Research Report for the Low Pay Commission

The Geography of the National Minimum Wage

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Summary

Since its inception, the UK minimum wage has been administered on a national basis, with both adult and youth rates applying to all parts of the country. Some commentators have argued recently that the UK should adopt a regional minimum wage, based on the, as yet untested, argument that employment in certain regions may be compromised by a national wage floor above regional productivity levels. While employment and unemployment across Britain's regions has diverged for decades, well before the minimum wage was introduced, it is true that longstanding geographic variation in wage rates across the UK has consequences for the "bite" of the national minimum wage, (NMW) in different areas. If the NMW reaches further up the wage distribution in certain parts of the country than in others then any effects of the NMW are likely to be more prevalent in areas where the bite is larger, other things equal.

Our study looks to see how *changes* in the bite of the NMW across local labour markets over the 9 years of the minimum wage's existence are associated with changes in local area performance. We use an 'incremental differences-in-differences' (IDiD) estimator for this purpose to identify the incremental effects of the NMW in each year since its introduction.

The NMW appears to be associated with a significant fall in wage inequality in the bottom half of the distribution. Areas where the NMW "bites" more have experienced larger declines in the 50-5 and 50-10 wage ratios than elsewhere.

While the overall effects of the introduction of the NMW on employment rates over its 9 year existence are neutral, when we examine the effect in each year we find small but significant positive effects on employment in the period beginning in 2003.

Unlike employment, there is some evidence of a significant association between unemployment and the NMW. Areas where the NMW has more bite appear to have experienced higher unemployment, averaged over the entire period.

However, this overall average positive effect disguises significant negative effects in later years. Hence any upward association between the NMW and the unemployment rate is confined to the earliest years of the NMW’s existence. Thereafter unemployment rates fell more in areas more affected by the NMW.

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I. INTRODUCTION

There are by now a large number of studies on the impact of the National Minimum Wage (NMW) for many industrialised countries. Most especially there are a huge number of papers on the impact of the NMW on employment, (see Brown et al (1982) Card and Krueger (1995) for summaries of the United States literature and Metcalf (2007) for a summary of the UK literature) However, only a few studies evaluate the impact of the (NMW) exploiting geographical variation in local or regional labour markets. Since its inception, the UK minimum wage has been administered on a national basis, with both adult and youth rates applying to all parts of the country. Some commentators have argued recently (Smith (2006)) that the UK should adopt a regional minimum wage, based on the, as yet untested, argument that employment in certain regions is compromised by a national wage floor above regional productivity levels.

It is true that employment and unemployment across Britain's regions has diverged for decades, well before the minimum wage was introduced, but it is also true that variation in employment and wage prospects, depending on the level of disaggregation, can be as wide within regions as between regions.[1] Moreover, there has been longstanding geographic variation in wage rates across the UK which has consequences for the bite of the national minimum wage, (NMW) in different areas. Stewart (2002) points out how the

[1] For example, using local authority and the 18 metropolitan county regions/countries as the areas of aggregation, the within-region variations in employment rates are much larger then the between region variation, according to the 2005 UK APS.

NMW reaches further up the wage distribution in certain parts of the country than in others.

Stewart (2002) is the only existing extensive UK study to use the varying bite of the minimum wage across local labour markets to identify labour market effects of the NMW. Examining employment growth following the introduction of the NMW he finds that, despite the undoubted differential “bite” of the NMW across local labour markets, there was no significant effect on employment growth in the first two years after the introduction of the NMW. Our study will build on this earlier work by looking to see how *changes* in the bite of the NMW across local labour markets over the 9 years of the minimum wage’s existence are correlated with changes in local area performance. Our additional insight is to try to differentiate between the overall effect of the NMW over the period and the effect of each incremental uprating of the NMW each year.

In the United States, two notable studies exploit the geographical variation in wages to try to identify the employment effects of changes in the federal minimum wage. Card (1992) assesses the effect of the 1990 increase in the federal minimum wage on teenagers’ wages and employment. Since wages vary across states so does the treatment effect, depending on the state-level incidence of teenagers’ low pay. Neumark and Wascher (1992) is a longer panel study that exploits both time and state variation in minimum wages to identify the impact of the minimum wage on employment of teenagers and young adults. Each state again is treated as a specific observation from 1973 to 1989 for large states and from 1977 to 1989 for smaller states. The employment to population ratio is then regressed on a coverage adjusted Kaitz Index and a vector of control variables including state and year effects. These papers produce contrasting results. Neumark and Wascher (1992) found that increases in the NMW reduce employment among youths. Card (1992) found employment effects to be absent or positive.

Existing evidence from the UK suggests that the employment effects of the NMW have been small or zero (Stewart, 2002, 2004a, 2004b, and Dickens and Draca, 2005). One of the possible reasons suggested is that long-run effects are not been captured by previous studies. Since in the short-run the costs of adjusting inputs tend to be high, the response of employment to NMW increases might not be immediate. As recently pointed out by Neumark and Wascher (2007): "Most of the existing research on the United Kingdom has been limited to estimating short-run effects, and in our view, the question of the longer-run influences of the national minimum wage on U.K. employment has yet to be adequately addressed" (p.121). This study will therefore try to look at the long-run effects of the NMW in the UK.

Our first contribution is to look at the incremental impact of the NMW by the examination of the different impact the annual uprating of the NMW has each year. Hence instead of using a simply policy on - policy off Difference-in-Differences model we examine a model in which each year's change in the NMW is considered as a separate interaction effect. This 'Incremental Difference-in-Differences' (IDiD) estimator is a logical corollary of the econometric model suggested by Wooldridge (2007) and Bertrand et al (2004).

Secondly we seek to assess whether the definition of the variable used for the NMW makes a difference. In the empirical literature there is some debate over the exact definition of which variable to use to measure (or to instrument for) the NMW. In this work three possible minimum wage variables will be used and compared. First of all, two measures that focus on the proportion of workers directly affected by increases in the minimum wage: the minimum wage "share" (proportion paid at or below the minimum wage) and the "spike" (proportion paid at the minimum). Thirdly, the Kaitz index will be used. This measure has been variously used and defined in the literature which relates the minimum wage to other wages. Our results will compare estimations for the Kaitz Index, the Share at or below the NMW and the Spike at the NMW.

Thirdly, we examine whether the definition of the geographical unit used for the analysis matters. Since the choice of what constitute a local labour market in Great Britain is still open to discussion, the analysis will be undertaken at two different level of geographical aggregation. As in Stewart (2002) Great Britain will be divided in 140 areas comprising Unitary Authorities and Counties. However, the same analysis will be done at 406 areas level which include Unitary Authorities and Districts. Our analysis remains agnostic as to what is the correct definition of a 'local' labour market.

A fourth contribution of our work, relative to the literature, is an attempt to set out the different estimates in the literature in some context. Hence we make some effort to examine the specification issues associated with: dynamic specification to incorporate the lagged effects of the impact of the NMW, fixed effects for geographical areas, time and interaction effects, and we also assess whether the estimates differ if we include young people (those aged 16-25), or omit them or just use them alone for the analysis. In this testing of robustness we are suggesting that much of the previous literature is presented as if it were finding results which are in stark contrast to each other. Our take on this literature is that most of it estimates fundamentally different parameters and that this explains a large degree of the difference in results.

Previous research in the UK focused mainly on the employment effects of the NMW and for the most part found mainly no impact. Therefore, this study will concentrate not only on the effects of the NMW on employment, but also on other different measures of local area performance such as the proportion of workers claiming Job Seeker Allowance, the average workings hours of employees and the extent of income inequality in the locality. Labour market adjustments due to the minimum wage may take place at the extensive margin (number of workers, employment and unemployment) or at the intensive margin (average hours). The introduction of the minimum wage and the following up-ratings might induce employers with high proportion of low paid workers to adjust working hours. Moreover, one of the motivations of the introduction of the minimum wage was to reduce the negative trend of wage inequality which characterised the British labour market in the 1980s and 1990s. Therefore, this study will also analyse how changes in the local area minimum wage incidence are related to the extent of income inequality in the locality.

The paper is organized as follows. Section II describes the datasets used and the characteristics of the data and contains a description of the maps of the incidence of the minimum wage and the measures of local area performance in each local area. Section III outlines the methodology for the analysis. The main results of the analysis are presented in section IV. Section V concludes.

II. DATA

The central idea of this paper is to see whether geographic variation in the “bite” of the minimum wage is associated with geographic variation in employment and other indicators of local market performance (wage inequality, unemployment, and hours of work). Geographical variation in wages in the UK is exploited in order to evaluate the impact of the NMW on a series of indicators of local area performance. The data used in this study are drawn primarily from three sources. Data on earnings, hours and a restricted number of covariates all disaggregated by geography are provided by the New Earnings Survey (NES) from 1997 to 2003 and by the Annual Survey of Hours and Earnings (ASHE), which replaced the NES in 2004. In both surveys, conducted in April of each year, employers are asked to provide information on hours and earnings of the selected employees. The geographic information collected for the full sample period used in the paper is based on workplace rather than residence. This is the only UK dataset that has hourly wage information from 1997 to 2007 at the various levels of geographical disaggregation used in this paper. One limitation of ASHE/NES is that, being sourced from pay records, it has limited personal information, so data on employment and human capital are not available. Alongside the hourly wage, the ASHE data enable us to compute estimates of three different measures of wage inequality at the same geographic levels, (the $50^{th}/5^{th}$, $50^{th}/10^{th}$, and $50^{th}/25^{th}$ percentiles of the wage distribution) along with average total hours worked by full-time and part-time employers, (see the Appendix for a detailed description of the variables and the limitations affecting the ASHE\NES dataset).

The geographic based measure of the minimum wage should reflect the industrial composition of each local labour market. Over time local industries grow while others decline. The changing industrial composition of an area and the extent to which industries are low and high paying will affect the changing incidence of the minimum wage working in a locality. The choice of what constitutes a local labour market is open to discussion, therefore the analysis is conducted at two different levels of aggregation. First of all, the analysis is conducted at Unitary Authority and District level including 32 London boroughs, 238 districts[2], 36 Metropolitan districts and the 46 Unitary Authorities in England. The geography also includes the 22 Unitary Authorities in Wales and the 32 Unitary Councils in Scotland, resulting in 406 local areas in Great Britain. The median sample cell size is 311 and the smallest cell is 37. The second level of analysis is conducted at Unitary Authority and County level including 34 English counties, 6 English metropolitan counties, 46 English Unitary authorities, Inner and Outer London and finally 52 Unitary authorities in Scotland[3] and Wales. This geography results in 140 local areas in Great Britain. Here the median sample cell size is 575 and the smallest cell is 42.

The ASHE and NES estimates on hourly earnings and therefore the minimum wage variables used in this paper are recorded in April of each year. Since the minimum wage was first introduced in April 1999 but then up-rated each October of the following years, the NMW measures are therefore recorded six months after each NMW uprating. There are however two exceptions: April 1999 which is contemporaneous to the introduction of the minimum and April 2000, which is one year from the introduction of the minimum[4].

[2] The London borough City of London and the district Isles of Scilly are excluded from the analysis due to small sample sizes.

[3] The Orkney Islands, Isles of Shetland and Western Isles are aggregated together. The 36 English metropolitan districts are combined resulting into 6 English Metropolitan Counties. Also, London Boroughs are aggregated into Inner and Outer London. This allows to have conform geographies in the LFS and in the ASHE/NES, using the definition of the variable "uacnty" in the LFS.

[4] Measures on the other dependent variables such as wage inequality and hours are taken from the ASHE\NES dataset and therefore measured in April of each year.

To reduce simultaneity concerns data the wage data in April of year t is concerning a minimum wage upgrade in October of year t-1 is matched to employment data taken from June to August of year t, while data on unemployment is collected from May to September of year t. [5] One potential problem with the timing of the data we use is that potentially this means that the estimated impact effect we identify is a mixture of the impact of the uprating in year t-1 and the already announced anticipation of the effect of the new NMW level in year t. It will not be possible to separately identify the effects of the anticipation and expectation of an up-rating from the actual implementation effect. Data on employment at these levels of aggregation derived from the Labour Force Survey (LFS) are available via NOMIS for yearly data for 1997 and 1998. For the period 1999 to 2005 we use employment rates calculated from the quarterly LFS local area data. For the years 2006 and 2007 we use the quarterly LFS Special License data to calculate the employment rate.

Since the NMW has a youth rate covering 18-21 year olds and an adult rate, and since, based mainly on the findings of the US literature, young workers are considered to be the most exposed to any potential negative effects of the NMW, it is important to look for differential effects across age groups. Data availability mean that the analysis is undertaken for three age groups[6]: All workers from 16 years old to retirement age (65

[5] For the pre-period 1997 and 1998 data on employment rate is collected from March 1997 to February 1998 and from March 1998 to February 1999. This is because quarterly data was not available for these two years.
Since LFS Local Area data is only available in seasonal quarters, it was only possible to choose the quarter June-August and not a longer period (eg. from May to September) as for the claimant count rate.

[6] Due to data restrictions, analysis of the impact of the NMW on the proportion of people claiming Jobseeker Allowance and National Credits is undertaken only for persons from 16 years to retirement age.

years for men and 60 for women); Adults workers, from 25 years old to retirement age[7]; Younger workers aged 16 to 24.

Measures of the National Minimum Wage

One of the most widely used variables in the literature is the Kaitz index, the ratio of the minimum wage to the average wage, as measured in our study by the median wage. The closer the Kaitz index to one the “tougher” the bite of minimum wage legislation in any area. However since the denominator is the median wage, the Kaitz index can be influenced by factors other than the NMW and the median wage is arguably endogenous in an employment regression. A positive correlation between the employment rate and the median wage might be generated by an exogenous labour demand shift. This will create a negative correlation between the Kaitz index and the employment rate. As such two other minimum wage variables are used in this study. These two measures focus on the proportion of workers directly affected by increases in the minimum wage: the minimum wage “shares” (proportion paid at or below the minimum wage) and the “spike” (proportion paid at the minimum). The larger the spike or the shares, the more likely the impact of the minimum wage on the local wage. The “shares” and the “spike” should exclude the variation in real minimum wages that results from inflation or other aggregate factors (Neumark and Wascher, 2007).

