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Should You Do A Doctorate? The Changing Returns To Postgraduate Qualifications

Sven Hoeling
University of Warwick, s.hoeling@warwick.ac.uk

Lewis Gudgeon
University of Warwick

Felix Hagemeister
University of Warwick

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Abstract
Higher education in the UK has experienced radical change over the last two decades. The change has been driven by a number of factors, not least New Labour's policy to send 50% of school leavers to university. The increased supply of graduates has weakened a first degree's ability to function as a signal to employers, resulting in many individuals pursuing postgraduate study to make themselves more competitive. This paper aims to show the changing returns to Bachelor, Master and Doctoral degrees for the period 1997 to 2013 and recognises the increasing importance of Ph.D. graduates in the upcoming years.

Keywords
Education Economics, Econometrics, Microeconomics

Introduction

Higher education in the UK has experienced radical change over the last two decades. The change has been driven by a number of factors, not least New Labour's policy to send 50% of school leavers to university (BBC, 2002) as well recognition of the importance of higher education for being competitive internationally (Taylor 2002, p. 53). The increased supply of graduates has weakened a first degree's ability to function as a signal to employers, resulting in many individuals pursuing postgraduate study to make themselves more competitive on the job market (Katz and Murphy, 1992; Lindley and Machin 2011, p. 1). 11% of people in work aged 26-40 now hold a postgraduate qualification, compared to 4% in 1996 (Lindley and Machin 2013a, p. 3). In part this increase may be attributable to the economic uncertainty surrounding the Global Financial Crisis in 2008 (Lipsett, 2009). It is acknowledged in the literature that the relative wages of postgraduates have also risen compared to holders of a first degree (Lindley and Machin 2013b, p. 26), resulting in increasing within-graduate inequality (ibid.). Lindley and Machin (2013b) argue that the greater demand for postgraduates is due to rapid technological change, necessitating more highly educated individuals.
Differing returns to educational level matter because they are connected to social mobility (Lindley and Machin 2012, 2013a, p.5, Machin and Van Reenen 2007, p.10). A substantial body of literature analyses the increasing returns to postgraduate qualifications (e.g. Lindley and Machin, 2011, 2013a, 2013b; Walker and Zhu 2005). This paper makes a unique contribution by decomposing the returns to postgraduate qualification *by type of postgraduate qualification* and examining how these returns have changed over time since 1997. Using recent data, in contradiction of some research (Walker and Zhu, 2005) we find that, irrespective of gender, the real returns to a bachelor's degree have fallen, and similarly for master's and PGCE. Uniquely, returns to a doctorate have risen over time.

This paper is structured as follows: (I) we explain how our dataset is constructed and provide some summary statistics; (II) we set out our model and modelling strategy; (III) we discuss our results and possible policy implications and in (IV) we conclude.

I - Data and summary statistics

We use pooled cross-sectional data from the Quarterly Labour Force Survey in years 1997, 2005 and 2013. We take wave one individuals from Q2 (April – June) and condition our analysis on (i) employed individuals (employees or self-employed) who are (ii) aged over 25 (so likely not still in education), (iii) without a health problem that limits the amount of work they can do and (iv)

who record an hourly wage in the middle 98% of the distribution. We construct the real wage using CPI data, using base 2005=1. Our resulting sample consists of a total of 18,506 individuals: 7,405 from 1997, 6,216 from 2005 and 4,885 from 2013. The proportion of individuals who undertook postgraduate study grew over the three periods: 4.38% in 1997, 7.16% in 2005 and 10.05% in 2013. These figures correspond remarkably closely to Lindley and Machin's estimates above (2013a p. 3).

The mean real hourly wage is £9.97 with a standard deviation of 5.73. The minimum is £1.67, falling below the official minimum wage due to individuals working more than their officially contracted hours. The maximum is £37.17. Appendix [1] graphs the distribution of real hourly wage [1] (*rwage*). There are 8,938 male and 9,568 females in our sample with mean real hourly wages of £11.24 (s.d. 0.64) and £8.79 (s.d. 0.05) respectively. Differential earnings by gender are a feature of the literature (Lindley and Machin, 2011) and widely acknowledged, so the difference in means across genders is tested and significant at the 1% level. Appendix [2] shows the distribution of wages by gender: the male distribution is more platykurtic with more individuals at higher values of the wage distribution; the female distribution is more leptokurtic, peaking below £10 per hour. Appendix [3] shows how these gender differences persist through each year and almost every qualification level.

