** 1 per cent level; Bootstrapped standard errors in parentheses; Sample of those 6 months either side of 22 birthday April 1999-March 2009.

Table 16: Employment Outcomes for the Low Skilled at age 21 - Before NMW

	All		Females		Males	
Discontinuity	-0.001 (0.018)	-0.006 (0.019)	-0.002 (0.026)	-0.004 (0.028)	-0.000 (0.013)	-0.008 (0.014)
Observations	22136	22118	11837	11828	10299	10290
Rsquared	4.08e-05	0.0800	0.000172	0.0960	0.000121	0.0789
Chisq(8)	20.04	16.75	14.32	12.32	9.48	8.36
Pr>Chisq(8)	0.01	0.03	0.07	0.14	0.30	0.40
Controls	N	Y	N	Y	N	Y

Notes: See notes to Table 5; Sample of those 6 months either side of 21st birthday March 1992 - March 1999.