These measures are also applied to the area wage data in the two years of the sample before the NMW was introduced. Rather than record toughness at zero for 1997 and 1998, we deflate earnings in each local area and the nominal 1999 NMW level of £3.60

[7] Due to the presence of age bands in the Labour Force Survey, it was not possible to analyze the impact of the NMW on adults from 22 years to retirement age as in the adult rate of the NMW would require. Analysis is therefore restricted to persons from 25 years to retirement age.

by the appropriate average earnings index to give us estimates of the share, the spike and toughness in each area for these years.[8]

The logic of our identification strategy is evident in the descriptive statistics we present in Figures 1 to 6. Figure 1 clearly shows how both the real and nominal level of the NMW have been rising since 1999. Most marked is the rise in both real and nominal terms since 2003. This is mirrored in the rising level of the Kaitz Index over the same years. The overall difference in the NMW Share and the Kaitz Index across local areas is evident in the shape and form of the distribution of these statistics in Figures 2 and 3 respectively. In these figures we also graph how these distributions have changed between 1999 to 2007. While the Share in most areas is close to the mean, the distribution is right skewed so that there is a noticeable tail in the distribution where the estimated Share in a few areas is 10% or higher. In contrast the Kaitz index is left skewed, there is a minority of local areas where the NMW is much lower relative to the local average wage than elsewhere. This suggests that high wage areas are also low Kaitz index areas. Over time, there has been a marked shift in both distributions, with the share of people paid at the level of the NMW moving to the left and the Kaitz Index shifting to the right. The dispersion in both distributions (see Table 1) , despite the changing means is broadly unchanged.

Figure 4 again shows the aggregate movement of the Kaitz Index over time and the spread in the value of this Index by geography. The spreads around the respective averages are quite large. The 95% band for the Kaitz index is around 20 percentage points and the spread for the share estimate is around 5 points. While the average value of the Kaitz has risen, there is less evidence that these spreads have risen or

[8] We also try deflating by the retail prices index. See the robustness checks in the results section.

fallen consistently over time. It is precisely this variation - i.e. by geographical location over time that we exploit in our Incremental Differences-in-Differences estimation.

Figure 1. Change in Estimated NMW & Kaitz Index Over Time

Figure 2. Distribution of the NMW Shares across areas in 1999 and in 2007

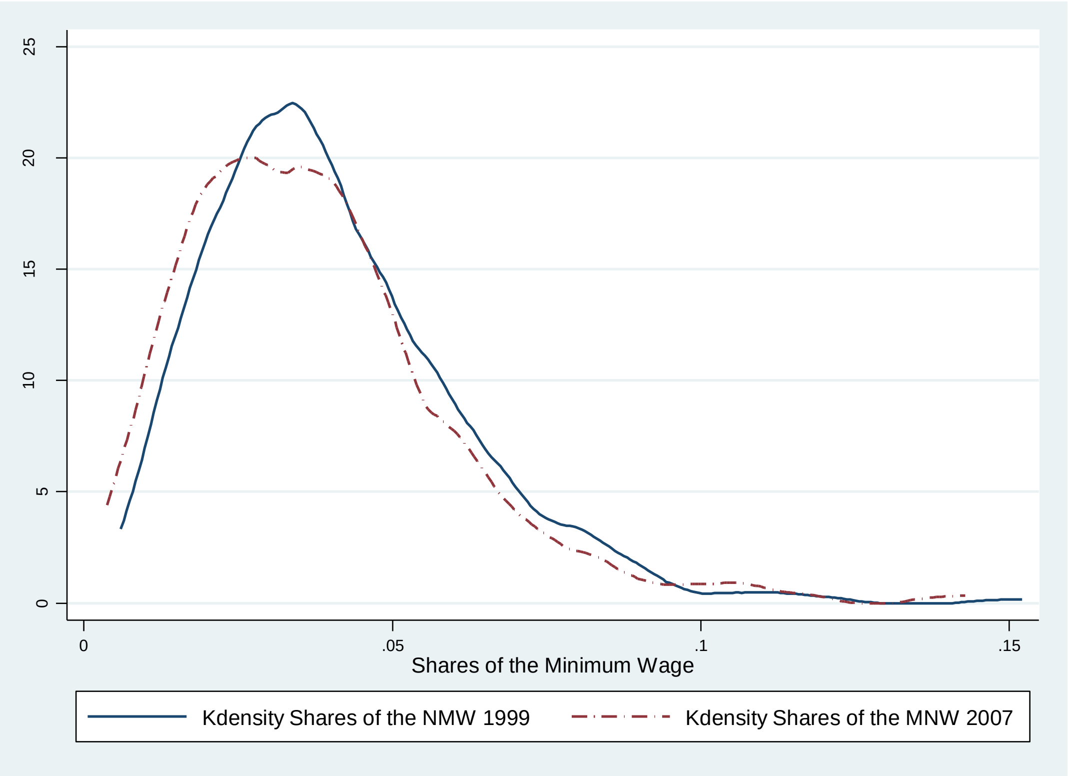


Figure 3. Distribution of the Kaitz Index across areas in 1999 and 2007

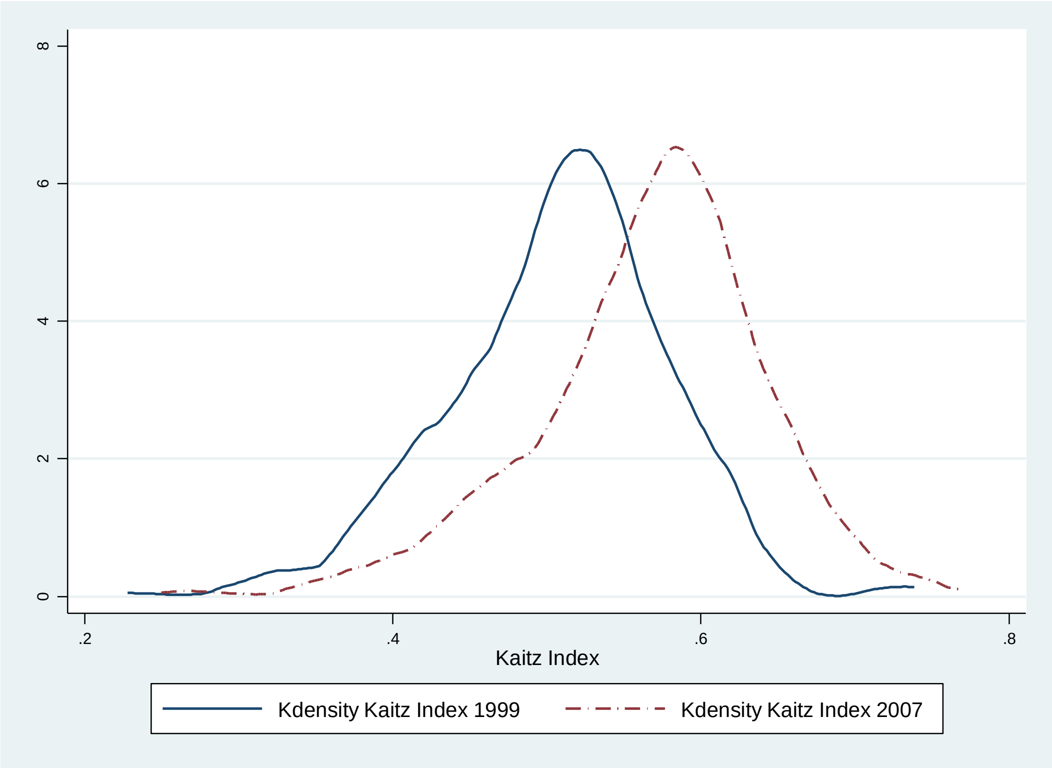
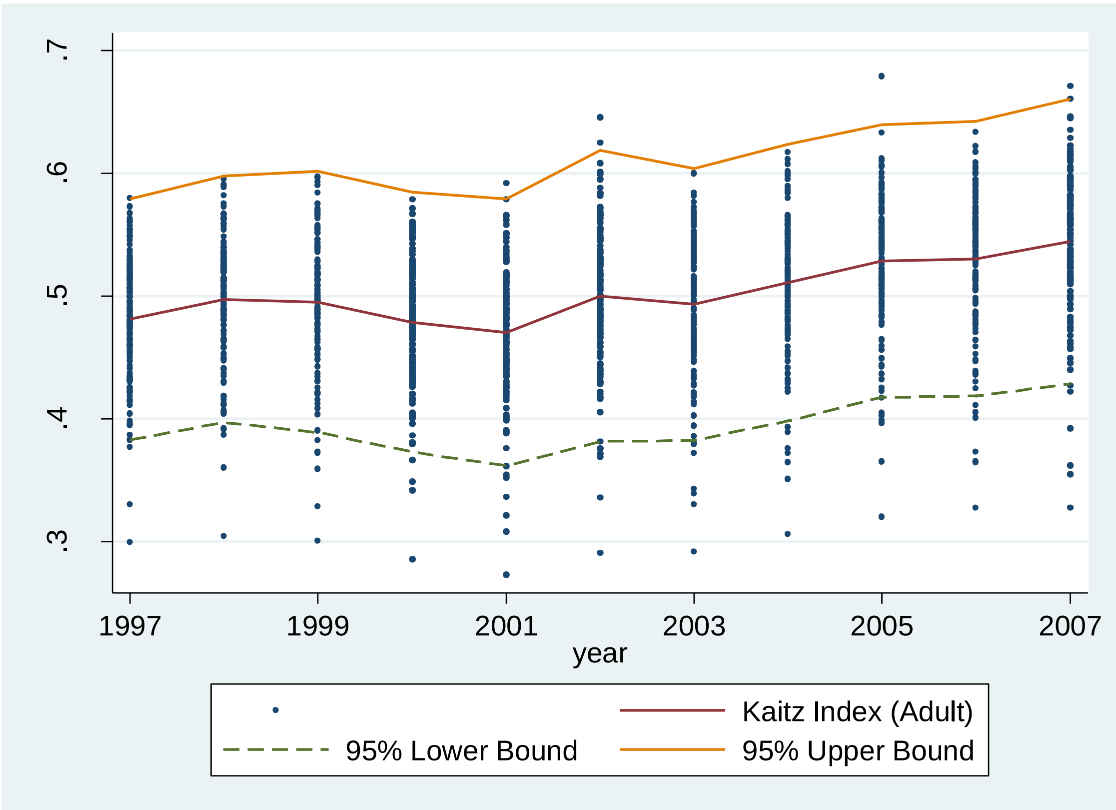


Figure 4. Distribution of Kaitz Index Across Areas and Time



III. METHODOLOGY AND IDENTIFICATION

To understand any of the estimation results relating to the impact of the NMW one must be clear about the exact form of the econometric specification and which parameters the model aims to identify. To do this it is important to review the different econometric specifications which have been used to estimate the impact of the NMW. For simplicity of exposition we will refer to these different approaches as the first, second and third generation approaches. These labels are approximately chronological and reflect the advances in the quality of data available to successive generations of researchers.

First Generation Studies: Time Series.

The most primitive of the equations used in this context was estimated using only time series data based on a reduced form labour market demand equation:

$$E_t = \alpha + \beta MW_t + \delta X_t + \varepsilon_t \tag{1}$$

where E_t is employment at time *t*, MW_t is the level of the NMW at time *t*, and X_t is a set of controlling regressors. Numerous studies of this kind were detailed in the survey by Brown et al (1982). Most of the studies reported in this survey found the 'intuitively correct' negative sign on the coefficient for the NMW in an employment equation. This specification suffers from the logical identification problem associated with determining whether or not one is estimating the labour demand schedule or some hybrid of the demand and supply of labour. Additional problems with such a specification are that typically the level of the NMW is not independent of other government social welfare programs which take place at the same time and also that over time there is not sufficient variation in the real value of the NMW to ascertain its marginal effect, more specifically, to ascertain a 'causal' effect of a change in the NMW on employment. An additional potential source of endogeneity is the extent to which the government may set (or influence the setting) of the NMW in period t+1 based on the levels of employment, unemployment, vacancies, or wage inflation in period t, or expectations of what may happen to these macroeconomic aggregates in period t+1.

In the light of these identification problems, the results of the time series studies must be very cautiously interpreted. A detailed examination of these negative employment effect results of the NMW are to be found in the Card and Krueger (1995) volume. They cast empirical doubts on the validity of these negative employment effect results.

Second Generation Studies: Panel Data.

Among the first to use panel data to address the question of the impact of the MW were Neumark and Wascher (1992) who used US state data from 1973-1989. They estimated the model :

$$E_{jt} = \alpha + \gamma T_t + J_j + \beta MW_{jt} + \delta X_{jt} + \varepsilon_{jt} \qquad (2)$$

Where E_t is employment at time *t* in State *j* , MW_{jt} is the measure of the NMW (adjusted for coverage) at time *t* in State *j*, X_t is a set of controlling regressors at time *t* in State *j*, T_t is a set of year effects and, J_j is a set of State fixed effects. (In the remainder of this discussion the controlling regressors will be omitted from the equations for convenience.) Later Neumark and Wascher (2004) use the same specification to estimate the impact of the NMW laws across countries, with the slight modification that now the MW_{jt} term is similar to the Kaitz index, namely the ratio of the NMW in country *j* at time *t* divided by the average wage in that year[9].

[9] Usually the Kaitz index is also weighted by some measure of 'coverage' of the NMW in the sense of the fraction of the labour force that the NMW applies to.

Neumark and Wascher in their various papers, whether at the US State level or at the level of countries, also find a negative employment effect of the MW. At the same time, various papers (and the book by) Card and Krueger were being published which found 'counter intuitive' positive employment effects of the MW. In spirit the work of Card and Krueger was different. It appealed to micro-econometric data in which there was a 'control state' in which the MW wage not changed and compared it to a 'treatment state' in which there had been a change in the level of the MW but using differences-in differences. Strictly speaking the results of these studies were not comparable with those based on the panel data of Neumark and Wascher. We elaborate on the quasi-experimental approach to the evaluation of the NMW by considering the Card (1992) paper which is potentially comparable to the Neumark and Wascher studies.