We graph the mean hourly earnings by occupation in Appendix [4], with managers and professionals earning the highest wages (means of £13.99 (s.d. 6.97) and £14.94 (s.d. 6.04)
respectively). Appendix [5] shows that increased tenure with employer is associated with higher wages. Finally, Appendices [6-8] demonstrate that although most of the sample is white, the composition of ethnicities has become more diverse over the three periods, with the white proportion of the sample falling from 95.76% in 1997 to 93.60% in 2005 and 89.85% in 2013. Appendix [9] shows that aside from the 'other' category, Asian or Asian British individuals have the highest mean hourly wage at £10.20 (s.d. 6.48), compared with the mean wage for white individuals of £9.97 (s.d. 5.71).

II - The Model

We use OLS to model wage determinants, with particular emphasis on how returns to postgraduate qualifications have changed over 1997-2013. Using the standard form of the human capital earnings function (Mincer 1974) and Walker and Zhu's estimation (2005) as a platform, after trialling many specifications our final base model is:

$$\ln(rwage) = \alpha + \beta_1 sex_i + \beta_2 lage_i + \beta_{3-9} emplen_i + \beta_{10} publicr_i + \beta_{11-14} ethnic_i + \beta_{15-16} year_i + \beta_{17} noqual_i + \beta_{18-20} NQF(1,2,4)_i + \beta_{21} NVQ5_i + \beta_{22} other\deg_i + \beta_{23} otherpg_i + \beta_{24-26} year_i \times bachelors_i + \beta_{27-29} year_i \times PGCE_i + \beta_{30-32} year_i \times masters_i + \beta_{33-35} year_i \times doctorate_i + \beta_{36-43} socmajm_i + \beta_{44-62} uresmc_i + \varepsilon_i$$

sex = gender
age = age
$lage$ = natural log of age
$emplen$ = years with current employer
$publicr$ = work in public sector
$ethnic$ = ethnicity
$year$ = year (1997, 2005 or 2013)
$noqual$ = no qualifications
$NQF(1-4)$ = National Qualification Framework Levels 1-4
$NVQ5$ = NVQ level 5
$bachelors$ = bachelors degree highest qual
$PGCE$ = PGCE highest qual
$masters$ = masters highest qual
$other\deg$ = other degree
$otherpg$ = other postgrad highest qual
$doctorate$ = doctorate highest qual
$socmajm$ = employment sector
$uresmc$ = region

We conditioned our analysis on individuals with positive tenure with their employers and with an age between 0 and 96 years when completed education, restricting our sample to 18,384 observations. The above functional form was selected after trialling different specifications with quadratic, cubic, quartic and log-forms of *age* and *edage* and plotting the residuals of each specification. We have a good degree of confidence in the robustness of our results: (i) the plotted residuals of the model appear normally distributed (as we should expect with a large sample by the Central Limit Theorem); (ii) the model has a high R^2 value of .520; (iii) the model passes a RESET test with a p-value of 33.36% and (iv) we found a similar pattern on *year postgraduate* coefficients for each specification we tried. Exclusion of *edage* and *edagesq* is reasonable as we already capture the effects of education with our qualification variables and improves the performance of our model in a RESET test. We use robust standard errors as we find evidence of

heteroscedasticity when plotting the residuals versus the predicted values and this is further verified by a Breusch-Pagan test; we reject the null of constant variance with a Chi-squared value of 306.38. Part of the explanation for heteroscedasticity is that many individuals report their wages to the nearest £5,000. Our results are reported in Appendix [10], with our preferred specification in column five.

Since our summary statistics suggest a structural break across gender, we perform a Chow test for structural change, yielding an F-statistic of 4.36: so we reject a null hypothesis of no structural change at the 1% level (critical value 1.32) and opt for a more flexible model, allowing for structural change across all of our explanatory variables. Although a RESET test now indicates possible misspecification, we remain confident in the robustness of our results because the inflexible model appeared correctly specified, the residuals for this flexible version (Appendix [12]) appear normally distributed and the model has an R^2 value of 0.525. While misspecification is in general a concern in applied econometrics, as Clarke (2005) states we are possibly never going to work with a perfectly specified model anyway: our models are simply first-best approximations. The final results relevant for our purposes are reported in Appendix [11].