The logical critique of this model as compared to the first generation time series model is that it still suffers from potentially all the same sources of potential heterogeneity bias as the simple time series model. Indeed it could even be argued that using geographical States as the unit of observation could potentially have even more problems - if for example - one state legislature's decision to implement or change a MW is heavily influenced by another neighbouring state's policy decision. This concern is less of a problem in the UK context as we are using up to 406 geographical areas as our unit of analysis and there is a NMW rather than a state MW - in which case the actually level (and change) in the NMW is not under the control of the authorities in any particular location. A second way in which panel data may suffer less from endogeneity bias is that fixed effect estimation identifies potential causal inferences based on changes in the regressor and regressand given the assumption that the unobserved heterogeneity across areas remains constant over time periods.

A further issue with panel data constructed by aggregating individual data within each geographical area which may be of concern, is that by default such models assume independent disturbances across areas which may not be appropriate if neighbouring local labour markets are to some extent integrated.

Third Generation Studies: Reduced Form and Difference-in-Difference Studies.

The proposed 'structural' econometric model consists of two equations. The first is a form of labour demand equation which suggests that any change in the employment rate in area j is a movement along the labour demand curve which results in the wage level in area j.

$$\Delta E_j = \gamma_0 + \eta \Delta W_j + u_{1j} \tag{3}$$

The second equation is a form of identity suggesting that the wage increase in area j is a function of the proportion in the area who are 'low paid', P_j.

$$\Delta W_j = \alpha_1 + \lambda P_j + u_{2j} \tag{4}$$

Substituting equation (4) into equation (3) we get:

$$\Delta E_j = \gamma_0 + \beta P_j + \varepsilon_j \tag{5}$$

Where $\beta = \eta \lambda$, with λ assumed to be positive, implying that β has the same sign as η which basic economic theory would suggest is negative if the demand for labour falls as wages rise. The precondition for identification is that the proportion in the area who are 'low paid', P_j, could be used as a predetermined instrument for the endogenous wage change.

The central idea of this paper is to see whether geographic variation in the “bite” of the minimum wage is associated with geographic variation in employment and other indicators of local market performance (wage inequality, unemployment, and hours of work).

This can be done by pooling the available data over the eleven year periods and letting the treatment be the possible measures of the “bite” of the NMW in each area at time *t*, P_{jt}, so that the model estimated is:

$$E_{jt} = \gamma_0 + J_j + T_t + \gamma_1 Y_t + \gamma_2 P_j + \theta^{DiD} Y_t P_{jt} + \varepsilon_{jt} \tag{6}$$

where *j = area 1, …, area 406 (*or alternatively *j= area 1, …, area 140)* is an index of local areas and *t* indexes years, T_t is a set of year effects and, J_j is a set of State fixed effects, is the effect of within-area change in the NMW incidence on area performance E_{jt}. In our data t = 1997, 1998, 1999, …, 2007 where 1997 and 1998 are 'pre-policy on' time periods in which $Y_t = 0$ and 1999-2007 are policy on periods in which $Y_t = 1$.

In addition, in some specifications a control vector X_{jt} is added to the model, including the average age of people of working age employed at time *t* in area *j*, the proportion of women of working age employed at time *t* in area *j* and finally a human capital variable (proportion of persons in working age with NVQ4 level or more). ε_{jt} are assumed to be independently distributed across areas. However, heteroskedasticity and serial correlation of arbitrary form are allowed since no restrictions are placed in the form of the auto-covariances for a given individual area (Arellano, 1987).

The use of panel data permits explicit estimation of the local area and year effects as distinct from the effects of changes in the minimum wage variable. Area fixed effects can control for omitted variables that vary across local areas but not over time.

Examples might be persistent areas level specific factors, such as unmeasured economic conditions of local areas economies that give rise to persistently tight labour markets and high wages in particular areas independently of national labour market conditions.

Time fixed effects can control for omitted variables that are constant across local areas but evolve over time. For example, they might control for changes in aggregate economic conditions such as national shocks or policies (e.g. changing interest rates or large movements in the price of oil) that might influence the indicators of local areas performance in all local areas.

In the model of equation (6), the coefficient θ will measure the combined impact of NMW over all the policy-on years relative to the policy off years in the data. This is of course provided that the proportion in the area who are 'low paid', P_j, is a valid predetermined IV for the endogenous wage change.

Dynamic specifications of minimum wage effects

One important question to ask in this study is how long it should take the introduction (or changes) in the NMW to have its full effects on employment and other economic indicators. From an empirical point of view, this raises the specification issue about including in the regression a lagged effect of the minimum wage variable.

The debate is on this question is still ongoing. On the one hand, employers might react relatively quickly to increases in minimum wages. Employers might even adapt before the implementation of the minimum wage. Brown et al. (1982), regarding employment, argue that:" One important consideration is the fact that plausible adjustment in employment of minimum wage workers can be accomplished simply by reducing the rate at which replacements for normal turnover are hired.", (p.496). Another reason given by the authors is that minimum wages increases are announced months before they are implemented, therefore firms may have begun to adapt before the increase of the minimum wage come effectively into force. On the other hand, it might take time to employers to adjust factors inputs to changes in factors prices. For example, Hamermesh (1995) points out that in the short run, capital inputs might be costly to adjust. If firms adjust capital slowly following an increase of the minimum wage, the adjustments of labour input might be slowed as well. In an attempt to capture these effects, this study will also include specifications that use the lagged minimum wage measure[10].

The use of a lagged minimum wage measure as well as the inclusion of fixed effects in the regression also helps to decrease the possible endogeneity of the minimum wage variable which occurs from correlation of either the proportion paid at the minimum or, in case of the Kaitz index, the minimum wage and the median wage with labour market conditions or productivity. One variant of the specification might be:

$$E_{jt} = \gamma_0 + J_j + T_t + \gamma_1 Y_t + \gamma_2 P_{jt} + \gamma_2 P_{jt-1} + \theta^{L1} Y_t P_{jt} + \varepsilon_{jt} \tag{7}$$

where the coefficient θ^{L1} is logically different to θ in equation (6) above as the former controls for the one period lagged effect of the introduction of the policy.

[10] Two specifications will be used: one will use both contemporaneous and lagged minimum wage measures, the other will use only the lagged minimum wage measure.

Incremental Differences-in-Differences specifications of minimum wage effects

One interesting issue is to try to capture the additional effects of each incremental increase in the minimum wage from its introduction. Specifically, the panel data set used in this study permits to estimate an equation of this form:

$$E_{jt} = \gamma_0 + J_j + \sum_{\tau=1999}^{2007} \gamma_1 Y_\tau + \theta_0 P_{jt} + \sum_{\tau=1999}^{2007} \theta_\tau^{IDiD} Y_\tau P_{j\tau} + \varepsilon_{jt} \tag{8}$$

where *j= area 1, …, area 406 (* or alternatively *j = area 1,…, area 140),* τ is indexed from 1999 (the year in which the NMW was introduced and subsequently up-rated), J_j are area effects, and the incremental Diff-in-Diff coefficients θ_τ^{IDiD} measure the additional incremental effect of the up-rating of the NMW in each year, starting from the introduction of the policy in 1999 and measuring them all relative to the off period of 1997 and 1998. In addition, in some specifications, a control vector X_{jt} is added to the model, including the average age of people of working age employed at time *t* in area *j*, the proportion of women of working age employed at time *t* in area *j* and finally a human capital variable (proportion of persons in working age with NVQ4 level or more).

Spatial Models.

One clear limitation of the econometric models so far discussed is that they take no account of the influence of one unit of observation on another. Specifically, as all our geographical areas have bordering areas then it may well be that there is a clear relationship between these contiguous areas. The geographer would be interested in how these areas relate in the dimension of location and space and would attempt to model the spatial interactions by using: the distance between centroids, the amount of shared border, the relative size of neighbouring states, the availability and efficiency of transport links. The economist would be interested in the extent to which these neighbouring states have local labour markets which are inter-related. To this end economists have spent a lot of time trying to define what a local labour market it. The definition which is sometimes used is then that the fraction of workers who live and work in that geographical locality is at least 75%. One way of approaching estimation is to try and force the definition of what a local labour market is and only estimate the results selectively for those geographies which qualify as a local labour market. This approach is intrinsically difficult though since the estimation, will by definition be only for small local areas and we are actually interested in the impact of the NMW over the whole country. The other aspect of this which is arbitrary is the cut-off of what one considers to be a good definition of a local labour market. There is, potentially, a different approach. It is possible to reweight all our estimates by the fraction of the people at each location who live and work in different areas. Specifically we wish to use a spatial regression model where our weighting matrix is provided by the commuting patterns we empirically observe between geographical locations. More formally this means estimating the model in equation (8) but using Generalized Least Squares where the weighting matrix Ω is provided by our commuting matrix. Hence in notation, if we consider all the various regressors on the right hand side of (8) (in matrix form dropping the subscripts) to be denoted by Z then we can rewrite (8) as:

$$E = Z\delta + \varepsilon$$

in this model the GLS estimator is:

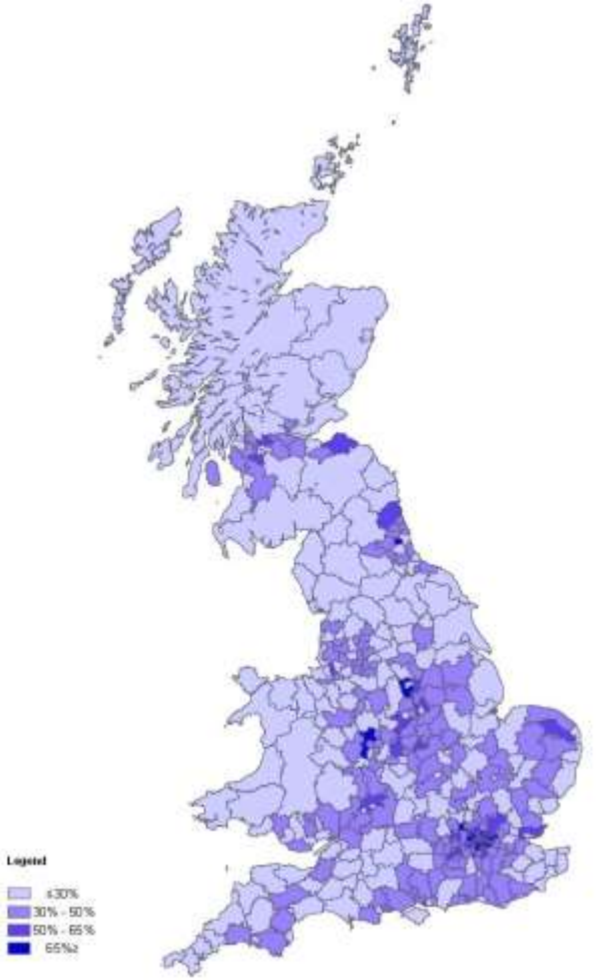
$$\hat{\delta} = (Z'\Omega^{-1}Z)Z'\Omega^{-1}E \qquad (9)$$

We would therefore be explicitly controlling for the direct form of the correlation of the disturbances at each pair of locations explicitly. The weighting matrix is a natural choice as well because the individual commuting decisions of each person in each area would determine its structure. Arguably this also has the nice interpretation that we are - in effect - taking account of all the influences listed above that the geographer and the economist would which to weight by as by definition the commuting choices of individuals will be determined by the complex set of decisions that each person undertakes when they decide to live in one place and work (by commuting to another, i.e. relative wage rates, job prospects, transport links distances etc). These commuting patterns can also help define local labour market boundaries. The lower the share of commuting the more the local area boundaries conform to a local labour market. As yet, however, computational burdens preclude us from following this strategy in the present report. Instead to try to allow for the heterogeneity and serial correlation these spatial linkages and the other influences on the data may create, the estimates of models (7) and (8) are derived using the fixed effects estimate that is robust to heteroskedasticity and serial correlation of unknown form, (Wooldridge (2002 p 275).

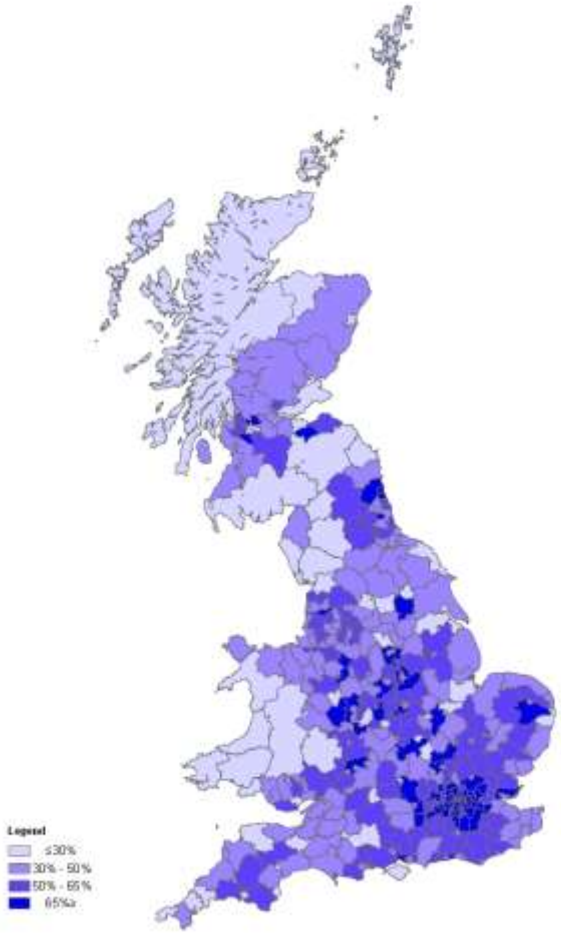
The commuting patterns that we observe for the 406 local areas in our data are plotted in Figure 5, which shows us not only the spatial variation of commuting behaviour in the UK but also how much it differs between low wage workers (in the bottom 25% of the hourly earnings distribution) and other employees. At this level of aggregation the median commuting rate is 0.49 (0.30 for low wage workers). Clearly we see that commuting is more prevalent in those who earn more but it is also common - at around 60% - amongst the low paid in the London area. There is ,as yet, not enough information in the ASHE data to determine whether these commuting patterns have changed over time.

Figure 5. Commuting patterns, (persons of working age): Share of people who live in an area but work in another area 2005-2006-2007

Low paid workers



All workers



IV. RESULTS.

Summary Statistics

Figure 6 shows the geographic counterpart to Figure 4 outlining the share of minimum wage areas in each of the 406 local areas. It is immediately clear that there is a high level of variation of the "bite" of the minimum wage across areas. The extent to which the introduction of the NMW and the successive up-ratings influenced an area's wage distribution varies considerably. The impact of the minimum wage in the region around London tends to be lower than in the rest of the country. Areas particularly affected are the rural periphery of the country and the formerly industrialised urban areas. Over time the maps show the "bite" of the minimum wage increasing across more areas, with the mean value of the Kaitz index rising from 0.51 to 0.57 over the period since the introduction of the NMW. However the dispersion of the Kaitz index in the 406 areas is little changed from 0.136 in 1999 to 0.130 in 2007, (Table 1), as measured by the coefficient of variation. The 90-10 differential, a measure of more of absolute rather than relative differences, is also little changed over the period.[11] Figure 7 draws the map for our principal outcome measure, namely the employment rate, across the same 406 areas over time. We then repeat our outcome analysis for unemployment , hours of work and wage inequality.

Table 1 provides some summary statistics regarding the dispersion of these variables over time. It is clear that the average employment rate in Britain, on this measure, has risen over the first half of the sample period and then stalled somewhat at around 76%. Dispersion of employment rates across areas is broadly unchanged over the sample period. While the downward trend in the aggregate unemployment rate is in line with the

[11] Table A1 in the Appendix lists the top and bottom 10 local areas ranked by the Share and the Kaitz index over time.

trend in the employment rate, the dispersion of unemployment rates does seem to rise when unemployment is falling, suggesting that there are leading and lagging areas of the country in an upturn. Dispersion in wage inequality across areas however does appear to have fallen along with the mean value of the 50/5 hourly wage ratio.

Figure 6. Share of the Minimum Wage (persons of working age

1999 – 2000 -2001 **2005 – 2006 - 2007**

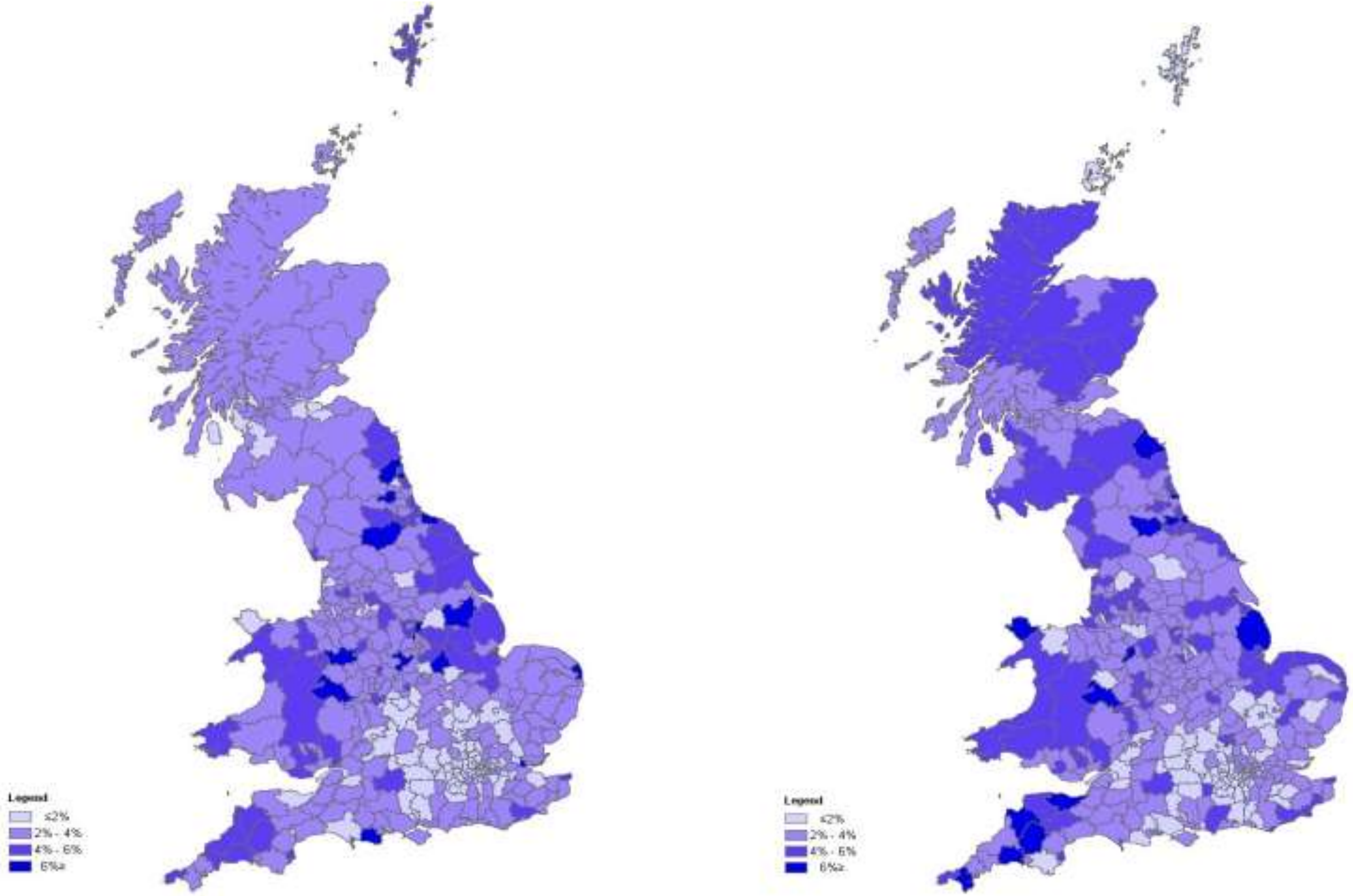


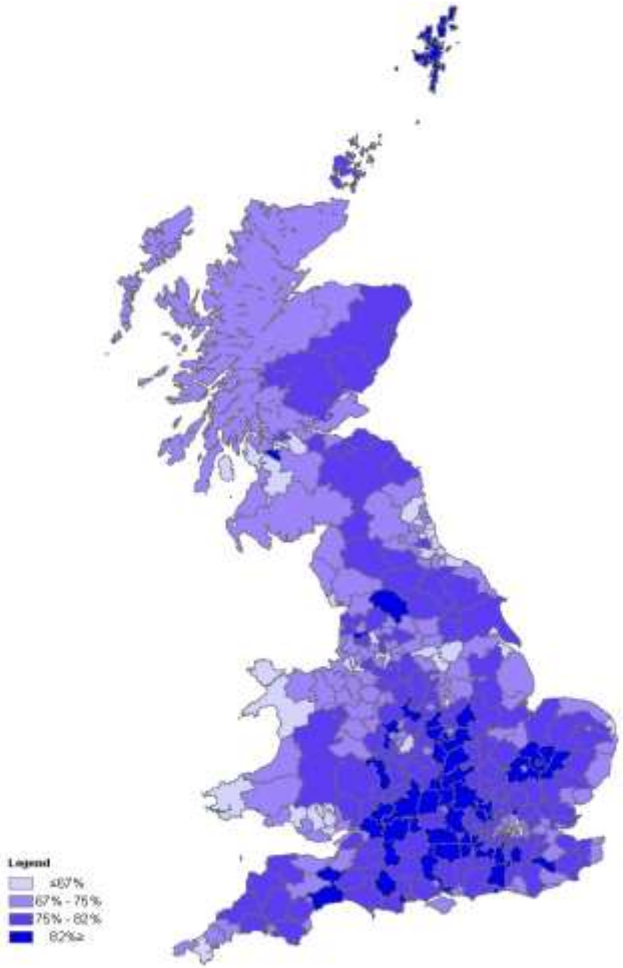
Figure 7. Kaitz Index, (persons of working age)

1999 – 2000 -2001

2005 – 2006 - 2007

Figure 8. Employment rate (persons of working age)

1997-1998



2005 – 2006 - 2007

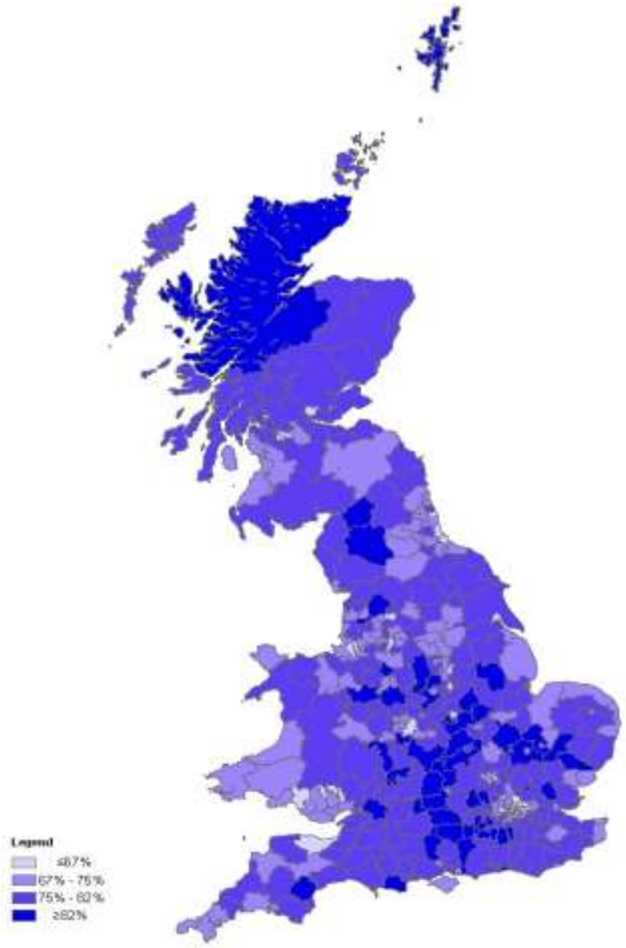


Figure 9. Claimant count (persons of working age)

1997-1998

2005 – 2006 - 2007

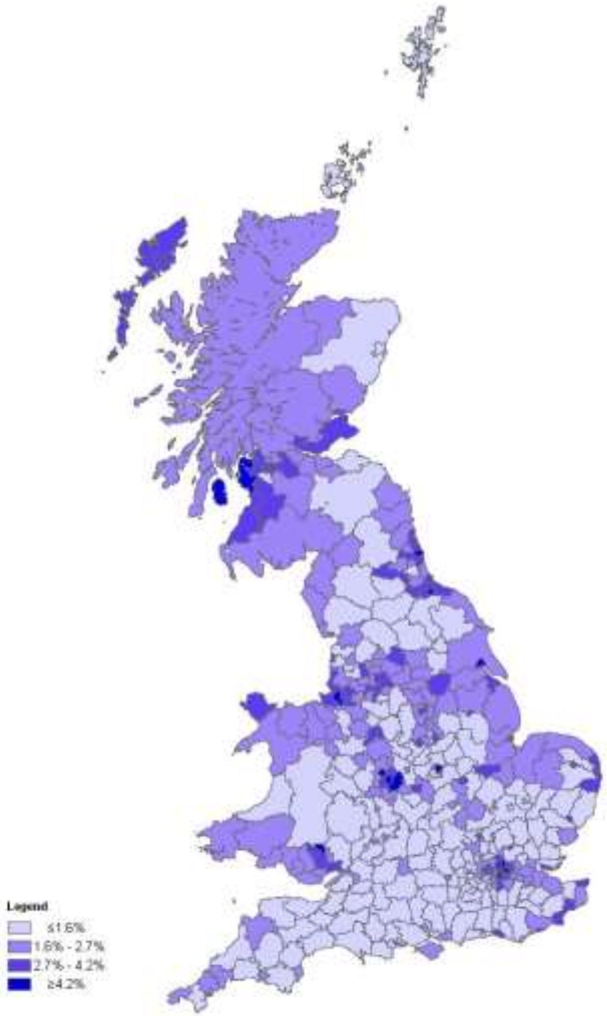
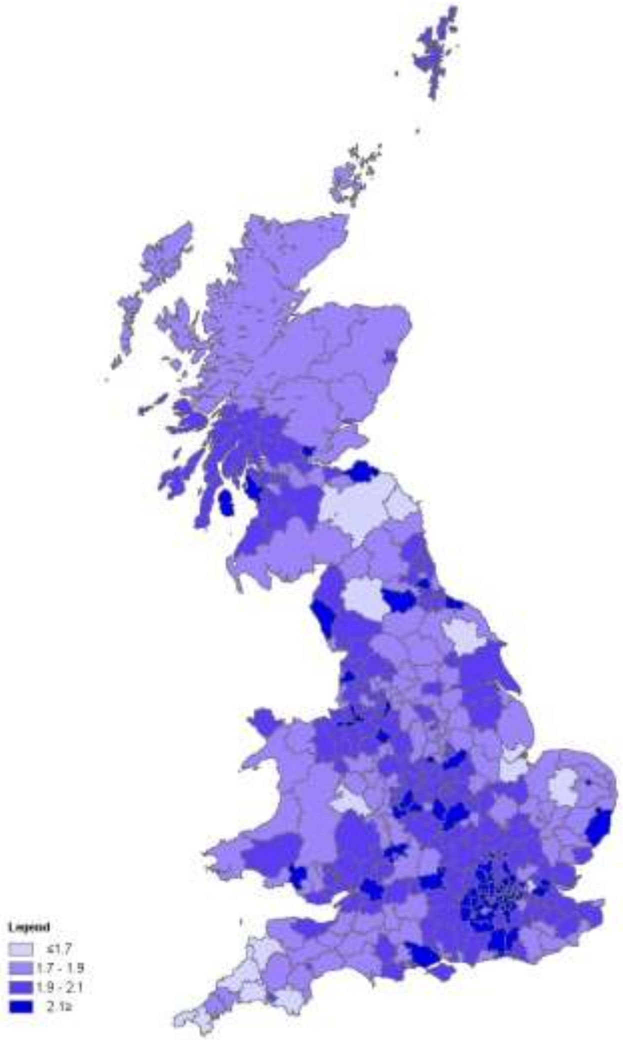