There is, however, some cause to be concerned about endogeneity bias: in particular, that the coefficients on higher education levels are positively biased as a result of underlying unobserved ability. A highly driven and intelligent individual may undertake a doctorate as a result of these unobserved characteristics, but also earn more *also for those reasons* in addition to the additional wages that a doctorate may facilitate. Blackburn and Neumark (1995, p. 228) suggest that ability bias may be as high as 40%. Moreover, our estimates might suffer from discount-rate bias: individuals with a higher discount rate may choose less education (Harmon and Walker 1995, p. 1278). Therefore ideally one wants a variable to proxy ability (Griliches and William M. Mason, 1972). Unfortunately the LFS does not record ability as a proxy for these unobservables (Blackburn and Neumark 1995, p. 221; Harmon and Walker 1995, p. 1278), so we must be aware of these as possible sources of bias such that the true coefficients may be lower.

III – Results

First we compare our findings (Appendix [10]) to those in the literature by using the model that does not account for the structural break found in the previous section. Only this allows for a real comparison to recent findings with regards to changing returns to bachelor's and master's degrees. Then we present our more specific findings (Appendix [11]) with a special focus on the

returns to a doctoral degree, broken down by gender, as formalised at the end of the last section.

Ceteris paribus, we find that over the three years the returns to a bachelor's degree (relative to the default of NQF3 / A-level) have fallen: in 1997 the returns were 23.21%; in 2005 20.46% and in 2013 18.06%. This suggests a changed picture from Walker and Zhu (2005) who report that in 2005 there was no evidence that despite the increase in the number of graduates the mean returns were not falling. We also find that the returns to a master's have fallen: 31.60% in 1997, 29.63% in 2005 and 23.93% in 2013. The returns to a PGCE follow a similar pattern.

Yet, significantly, we find that the returns to a doctorate have risen, from 36.37% in 1997, through 36.22% in 2005, and then 44.65% in 2013.

Allowing for structural change by gender our model provides some additional interesting insights. Irrespective of gender, the returns to a bachelor's degree have fallen consistently over the three periods: for males the return (again relative to NQF3) was 24.54% in 1997, 19.45% in 2005 and 17.85% in 2013; for females the returns were 23.71% in 1997, 22.29% in 2005 and 19.00% in 2013. Regardless of gender the returns to a master's degree have also fallen: for men the returns were 30.99% in 1997, 25.93% in 2005 and 21.92% in 2013; for females the returns were 36.36% in 1997, 36.17% in 2005 and 27.48% in 2013. PGCE returns demonstrate a similar broadly decreasing pattern irrespective of gender.

In contrast, the return relative to no qualifications for a doctorate has broadly *increased* over the years, irrespective of gender: for males the returns were 36.41% in 1997, 41.15% in 2005 and 42.31% in 2013; for females 44.81% in 1997, (only) 29.22% in 2005 and 49.46% in 2013. While females enjoy a higher marginal effect of higher education levels, as Appendix [13] shows, their overall wages are predicted overall to be lower. Indeed Appendix [13] shows that the predicted wage is converging for males and females for doctorate holders, corroborating the prediction of Lindley and Machin (2013a) of some gender convergence and providing some evidence of improved social mobility for women.

The sample sizes of males and females across the three years permit us varying degrees of confidence in our results. The samples are large (above 300 in all cases) for individuals for whom a bachelor's is their highest qualification, giving us a high degree of confidence in our findings of decreasing returns. Similarly, our sample sizes for master's remain relatively large: while the male sample remains at approximately 100, we note with interest that the number of women undertaking master's study increased from 49 in 1997 to 100 in 2005 and 135 in 2013, providing additional evidence of

improved female social mobility. However, the sample size of about 30 individuals of each gender in each year for doctorate students permits us less confidence in our results; though we note that the number of female individuals undertaking doctorate studies has also increased over the three periods.