Figure 10. Wage Inequality, (persons of working age) 50th percentile divided by 5th percentile

1997-1998



2005 – 2006 - 2007

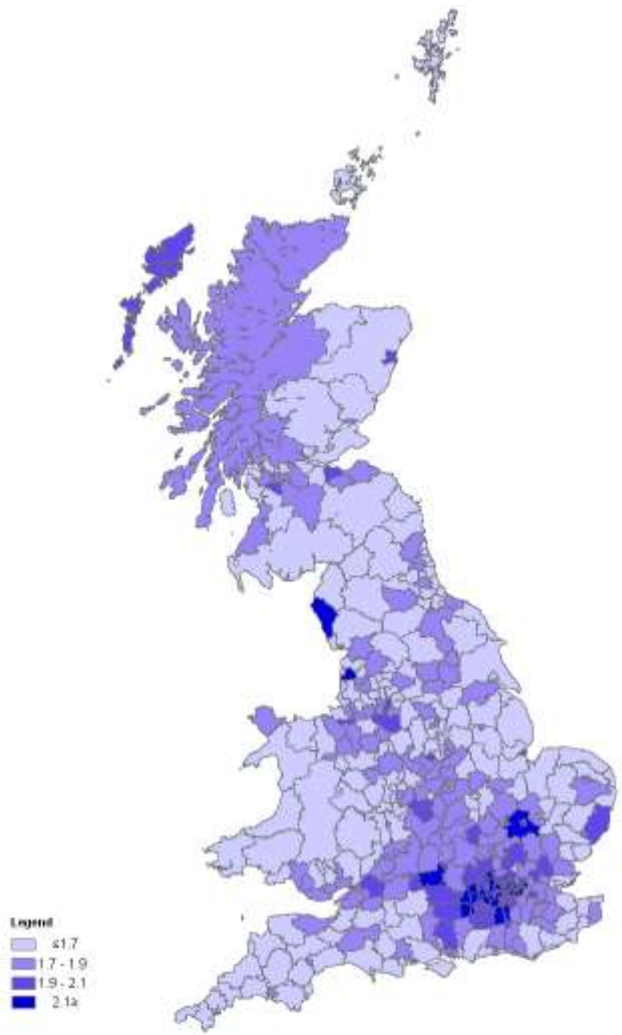


Table 1. Area Dispersion in Key Variables (406 areas)

Year	Share			Kaitz Index			Employment Rate			Unemp. Rate			50/5 Hourly Wage Ratio		
	Mean	C.V..	90-10	Mean	C. V.	90-10	Mean	C. V.	90-10	Mean	C.V.	90-10	Mean	C. V.	90-10
1997	0.041	0.535	0.054	0.498	0.135	0.169	0.747	0.089	0.161	0.038	0.490	0.046	1.954	0.094	0.439
1998	0.050	0.472	0.060	0.511	0.132	0.178	0.753	0.091	0.173	0.032	0.527	0.043	1.992	0.111	0.458
1999	0.040	0.505	0.049	0.508	0.136	0.186	0.761	0.093	0.186	0.030	0.523	0.041	1.915	0.110	0.513
2000	0.024	0.606	0.036	0.492	0.139	0.181	0.768	0.088	0.171	0.026	0.550	0.035	1.889	0.107	0.477
2001	0.023	0.608	0.031	0.484	0.144	0.182	0.765	0.092	0.179	0.022	0.559	0.033	1.910	0.113	0.518
2002	0.031	0.559	0.041	0.514	0.145	0.194	0.765	0.088	0.170	0.022	0.535	0.029	1.867	0.121	0.521
2003	0.021	0.561	0.030	0.505	0.138	0.179	0.767	0.086	0.163	0.022	0.521	0.027	1.855	0.119	0.501
2004	0.030	0.586	0.038	0.525	0.138	0.189	0.764	0.086	0.157	0.019	0.541	0.024	1.827	0.116	0.536
2005	0.028	0.537	0.037	0.548	0.129	0.188	0.765	0.085	0.164	0.020	0.523	0.024	1.778	0.122	0.497
2006	0.032	0.499	0.038	0.552	0.125	0.179	0.759	0.098	0.187	0.022	0.494	0.027	1.774	0.125	0.515
2007	0.038	0.572	0.050	0.568	0.130	0.191	0.759	0.084	0.162	0.019	0.512	0.024	1.733	0.132	0.551

Source: ASHE

Regional Persistence

One way of examining how persistent any indicator of economic performance is over time is to compare the level of the indicator in an area in one year (or its rank) with the level (or rank) in another year. A simple regression of the form

$$\text{Level}_t = \beta_0 + \beta_1 \text{Level}_{t-j} + u_t \qquad j = 1, 2\ldots T \qquad (10)$$

Can indicate the extent of movement within a distribution over time. If the distribution of the indicator in levels (or area rankings) remains unchanged over time then the coefficient β_1 =1. If there is convergence in levels then β_1 <1 and divergence implies β_1 >1. The coefficient on the intercept indicates whether the average level moves up or down over time.

Figure 11 gives the scatter diagram of observations on two measures of NMW toughness, the Share and the Kaitz index, for each of the 406 areas in 1999 and in 2007. The regression line based on equation (10) is superimposed on top for the toughness measures in levels (top panel) and the area rankings of each measure (bottom panel). Figure 12 repeats the exercise for the 140 areas. In both cases the Share of the NMW in each area (and the area rankings of the share) show much more volatility over time than does the Kaitz index. The slope coefficient on the Kaitz regressions are quite close to one and the observations are much more closely clustered around the regression line. This means that despite the average value of the Kaitz index moving up over time (as indicated by the positive coefficient on the constant term), the area rankings in 2007 are very similar to those observed in 1999. This result is similar whether 406 area level of aggregation is used or whether the 140 areas are used. The volatility of the Share may reflect the greater degree of measurement error associated with estimating this indicator in what are, even at 140 areas, relatively small samples. A list of the top and bottom 10 local areas in terms of rankings is given in Table 2. Note that by 2007, the NMW appears to be at least 70% of the local median wage in at least 10 local labour markets. In such areas it may be that the NMW is now an important factor in local wage determination.

Figure 11. Persistence in Area Performance Over Time (406 areas)

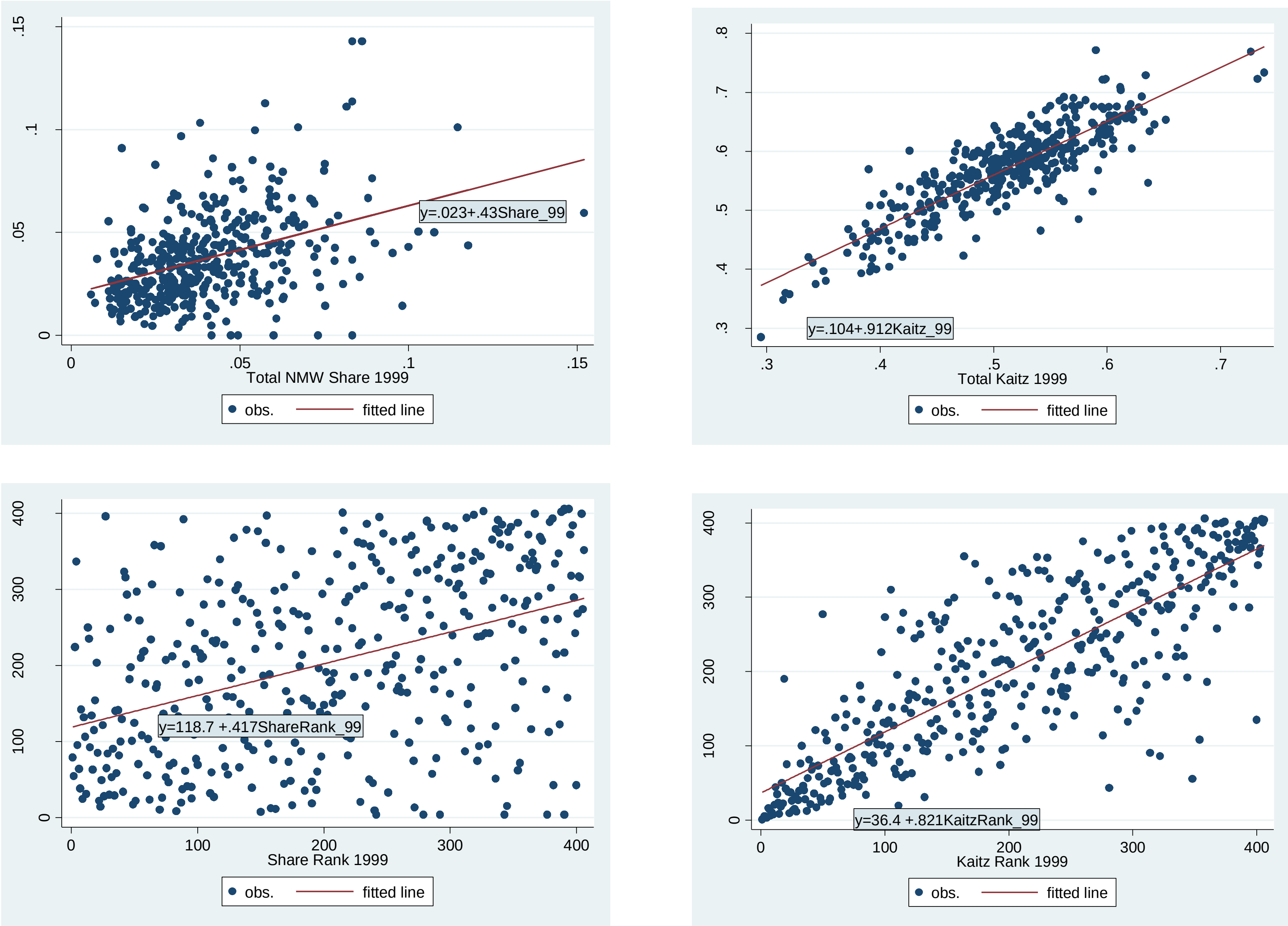


Figure 12. Persistence in Area Performance Over Time (140 areas)

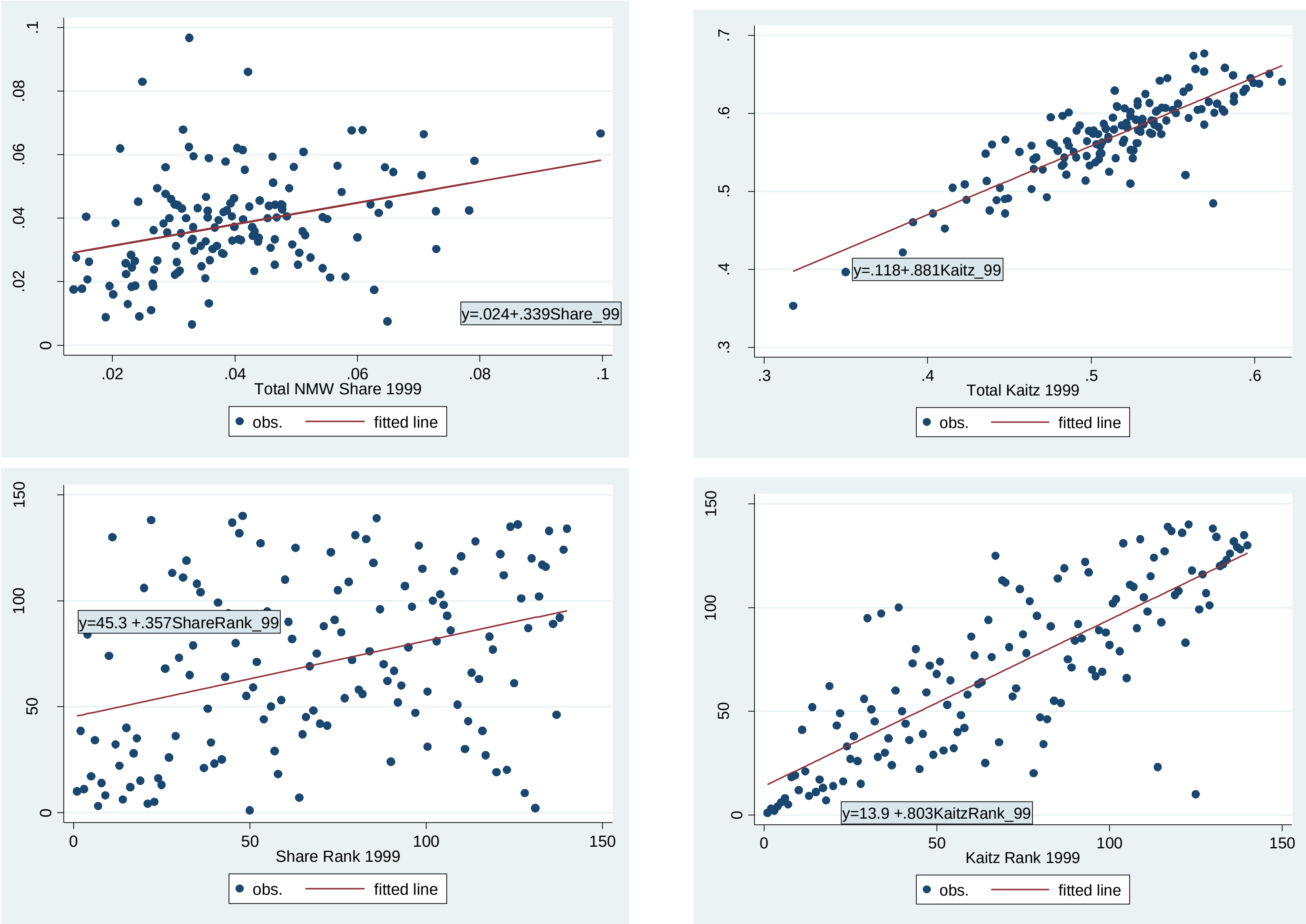


Table 2. High and Low Paying Areas (Top 10, Bottom 10)