Our findings are as we might expect. With ever more individuals undertaking a first degree, more individuals are choosing to pursue master's study to distinguish themselves in the workplace and signal to employers. This can partly be seen as a response to demand side pressures and skill-biased technical change (Lindley and Machin, 2011): there has been significant technological growth and more educated workers are likely to be better able to work with the new technologies, particularly IT technology. Indeed, utilising a Constant Elasticity of Substitution production function, Lindley and Machin (2011) contend that graduates and postgraduates are imperfect substitutes in production with respect to their ability to use new technologies. Yet as more individuals undertake postgraduate study to master's level, the resulting increased supply of postgraduates has led to a fall in their real wage – and it appears that perhaps to distinguish themselves in the workforce more individuals are undertaking doctoral studies.

The increasing number of individuals undertaking postgraduate education is a concern for policy regarding social mobility as Lindley and Machin (2013a) posit. The recent £9,000 cap on undergraduate fees means that it has become more expensive to acquire a bachelor's degree; the additional £20,000 per year (Lindley and Machin 2013a, p. 3) for a master's course and the difficulty of getting funding in most cases may mean that postgraduate study is only possible for students from affluent backgrounds. This raises serious concerns about social mobility and may threaten to widen wage inequality.

IV – Conclusion

We have used OLS on a pooled cross-section to estimate the differential and changing returns to postgraduate levels of education over the period 1997-2013. We observed, in contrast to some previous empirical work and constituting this paper's unique empirical contribution, that the returns to a bachelor's degree appear to have fallen over the period, master's degrees appeared to exhibit similar diminishing returns, while having a doctorate was associated with uniformly increasing returns. Moreover, allowing for a structural break across gender, we observed that the change in returns for bachelor's, master's and doctorates were shared by both genders.

The increasing number of individuals undertaking postgraduate study should also give rise to concerns about social mobility (Marr 2012, p.3, Lindley and Machin 2013, p.22). Postgraduate qualifications are expensive and more attainable for a student from an affluent background. Increasing returns to postgraduate qualifications may mean that only the already wealthy are able to attain such qualifications, perpetuating a cycle of social immobility. New Labour's policy to send 50% of school leavers to university may facilitate greater social mobility overall, but distort prospects for social progress at the top of the education distribution. As such, as Lindley and Machin (2013a, p. 6) suggest, the government may wish to consider a state backed loan scheme in addition to backing Professional Career and Development Loans, which would facilitate better support for students from low and middle income backgrounds. Universities, professional associations and government may also wish to offer a greater range of bursaries to the brightest graduates to prevent them from being priced out of postgraduate education (ibid.).

Taking other European countries as an example, where postgraduate qualification is very cheap and in some cases even for free, the UK needs to consider the implications that follow. Lindley and Machin (2013a, p.22) conclude that Britain is a low mobility nation in terms of social mobility. In a more globalised world, labour mobility is increasing and the easy access to postgraduate education on the Continent and hence their highly qualified labour force might affect the competitiveness of the UK's own labour force in the long run.

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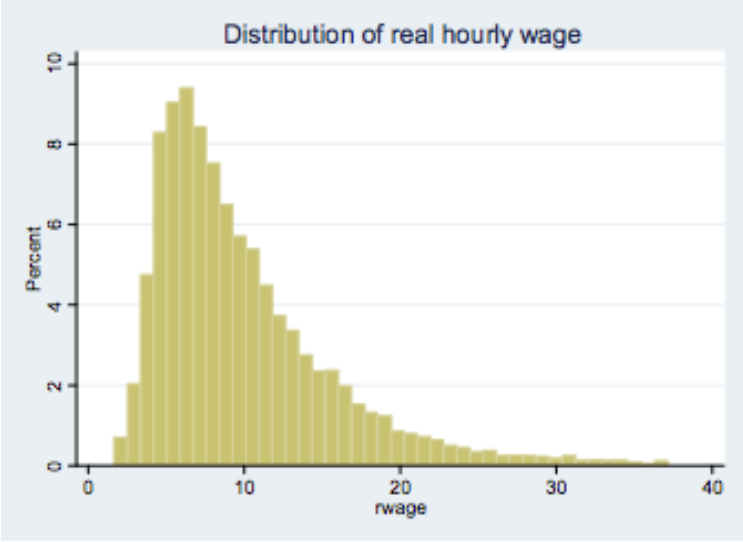
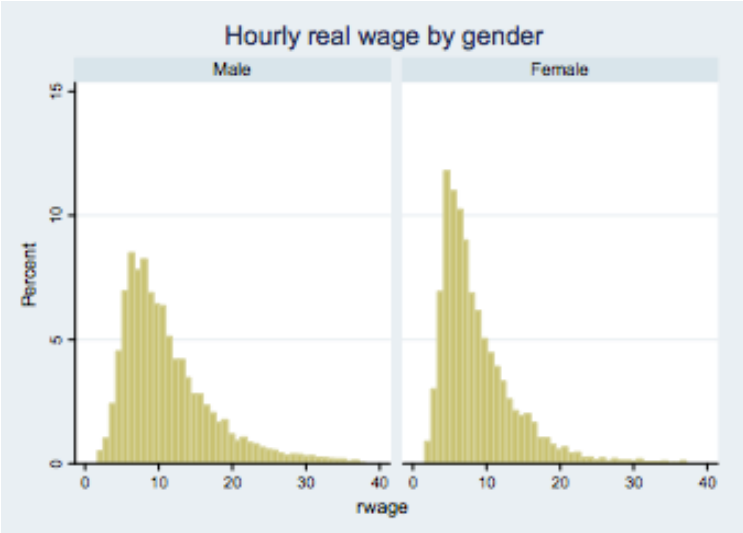
Appendix

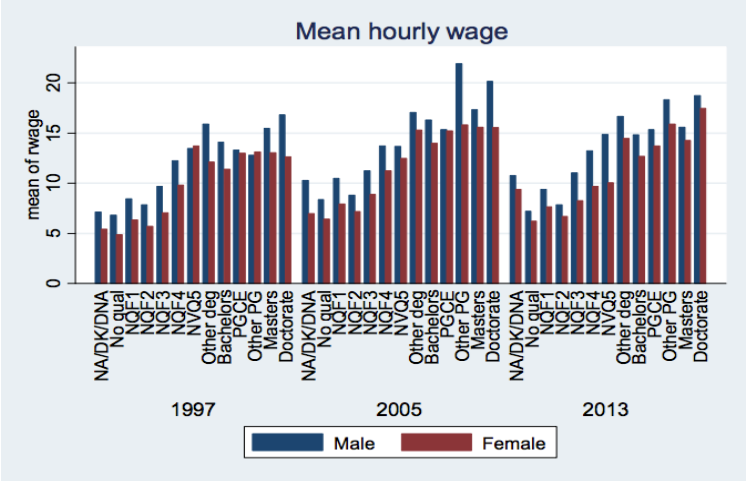
(1)



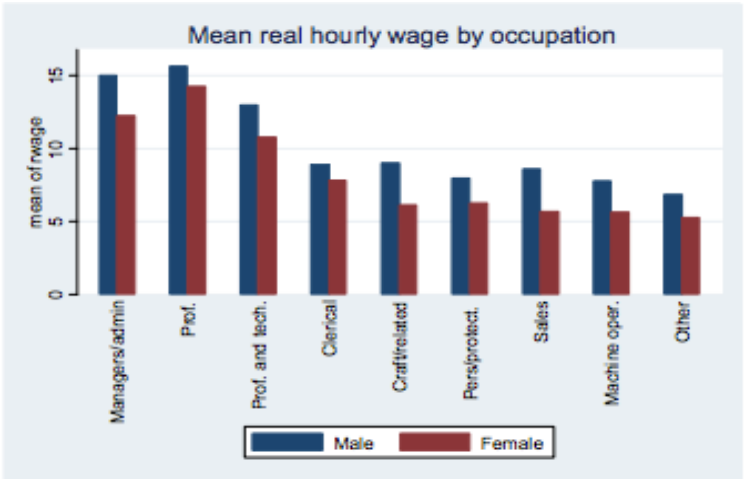
(2)