	Top				Bottom			
	Share		Kaitz		Share		Kaitz	
1999								
1	Sutton	.006	Tower Hamlets	.295	Blyth Valley	.152	Torridge	.738
2	South Bucks.	.007	Islington	.315	Derwentside	.118	Penwith	.732
3	Hackney	.008	Camden	.317	Penwith	.115	S. Shrops.	.727
4	Newham	.010	Westminster	.320	Cas. Morpeth	.108	C.-le-Street	.651
5	Vale of W.Horse	.011	Hammersmith	.321	Easington	.103	N. Cornwall	.642
6	Basingstoke	.011	Hackney	.337	Oswestry	.100	Richmondshire	.637
7	Cotswold	.012	Lambeth	.341	S. Derbys.	.098	Havering	.636
8	Stevenage	.012	Southwark	.343	Richmondshire	.095	Eden	.633
9	Cherwell	.012	Bracknall Forest	.350	Caradon	.090	S. Holland	.632
10	Welwyn	.012	Three Rivers	.352	Weymouth	.089	W. Lindsey	.631
2007								
1	Chiltern	.001	Tower Hamlets	.285	Mendip	.143	Teesdale	.771
2	Orkney	.001	Islington	.348	Teesdale	.142	S. Shrops.	.769
3	Hackney	.001	Hammersmith	.356	Berwick	.114	Torridge	.734
4	Shetland	.001	Westminster	.357	W Devon	.113	Eden	.729
5	East Camb'shire	.001	Camden	.359	Wansbeck	.111	E. Lindsey	.723
6	Restormel	.001	Southwark	.374	Hyndburn	.103	Penwith	.722
7	Selby	.001	Three Rivers	.380	Penwith	.101	Blyth Vall.	.721
8	Mid Sussex	.003	Wokingham	.393	Torridge	.101	Derwentside	.721
9	Runnymede	.004	Copeland	.396	Chichester	.099	Boston	.709
10	Tunbridge Wells	.005	Bracknall Forest	.397	Hartlepool	.097	Berwick	.704

Regression Results

Table 3 outlines the OLS estimates of the NMW coefficients based on equation (7) which seeks to determine the average effect of the NMW when the (log of) employment is used as the dependent variable. For each NMW toughness measure there are 4 columns. The first column is the estimate from a simple regression of the dependent variable on the NMW measure, effectively the establishing the correlation between the two variables. The estimates confirm the long-established fact that employment rates are generally lower in low wage areas. The correlation is stronger when 140 areas are used rather than 406, (compare rows 1 & 2). In every regression the estimated coefficients based on the 406 areas are attenuated relative to the higher level of aggregation estimates. This suggests the presence of a greater degree of measurement error among the more disaggregated data. As such this might be an important influence in any decision about the appropriate local labour market boundaries. However any detailed exploration of this is left to future work.

There is little difference between the estimates when total employment rate is used as the dependent variable or when the adult (25 to retirement) rate is used (compare rows 1 and 3). The addition of year specific time dummies makes little difference to the estimates, (column 2), but the addition of area fixed effects removes the positive association between low wages and low employment, (column 3). Since any effect is now identified off variations in the NMW bite over time across areas, this suggests no overall difference in employment growth rates between areas where the NMW bites most compared to areas where the NMW has less impact. The further addition of time and varying area-level covariates has little effect, (column 4).[12]

[12] The estimated coefficients on the other covariates are given in Table A1 of the appendix.

Similar estimates of the NMW coefficient are observed in the second and third panels of Table 1 when the proportion paid at the minimum and the Kaitz index are used as alternative measures of the NMW bite. Again the general conclusion is that on this measure the NMW has little association with differential employment behaviour. [13]

Once possible concern with the results reported in Table 3 is that they do not focus on the outcomes of groups thought to be potentially more at risk, or to be at the margin of adjustment, following any changes in labour costs Table 4 therefore repeats the analysis for youth employment rates, (ages 16 to 24).[14] Since there is some debate about the relevant right hand side measure of the bite, Table 4 reports the estimates using area level estimates of the total bite, since, we believe, this better proxies the area-level cost shock following which employers may adjust along different margins. Results using toughness measures based solely on the population aged 16-24 are also given. The results in rows 3 and 4 are broadly similar to those based on the total area shares in rows 1 and 2. In each case there is little evidence of any significant association, averaged over the sample period, between area NMW toughness and the youth employment rate.

In order to examine whether the finding of no overall association across the entire sample period obscures differential patterns within the sample period, Table 5 presents the results of the Incremental Difference-in-Difference estimates based on equation (8). The reported estimates for several samples are all based on the same model specification as used in column 4 of Table 3. The results suggest that the average estimate of no association between the NMW bite and employment obscures significant changes over

[13] Alternative specifications using lagged values of the NMW toughness measures are given in Table A2 of the appendix. Again there is little evidence of much difference across these dynamic specifications.

[14] Data limitations mean that the sample period for youth begins in 1999.

the sample period. Over time, the initial (insignificant) negative association between employment and NMW toughness – given by the base line coefficient estimates - becomes positive and statistically significant. This means that in the latter periods of the sample, areas where the NMW bit most experienced higher employment growth. This effect is small [15] but it is clear that this effect is masked when the simple Diff-in-Diff Policy-On Policy -Off variable is used.

Table 6 offers a set of robustness checks using different cutoffs for the minimum wage threshold to allow for the possibility of measurement error in the hourly wage. Since the hourly wage is generated from separate variables on gross weekly pay and usual hours it may be that this is not the true underlying hourly wage (assuming such a notional wage exists). However building in some flexibility around the accuracy of the hourly wage variable by using the mandated minimum plus 5 or 10 pence to generate the share, spike and Kaitz variables makes very little difference to the estimates, nor does using the mean rather than the median as the denominator for the Kaitz index. Using weighted least squares regressions, taking account of the varying sample sizes of the local areas used to calculate wages, also makes little difference to the overall impression that while the full sample period there is little association between the bite of the minimum and employment, there are years toward the end of the sample period when there is a positive association between the bite of the NMW and employment. So employment appears to have risen more in areas where the NMW has more relevance.

.

[15] For example the coefficient estimate of .021 in column 1 for the 2004 interaction term means that a 10% point rise in the NMW share in an area is associated with 0.2% higher employment rate change, other things equal.

Table 3. Within Group and OLS Estimates of Minimum Wage Effects on Employment Rate, 1997-2007

	Proportion paid at or below NMW				*Proportion Paid at NMW*				*Kaitz Index*			
	1	2	3	4	1	2	3	4	1	2	3	4
Total 16-ret.	-0.021**	-0.020**	0.001	0.001	-0.012**	-0.012**	0.001	0.001	0.013	0.015	-0.021	-0.012
406 areas	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.012)	(0.013)	(0.023)	(0.024)
Total 16-ret.	-0.039**	-0.043**	0.009**	0.008**	-0.024**	-0.030**	-0.001	0.002	-0.109**	-0.150**	0.031	0.035
140 areas	(0.004)	(0.005)	(0.004)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)	(0.021)	(0.024)	(0.048)	(0.030)
Adult 25-ret	-0.023**	-0.022**	-0.001	0.001	-0.013**	-0.016**	0.001	0.001	-0.014	-0.026	-0.008	-0.006
406 areas	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.010)	(0.011)	(0.022)	(0.023)
Adult 25-ret	-0.038**	-0.042**	0.003	0.002	-0.026**	-0.034**	-0.002	0.003	-0.102**	-0.151**	0.066	0.047
140 areas	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.018)	(0.020)	(0.041)	(0.042)
Year Effects	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Area Effects	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Controls	N	N	N	Y	N	N	N	Y	N	N	N	Y

Note: HAC robust fixed effect estimates in brackets.** significant at 5% level

Table 4. Within Group and OLS Estimates of Minimum Wage Effects on Youth Employment Rate Estimates 1999-2007

	Proportion paid at or below NMW				*Proportion Paid at NMW*				*Kaitz Index*			
	1	2	3	4	1	2	3	4	1	2	3	4
406 areas	-0.009	0.004	0.009	0.001	-0.027**	-0.004	-0.001	-0.001	0.109**	0.249**	-0.180	-0.085
Total Share	(0.010)	(0.011)	(0.014)	(0.002)	(0.008)	(0.009)	(0.009)	(0.009)	(0.042)	(0.042)	(0.226)	(0.238)
140 areas	-0.045**	-0.030**	0.015	0.010	-0.055**	-0.044**	-0.016**	-0.016**	-0.145**	-0.024	0.131	0.151
Total Share	(0.011)	(0.012)	(0.018)	(0.017)	(0.006)	(0.007)	(0.009)	(0.009)	(0.024)	(0.054)	(0.187)	(0.184)
406 areas	-0.024**	-0.016**	-0.013	-0.013	-0.049**	-0.025**	-0.019	-0.019	-0.083	0.076	-0.198**	-0.199**
youth share	(0.008)	(0.008)	(0.008)	(0.008)	(0.013)	(0.014)	(0.014)	(0.014)	(0.053)	(0.060)	(0.170)	(0.071)
140 areas	-0.023**	-0.012**	0.001	0.001	-0.037**	-0.019**	-0.004	-0.004	-0.255**	-0.121**	-0.015	-0.020
youth share	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.010)	(0.011)	(0.011)	(0.056)	(0.066)	(0.092)	(0.094)
Year Effects	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Area Effects	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Controls	N	N	N	Y	N	N	N	Y	N	N	N	Y

Table 5. Incremental Difference-in-Difference Employment Rate Estimates

	Proportion paid at or below NMW				*Proportion Paid at NMW*				*Kaitz Index*			
	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Adult 25-ret 406 areas	Adult 25-ret 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Adult 25-ret 406 areas	Adult 25-ret 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Adult 25-ret 406 areas	Adult 25-ret 140 areas
	1	2	3	4	1	2	3	4	1	2	3	4
NMW	-0.006**	-0.002	-0.004	-0.006	0.009	-0.001	0.012**	-0.001	-0.041	-0.034	-0.032	-0.009
Base year	(0.003)	(0.007)	(0.003)	(0.006)	(0.006)	(0.002)	(0.007)	(0.002)	(0.026)	(0.050)	(0.025)	(0.045)
NMW**1999	-0.009	-0.011	-0.006	-0.006	-0.025**	-0.021**	-0.023**	-0.013**	-0.029	0.023	-0.009	0.023
	(0.006)	(0.011)	(0.006)	(0.011)	(0.007)	(0.006)	(0.007)	(0.006)	(0.022)	(0.040)	(0.032)	(0.036)
NMW**2000	-0.001	0.002	0.002	0.008	-0.013**	-0.007	-0.014	-0.006	0.020	0.078**	0.022	0.090**
	(0.005)	(0.010)	(0.005)	(0.010)	(0.007)	(0.005)	(0.008)	(0.006)	(0.021)	(0.038)	(0.020)	(0.034)
NMW**2001	0.004	0.002	0.003	-0.001	-0.009	-0.017**	-0.008	-0.013**	0.010	0.038	0.006	0.035
	(0.005)	(0.010)	(0.005)	(0.010)	(0.007)	(0.005)	(0.007)	(0.005)	(0.019)	(0.042)	(0.018)	(0.037)
NMW**2002	0.008	0.002	0.007	0.001	-0.010	-0.007	-0.009	-0.004	0.048**	0.068**	0.048**	0.036
	(0.006)	(0.010)	(0.006)	(0.010)	(0.007)	(0.005)	(0.008)	(0.005)	(0.020)	(0.035)	(0.021)	(0.034)
NMW**2003	0.012**	0.010	0.007	0.013	-0.008	0.004	-0.013**	0.005	0.074**	0.184**	0.054**	0.128**
	(0.006)	(0.012)	(0.006)	(0.011)	(0.007)	(0.006)	(0.008)	(0.006)	(0.024)	(0.044)	(0.022)	(0.039)
NMW**2004	0.021**	0.026**	0.012**	0.021**	-0.003	0.008	-0.011	0.003	0.078**	0.115**	0.050**	0.079**
	(0.006)	(0.010)	(0.006)	(0.009)	(0.007)	(0.006)	(0.008)	(0.006)	(0.025)	(0.044)	(0.022)	(0.037)
NMW**2005	0.013**	0.023**	0.006	0.017**	-0.004	0.013**	-0.004	0.008	0.072**	0.132**	0.031	0.067**
	(0.006)	(0.011)	(0.006)	(0.010)	(0.007)	(0.006)	(0.007)	(0.005)	(0.028)	(0.036)	(0.023)	(0.032)
NMW**2006	0.019**	0.033**	0.013**	0.023**	-0.001	0.011**	-0.004	0.006	0.077**	0.177**	0.063**	0.142**
	(0.008)	(0.011)	(0.007)	(0.010)	(0.008)	(0.006)	(0.009)	(0.007)	(0.031)	(0.036)	(0.028	(0.035)
NMW**2007	0.012**	0.020**	0.005	0.012	-0.003	0.011	-0.008	0.002	0.058**	0.143**	0.049**	0.116**
	(0.006)	(0.011)	(0.006)	(0.009)	(0.007)	(0.008)	(0.009)	(0.007)	(0.026)	(0.048)	(0.024)	(0.042)

All regressions contain year, area effects + controls

Table 6. Incremental Difference-in-Difference Employment Robustness Checks

	Proportion paid at or below NMW				*Proportion Paid at NMW*				*Kaitz Index*			
	Original	5p	10p	Cell size	Original	5p	10p	Cell size	Original	5p	10p	Cell size
NMW	-0.006**	-0.005	-0.006	-0.009**	0.009	-0.002	-0.006**	0.004	-0.041	-0.041	-0.042	-0.037
Base year	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.007)	(0.026)	(0.026)	(0.026)	(0.028)
NMW**1999	-0.009	-0.011**	-0.010	-0.011**	-0.025**	-0.010**	-0.007	-0.019**	-0.029	-0.029	-0.029	-0.035
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.0047)	(0.008)	(0.022)	(0.022)	(0.022)	(0.021)
NMW**2000	-0.001	-0.011**	-0.002	0.001	-0.013**	-0.001	-0.001	-0.010	0.020	0.021	0.021	0.027
	(0.005)	(0.006)	(0.005)	(0.006)	(0.007)	(0.004)	(0.004)	(0.008)	(0.021)	(0.021)	(0.021)	(0.022)
NMW**2001	0.004	0.003	0.001	-0.001	-0.009	0.003	-0.002	-0.010	0.010	0.010	0.010	0.010
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.005)	(0.004)	(0.008)	(0.019)	(0.019)	(0.019)	(0.017)
NMW**2002	0.008	0.006	0.007	0.010	-0.010	0.006	0.005	-0.002	0.048**	0.048**	0.049**	0.058**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.004)	(0.009)	(0.020)	(0.021)	(0.021)	(0.024)
NMW**2003	0.012**	0.012**	0.015**	0.001	-0.008	0.006	0.010**	-0.013	0.074**	0.074**	0.074**	0.007
	(0.006)	(0.006)	(0.006)	(0.008)	(0.007)	(0.005)	(0.004)	(0.010)	(0.024)	(0.024)	(0.024)	(0.036)
NMW**2004	0.021**	0.021**	0.023**	0.021**	-0.003	0.013**	0.019**	-0.001	0.078**	0.078**	0.079**	0.065**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)	(0.009)	(0.025)	(0.025)	(0.025)	(0.029)
NMW**2005	0.013**	0.012**	0.013**	0.021**	-0.004	0.007	0.010**	0.004	0.072**	0.073**	0.073**	0.097**
	(0.006)	(0.007)	(0.007)	(0.010)	(0.007)	(0.006)	(0.005)	(0.009)	(0.028)	(0.028)	(0.028)	(0.050)
NMW**2006	0.019**	0.023**	0.021**	0.028**	-0.001	0.018**	0.019**	0.008	0.077**	0.077**	0.078**	0.100**
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)	(0.006)	(0.008)	(0.031)	(0.032)	(0.032)	(0.037)
NMW**2007	0.012**	0.012**	0.015**	0.012	-0.003	0.010**	0.14**	-0.002	0.058**	0.058**	0.059**	0.077
	(0.006)	(0.007)	(0.007)	(0.008)	(0.007)	(0.006)	(0.005)	(0.009)	(0.026)	(0.026)	(0.027)	(0.050)

All regressions contain year, area effects + controls

Other Measures of Local Economic Performance

We now repeat the exercise for different dependent variables to try to elicit a more comprehensive view of the associations of the NMW with local economic performance. Table 7 gives the estimates of the average impact of the NMW on unemployment over the full sample period, using equation (7) as the basis for the estimation. Unlike employment, there is some evidence of a significant association between unemployment and the NMW. Areas where the NMW has more bite appear to have experienced higher unemployment, (column 1) and higher unemployment growth[16] (column 4) over the full sample period.

However, as the incremental difference in difference estimates in Table 8 show, this overall average positive effect disguises significant negative effects in later years. Hence any upward association between the NMW and the unemployment rate is confined to the earliest years of the NMW's existence. Thereafter unemployment rates fell more in areas more affected by the NMW.[17]

Finally Tables 9 and 10 document the fact that the NMW appears to be associated with a significant narrowing of wage inequality in the bottom half of the distribution. There are obvious endogeneity concerns here regarding the validity of regressing a measure of wage inequality on another variable linked to wages. For this reason we do not use the Kaitz index as an NMW toughness proxy and the remaining estimates should be seen as indicative only of correlations in the data. Column 1 of Table 9 confirms the negative association between inequality and the NMW. Low paying areas typically have lower wage inequality. However once time and area effects are

[16] Since aggregate unemployment has been falling over the sample period, the implication is that unemployment rates fell less in areas where the NMW has more bite.

[17] Diasggregated unemployment rates by age and local area are not available over the full sample period.

added to the model then the NMW coefficients become positive, indicating that wage inequality rose in areas where the NMW bit more. Note that there are also smaller effects as move up wage distribution. The NMW coefficients for the 50-10 wage ratio are smaller than the equivalent coefficients using the 50-5 ratio as an outcome. Aside from reducing the endogeneity bias this may also indicate smaller spillover effects of the NMW as the lower percentile used in the measure of inequality moves further away from the percentile at which the NMW bites.

However once again the average full-sample estimates disguise the fact that any positive correlation between inequality being higher in low pay areas is gradually eroded over time as the NMW evolves. The coefficients on the interaction terms in the latter half of the sample are all negative, indicating that inequality fell more, in the latter half of the sample, in areas where the NMW bit most.

Table 7. Within Group and OLS Estimates of Minimum Wage Effects on Claimant Count

	Proportion paid at or below NMW				*Proportion Paid at NMW*				*Kaitz Index*			
Unemp.	1	2	3	4	1	2	3	4	1	2	3	4
Total 16-ret.	0.246**	0.191**	0.018**	0.018*	0.043**	0.077**	-0.004	-0.004	0.010	0.262**	0.286	0.285**
406 areas	(0.014)	(0.014)	(0.005)	(0.005)	(0.012)	(0.013)	(0.004)	(0.004)	(0.068)	(0.071)	(0.051)	(0.052)
Total 16-ret.	0.333**	0.304**	0.020**	0.018*	0.104**	0.175**	0.010*	0.104	0.526**	1.142**	0.386**	0.368**
140 areas	(0.025)	(0.028)	(0.010)	(0.010)	(0.020)	(0.021)	(0.005)	(0.005)	(0.138)	(0.156)	(0.104)	(0.106)
Year Effects	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Area Effects	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Controls	N	N	N	Y	N	N	N	Y	N	N	N	Y

Table 8. Incremental Difference in-Difference Unemployment Estimates (Claimant Count)

	Proportion paid at or below NMW		*Proportion Paid at NMW*		*Kaitz Index*	
	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas
NMW	0.008	0.008	0.007	0.005	0.229**	0.210
Base year	(0.011)	(0.025)	(0.015)	(0.008)	(0.064)	(0.134)
NMW*1999	0.078**	0.100**	0.037	0.050**	0.249**	0.350**
	(0.016)	(0.033)	(0.017)	(0.016)	(0.063)	(0.133)
NMW*2000	0.094**	0.103**	0.043**	0.060**	0.358**	0.479**
	(0.016)	(0.031)	(0.017)	(0.014)	(0.070)	(0.149)
NMW*2001	0.091**	0.086**	0.012	0.050**	0.329**	0.388**
	(0.015)	(0.031)	(0.018)	(0.015)	(0.067)	(0.128)
NMW*2002	-0.005	0.001	-0.001	0.021	-0.241**	-0.312**
	(0.013)	(0.030)	(0.016)	(0.014)	(0.052)	(0.127)
NMW*2003	-0.065**	-0.073**	-0.025	-0.015	-0.484**	-0.671**
	(0.014)	(0.032)	(0.017)	(0.015)	(0.060)	(0.141)
NMW*2004	-0.074**	-0.069**	-0.053**	-0.030*	-0.560**	-0.613**
	(0.015)	(0.035)	(0.017)	(0.016)	(0.059)	(0.134)
NMW*2005	-0.063**	-0.059**	-0.055**	-0.048**	-0.485**	-0.542**
	(0.015)	(0.032)	(0.017)	(0.016)	(0.067)	(0.131)
NMW*2006	-0.066**	-0.132**	-0.052**	-0.060**	-0.327**	-0.702**
	(0.018)	(0.035)	(0.018)	(0.020)	(0.075)	(0.162)
NMW*2007	-0.019	-0.053	-0.017	-0.029	-0.178**	-0.434**
	(0.017)	(0.037)	(0.019)	(0.022)	(0.078)	(0.163)

Note: All regressions contain year, area effects + controls

Table 9. Within Group and OLS Estimates of Minimum Wage Effects on Wage Inequality

	Proportion paid at or below NMW				*Proportion Paid at NMW*			
	1	2	3	4	1	2	3	4
50-5								
Total 16-ret.	-0.045**	-0.065**	0.031**	0.033**	-0.062**	-0.054**	-0.008**	-0.008**
406 areas	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Total 16-ret.	-0.039**	-0.066**	0.028**	0.031**	-0.047**	-0.038**	-0.005**	-0.005**
140 areas	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
Adult 25-ret	-0.037**	-0.056**	0.035**	0.036**	-0.057**	-0.053**	-0.006**	-0.005**
406 areas	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Adult 25-ret	-0.028**	-0.052**	0.030**	0.032**	-0.039**	-0.034**	-0.003	-0.002
140 areas	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
50-10								
Total 16-ret.	-0.037***	-0.049***	0.019***	0.020***	-0.039***	-0.036***	-0.002	-0.002
406 areas	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Total 16-ret.	-0.029***	-0.047***	0.020***	0.022***	-0.028***	-0.025***	-0.003*	-0.003*
140 areas	(0.004)	(0.005)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
Year Effects	N	Y	Y	Y	N	Y	Y	Y
Area Effects	N	N	Y	Y	N	N	Y	Y
Controls	N	N	N	Y	N	N	N	Y

Table 10. Incremental Difference in-Difference Wage Inequality Estimates

	Proportion paid at or below NMW				*Proportion Paid at NMW*			
	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas	Total 16-ret. 406 areas	Total 16-ret. 140 areas
	50-5		50-10		50-5		50-10	
NMW	0.092**	0.095**	0.054**	0.003	-0.002	0.004**	-0.001	0.001
Base year	(0.006)	(0.010)	(0.005)	(0.002)	(0.006)	(0.002)	(0.005)	(0.002)
NMW*1999	-0.035**	-0.052**	-0.009	0.008*	0.007	-0.006	0.014**	0.011**
	(0.008)	(0.012)	(0.006)	(0.004)	(0.007)	(0.004)	(0.006)	(0.004)
NMW*2000	-0.053**	-0.050**	-0.027**	0.005	0.006**	0.005	0.008	0.006
	(0.007)	(0.010)	(0.006)	(0.005)	(0.007)	(0.004)	(0.006)	(0.005)
NMW*2001	-0.057**	-0.061**	-0.031**	-0.011**	0.002	-0.011**	0.004	-0.005
	(0.007)	(0.011)	(0.006)	(0.004)	(0.008)	(0.004)	(0.006)	(0.004)
NMW*2002	-0.067**	-0.079**	-0.032**	-0.009*	-0.011	-0.014**	-0.003	-0.003
	(0.008)	(0.012)	(0.006)	(0.005)	(0.007)	(0.005)	(0.006)	(0.004)
NMW*2003	-0.062**	-0.064**	-0.036**	-0.014**	0.001	-0.011**	0.001	-0.006
	(0.007)	(0.011)	(0.006)	(0.004)	(0.008)	(0.004)	(0.007)	(0.004)
NMW*2004	-0.069**	-0.073**	-0.043**	-0.011*	-0.005	-0.017**	-0.004	-0.001
	(0.007)	(0.011)	(0.005)	(0.004)	(0.007)	(0.004)	(0.006)	(0.004)
NMW*2005	-0.092**	-0.094**	-0.055**	-0.009*	-0.015	-0.017**	-0.009	0.001
	(0.007)	(0.012)	(0.006)	(0.005)	(0.017)	(0.006)	(0.006)	(0.005)
NMW*2006	-0.077**	-0.097**	-0.047**	-0.017**	-0.009	-0.025**	-0.007	-0.010
	(0.007)	(0.012)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
NMW*2007	-0.102**	-0.116**	-0.064**	-0.027**	-0.028**	-0.036**	-0.021**	-0.014**
	(0.007)	(0.013)	(0.006)	(0.006)	(0.007)	(0.008)	(0.006)	(0.007)

All regressions contain year, area effects + controls

V. CONCLUSIONS

Our preliminary conclusion is that much of the debates over the employment effects of the NMW have generated a 'lot of heat but not much light'. This conclusion is warranted to the extent that our examination of the empirical literature made it clear that much of the controversy and debate over whether the effects on employment are negative or positive is actually arguing about different estimated parameters in the sense that they use different estimation strategies, with different types of data, on widely different samples of people of different ages. The truth is that most of the papers in the literature are estimating different marginal effects.

Our identification strategy was to use two sources of variation to try and identify the effect of the NMW. The first is to exploit a natural variation in how the NMW bites in different geographical locations. In our UK case the MW is set nationally and so there is no decision to be made at the local level (in sharp contrast to the US case). This means that the natural variation in the way the NMW works must be different at each geographical area.

Our second source of variation was to examine the effect of changes in the uprating of the NMW over the years since it was introduced. This estimation is based on an Incremental Diff-in-Diff method which allows us to estimate the marginal (interaction) effect of each years change in the NMW. The combination of these two different methods of identification along with the rigorous use of different robustness checks means that we can be slightly more confident about the estimated effect of the impact of the NMW.

The conclusions from our estimated results are that overall there seems to be no significant impact of the NMW on employment when we use a conventional Diff-in-Diff estimation for the whole policy-on/ policy off effect. However, when we use of Incremental Diff-in-Diff estimation method we retrieve significant positive effects on employment in recent years. These findings are interesting as they are firstly consistent with much of the recent literature (i.e. since they get zero and small positive effects) but that they explain why it may be possible to get both zero and positive effects. Certainly it is hard to conclude from these estimates that employment or unemployment across regions has been affected adversely by a national minimum wage.

Finally it is reassuring that our empirical policy conclusions are consistent with the simple observation that the NMW has been uprated in the key years (2003, 2004 and 2005) at a faster rate than movements in the RPI or average earnings. This conclusion is of some substantive policy interest in that it means that the Low Pay Commission can be clear that there is scant evidence of a negative employment effect of the NMW and that shifting the NMW up - ahead of inflation - unlikely to be doing harm to employment

Bibliography

Arellano, Manuel, (1987), “Computing Robust Standard Errors for Within-Groups Estimators”. Oxford Bulletin of Economics and Statistics 49(4): 431-434.