Hourly real wage by gender
Male
Female
Percent
0
5
10
15
0
10
20
30
40
rwage

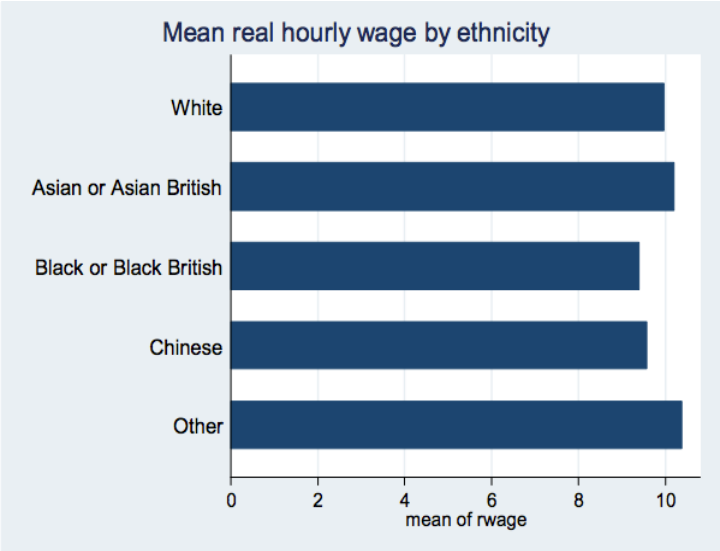
(3)


Mean hourly wage
mean of rwage
0
5
10
15
20
NA/DK/DNA
No qual
NQF1
NQF2
NQF3
NQF4
NVQ5
Other deg
Bachelors
PGCE
Other PG
Masters
Doctorate
1997
2005
2013
Male
Female

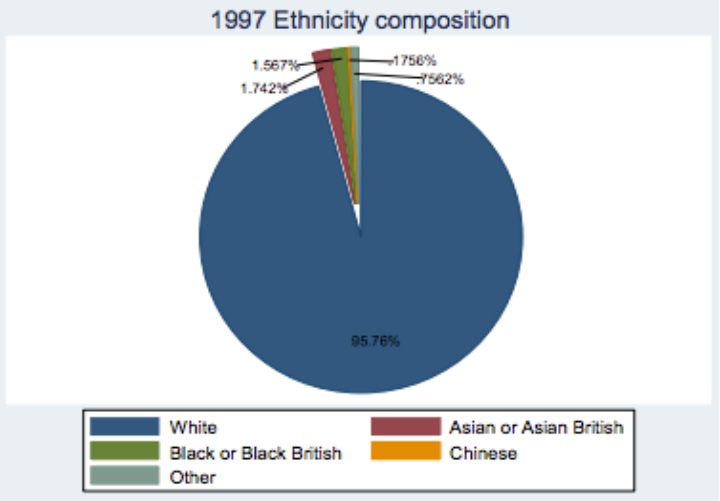
(4)


Mean real hourly wage by occupation
mean of rwage
0
5
10
15
Managers/admin
Prof.
Prof. and tech.
Clerical
Craft/related
Pers/protect.
Sales
Machine oper.
Other
Male
Female

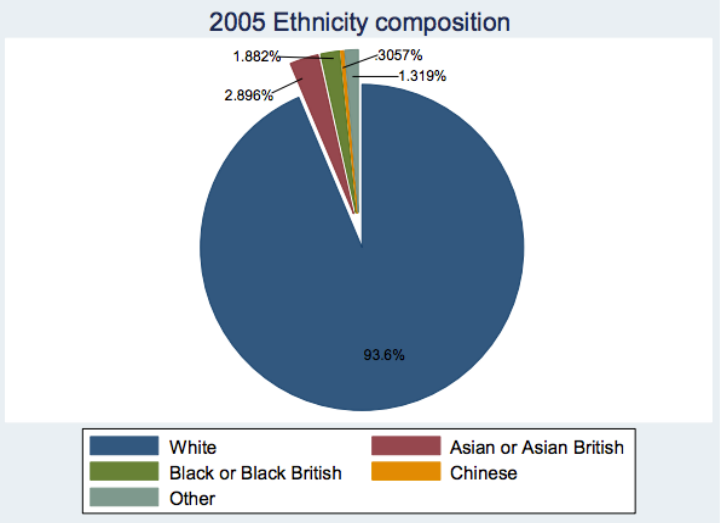
(5)


Mean real hourly wage by ethnicity
White
Asian or Asian British
Black or Black British
Chinese
Other
0
2
4
6
8
10
mean of rwage