Bertrand, M, Duflo, E, and Mullainathan, S. (2004), “How Much Should We Trust Difference-in-Differences Estimates?”, Quarterly Journal of Economics, Feb, p.249-275.

Brown, Charles, Gilroy, Curtis and Kohen, Andrew, (1982), “The Effect of the Minimum Wage on Employment and Unemployment”. Journal of Economic Literature 20(2): 487-528.

Card, David, (1992), “Using Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage.” Industrial and Labor Relations Review 46(1): 22-37.

Card, David, and Krueger, Alan, (1994), “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania.” The American Economic Review 84(4): 772-793.

Card, David, and Krueger, Alan, (1995), “Myth and Measurement: The New Economics of the Minimum Wage.” Princeton University Press, Princeton, NJ.

Connolly, Sara, and Gregory, Mary, (2002), “The National Minimum Wage and Hours of Work: Implications for Low Paid Women”. Oxford Bulletin of Economics and Statistics 64(Supplement): 607-631.

Dickens, Richard and Draca, Mirko, (2005), “The Employment Effects of the October 2003 Increase in the National Minimum Wage”. CEP Discussion Paper n.693. Report prepared for the Low Pay Commission.

Dolado, Juan, Kramarz, Francis, Machin, Stephen, Manning, Alan, Margolis, David, Teulings, Coen, Saint-Paul, Gilles and Keen, Michael, (1996), “The Economic Impact of Minimum Wages in Europe”. Economic Policy 11(23): 317-372.

Donald, S. and Lang, K. (2007), “Inference with Difference-in-Differences and other Panel Data”, Review of Economics and Statistics, 89(2), pp.221-233.

Hamermesh, Daniel, (1995), “Myth and Measurement: the New Economics of the Minimum Wage: Comment”. Industrial and Labor Relations Review 48(4): 830-834.

Hayes, Robert, Ormerod, Catrin and Ritchie, Felix, (2007), “Earnings: Summary of Sources and Developments”. Economic and Labour Market Review 1(1): 42-47.

Lemos, Sara, (2004a), “A Menù of Minimum Wage Variables for Evaluating Wages and Employment Effects: Evidence from Brazil”. IZA Discussion Paper n.1069.

Lemos, Sara, (2004b), “Are Wage and Employment Effects Robust to Alternative Minimum Wage Variables?”. IZA Discussion Paper n.1070.

Machin, Andrew, (2004), “Comparisons between Unemployment and the Claimant Count”. Labour Market Trends

Machin, Stephen and Manning, Alan (1994). “The Effects of Minimum Wages on Wage Dispersion and Employment: Evidence from the U.K. Wage Councils”. Industrial and labor Relations review 47(2): 319-329.

Manning, Alan and Dickens, Richard, (2002). “The Impact of the National Minimum Wage on the Wage Distribution, Poverty and the Gender Pay Gap”. Report prepared for the Low Pay Commission.

Metcalf, David, (2007). “Why Has the British National Minimum Wage Had Little or No Impact on Employment?”. CEP Discussion Paper n.781.

Meyer, Bruce, (1995), “Natural and Quasi-Experiments in Economics”. Journal of Business and Economic Statistics 13(2): 151-161.

Moulton B. (1990), “An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units', Review of Economics and Statistics, 72(2), pp334-38.

Neumark, David and Nizalova, Olena, (2007), “Minimum Wage Effects in the Longer Run”. The Journal of Human Resources 42(2): 435-452.

Neumark, David and Washer William, (2007), “Minimum Wages and Employment”. Foundations and trends in Microeconomics 3(1-2): 1-182.

Neumark, David and Washer, William, (1992), “Employment Effects of Minimum and Subminimum Wages: Panel Data on State Minimum Wage Laws”. Industrial and Labor Relations Review 46(1): 55-81.

Neumark, David and Washer, William, (2004), “Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis”. Industrial and Labor Relations Review 57(2): 223-248.

Ormerod, Catrin and Ritchie, Felix, (2007), “Issues in the Measurement of Low Pay”. Economic and Labour Market Review 1(6): 37-45.

Ormerod, Catrin and Ritchie, Felix, (2007), “Linking ASHE and LFS: Can the Main Earnings Sources be Reconciled?” Economic and Labour Market Review 1(3): 24-31.

Ormerod, Catrin and Ritchie, Felix, (2007), “Measuring Low Pay: the Importance of Timing”. Economic and Labour Market Review 1(4): 18-22.

Smith, D. (2006), “Does Britain Have Regional Justice or Injustice in its Government Spending and Taxation?”, Economic Research Council Digest, Vol. 37, No 1, pp. 9-26.

Stewart, Mark and Swaffield, Joanna, (2004), “The Other Margin: Do Minimum Wages Cause Working Hours Adjustments for Low-Wage Workers?” Report prepared for the Low Pay Commission.

Stewart, Mark, (2002), “Estimating the Impact of the Minimum Wage Using Geographical Wage Variation”. Oxford Bulletin of Economics and Statistics 64(Supplement): 583-605.

Stewart, Mark, (2004a), “The Impact of the Introduction of the UK Minimum Wage on the Employment Probabilities of Low Wage Workers”. Journal of European Economic Association 2: 67-97.

Stewart, Mark, (2004b), “The Employment Effects of the National Minimum Wage”. The Economic Journal 114: C110-C116.

Wooldridge, J. (2002), 'Econometric Analysis of Cross Section and Panel Data’, MIT Press, London, England.

Wooldridge, J. (2007), 'Differences-in-Differences Estimation' NBER Summer 2007 Workshop on 'What’s New in Econometrics?'.

APPENDIX

I. DEFINITION OF THE KEY VARIABLES

Dependent variables

Employment rate

Total number of employees, self-employed, unpaid family workers and participants in government-supported training and employment programs in working age as a proportion of people in working age in each local area.

This variable has been generated also for adult workers (25 to retirement age) and for young workers (16 to 24).

Data on employment used in this paper is taken from June to August of each year.

Source: Labour Force Survey. Residence based analysis.

Independent variables

Minimum wage shares

Proportion of workers paid at or below the minimum wage in each local area.

The shares are generated for three age bands in each local area:

- <u>16 to 24 years old</u>

Starting from 1999, the shares are a weighted average of the minimum wage shares of persons from 18 to 21 years and of persons from 22 to 24.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the shares are a weighted average of the minimum wage shares of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to 24.years.

- <u>16 to retirement age</u>

Starting from 1999, the shares are a weighted average of the minimum wage shares of persons from 18 to 21 years and of persons from 22 to retirement age.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the shares are a weighted average of the minimum wage shares of persons of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to retirement age.

- <u>25 to retirement age</u>

Source: ASHE, data recorded in April of each year. Workplace based analysis.

Spike of the minimum wage

Proportion of workers paid at the minimum wage in each local area.

The spikes are generated for three age bands in each local area:

- <u>16 to 24 years old</u>

Starting from 1999, the spike is a weighted average of the spike of persons from 18 to 21 years and of persons from 22 to 24.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the spike is a weighted average of the spike of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to 24 years.

- <u>16 to retirement age</u>

Starting from 1999, the spike is a weighted average of the spike of persons from 18 to 21 years and of persons from 22 to retirement age.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the spike is a weighted average of the spike of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to retirement age.

- <u>25 to retirement age</u>

Source: ASHE, data recorded in April of each year. Workplace based analysis.

Kaitz Index

Kaitz Index, generated as the ratio of the NMW to the median hourly wage in each local area.

The Kaitz index is generated for three age bands in each local area:

- <u>16 to 24 years old</u>

Starting from 1999, the Kaitz index is a weighted average of the Kaitz index of persons from 18 to 21 years and of persons from 22 to 24.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the Kaitz index is a weighted average of the Kaitz index of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to 24.years.

- <u>16 to retirement age</u>

Starting from 1999, the shares are a weighted average of the minimum wage shares of persons from 18 to 21 years and of persons from 22 to retirement age.

From 2004, with the introduction of the new development rate for young between 16 and 17 years, the shares are a weighted average of the minimum wage shares of persons of persons of 16 and 17 years, of persons from 18 to 21 years and of persons from 22 to retirement age.

- <u>25 to retirement age</u>

Source: ASHE, data recorded in April of each year. Workplace based analysis.

II. PROBLEMS WITH THE ASHE/NES DATASETS

Even if ASHE is considered to give reliable wage figures though payroll records and it has a relatively large sample size, there are some limitations of this dataset which affect this study.

a) <u>Possible measures of hourly earnings</u>

The Low Pay Commission recommended construction of the hourly pay variable on the NES/ASHE data involves dividing gross pay (excluding overtime, shift and premium payments) by basic paid hours. This variable closely matches the definition of National Minimum Wage. However, the variable is available in the panel from 2000 only, being necessary to use another measure of hourly earnings in this study which covers the period 1997 to 2007.

The variable used is a “basic hourly wage rate”, defined as gross weekly earnings excluding overtime, and divided by normal basic hours. As a result this variable will be slightly greater than the true hourly wage and the measurement error will tend to be larger, the higher shift and premium payments are. This might therefore result in an under-statement of the number of low paid workers.

b) <u>Discontinuities in NES/ASHE dataset across years</u>

Time series analysis has been complicated when the ASHE replaced the NES in 2004 and also by several changes in the ASHE methodology from 2004 to 2007.

First of all, the coverage of employees for the ASHE is greater than that of the NES. The NES surveys employees taken from HM Revenue & Customs PAYE record, excluding the majority of those whose weekly earnings fall below the PAYE deduction threshold. Moreover, this survey does not cover employees between sample selection for a particular year and the survey reference week in April. Thus, mobile workers who have changed or started new jobs between the drawing of the sample and the reference week are excluded. In conclusion, NES understate the proportion on NMW as it does not record the earnings of many low paid workers, especially part-time and mobile workers. In 2004, ASHE survey was introduced to improve on the representation of the low paid: it improved coverage of employees including mobile workers who have either changed or started new jobs between sample selection and the survey reference in April. Also, the sample was enlarged by including some of the employees outside the PAYE system.

Secondly, in 2005 a new questionnaire was introduced. In particular, the definition of incentive/bonus pay changed to only include payments that were paid and earned in April. Also, a new question including "pay for other reasons" was introduced. This implies respondents might include earnings information which was not collected in the past. Even if results for 2004 have been reworked to exclude irregular bonus/incentive payments and to allow for this missing pay, results from 1997 to 2003 remain inconsistent with the ones from 2004 onwards.

Given that the main source of information on hourly pay in this study includes shift and premium payments and from 2004 "pay for other reasons", estimations of measures of minimum wage and wage inequality might be affected by this discontinuity, with an increase of the average measurement error and the dispersion in the measurement error from 2004 onwards.

Finally, in 2007 the sample size of ASHE was reduced by 20%. ASHE results for 2007 are based on approximately 142,000 returns, down from 175,000 in 2006. The largest sample cuts occurred principally in industries where earnings are least variable, affecting the randomness of the sample.

Consistent series which takes into account of the identified changes has been produced going back from 2006 to 2004 and from 2007 to 2006. For 2004 results are also available that exclude supplementary information, to be comparable with the back series generated by imputation and weighting of the 1997 to 2003 NES data. Unfortunately, it is not possible to get consistent datasets for the entire period concerning this study (1997-2007).

Table A1. Within Group and OLS Estimates of Minimum Wage Effects on Employment (16 years to retirement age), 406 areas

	Employment Rate											
	Proportion paid at the NMW				Proportion paid at the NMW				Kaitz Index			
Independent Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
Measures of the NMW												
Proportion paid at or below the NMW	-0.021***	-0.020***	0.001	0.001								
	(0.002)	(0.003)	(0.002)	(0.002)								
Proportion paid at the NMW					-0.012***	-0.012***	0.001	0.001				
					(0.002)	(0.002)	(0.002)	(0.002)				
Kaitz Index									0.013	0.015	-0.021	-0.012
									(0.012)	(0.013)	(0.023)	(0.024)
Control vector												
Age				1.004				1.027				1.004
				(1.072)				(1.074)				(1.079)
Age squared				-0.025				-0.025				-0.025
				(0.027)				(0.027)				(0.027)
Age cubed				0.001				0.001				0.001
				(0.001)				(0.001)				(0.001)
Proportion with NVQ 4 or more				0.149***				0.149***				0.148***
				(0.024)				(0.024)				(0.024)
Proportion of Females				-0.005				-0.004				0.001
				(0.031)				(0.031)				(0.032)
Years Effects	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
Areas Effects	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Observations	4466	4466	4466	4466	4466	4466	4466	4466	4466	4466	4466	4466
R-squared	0.020	0.015	0.025	0.039	0.007	0.006	0.025	0.039	0.001	0.001	0.026	0.039

Table A2. Within Group Estimates of Dynamic Specifications of Minimum Wage Effects on Employment Rate (16 years to retirement age), 406 areas.

	Proportion at or below the NMW				Proportion at the NMW				Kaitz Index			
Independent Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
Proportion paid at or below the NMW t			0.001	0.002								
			(0.002)	(0.002)								
Proportion paid at or below the NMW t-1	0.002	0.002	0.002	0.002								
	(0.002)	(0.002)	(0.002)	(0.002)								
Proportion paid at the NMW t							0.001	0.001				
							(0.002)	(0.002)				
Proportion paid at the NMW t-1					0.002	0.002	0.002	0.002				
					(0.002)	(0.002)	(0.002)	(0.002)				
Kaitz Index t											-0.014	-0.003
											(0.027)	(0.028)
Kaitz Index t-1									-0.015	-0.011	-0.011	-0.010
									(0.025)	(0.025)	(0.026)	(0.025)
Years Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Areas Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Observations	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060
R-squared	0.013	0.027	0.013	0.027	0.013	0.027	0.013	0.027	0.013	0.027	0.013	0.027