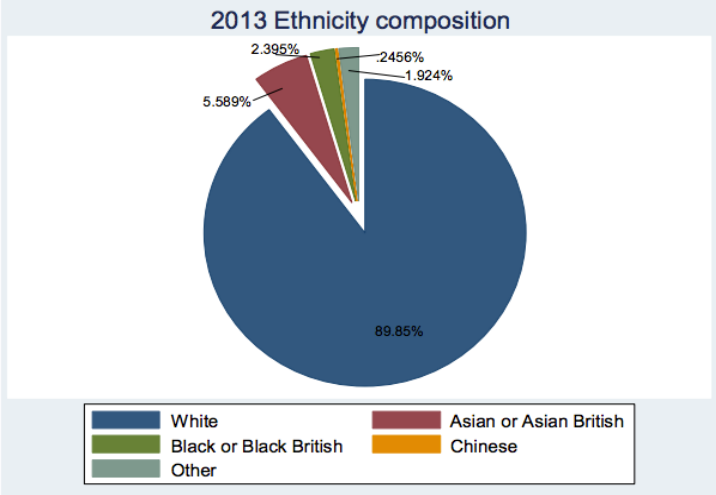
(6)


1997 Ethnicity composition
1.567%
1.742%
.1756%
.7562%
95.76%
White
Asian or Asian British
Black or Black British
Chinese
Other

(7)


2005 Ethnicity composition
1.882%
2.896%
.3057%
1.319%
93.6%
White
Asian or Asian British
Black or Black British
Chinese
Other

(8)


2013 Ethnicity composition
2.395%
.2456%
1.924%
5.589%
89.85%
White
Asian or Asian British
Black or Black British
Chinese
Other

(9)


Mean real hourly wage and tenure with employer
No answer
Less than 3 months
3 months but less than 6
6 months but less than 12
1 year but less than 2
2 years but less than 5
5 years but less than 10
10 years but less than 20
20 years or more
0
5
10
15
mean of rwage

(10) **OLS Results. Dependent Variable: logged real wage (*lnrwage*)**

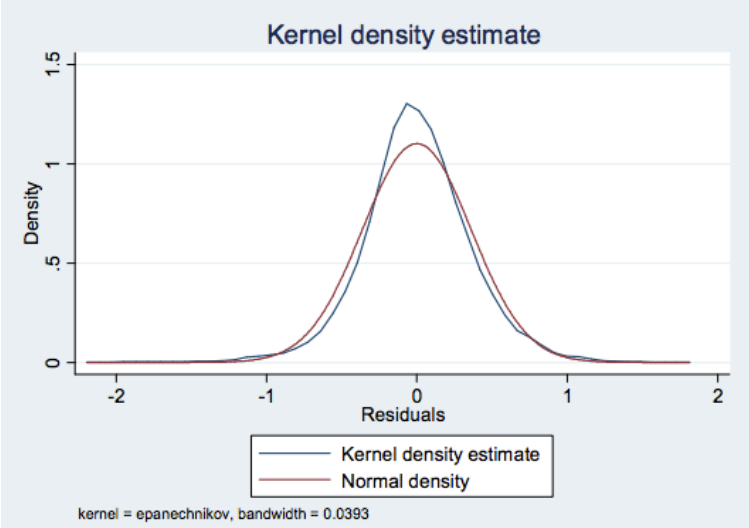
	(1)	Robust se(1)	(2)	Robust se(2)	(3)	Robust se(3)	(4)	Robust se(4)	**(5)**	**Robust se(5)**
sex	-0.191*	0.006	-0.193*	0.006	-0.193*	0.006	-0.190*	0.006	**-0.189***	**0.006**
age	0.034*	0.002	0.034*	0.002	0.255*	0.048				
age^2	0.000*	0.000	0.000*	0.000	-0.008*	0.002				
age^3					0.000*	0.000				
age^4					0.000*	0.000				
ln(age)							0.032*	0.012	**0.004**	**0.012**
edage	0.011*	0.001	0.050*	0.012	-0.019	0.083	0.056*	0.013		
edage^2			-0.001*	0.000	0.006	0.005	-0.001*	0.000		
edage^3					0.000	0.000				
edage^4					0.000	0.000				
Time w/ employer dummies	Yes		Yes		Yes		Yes		**Yes**	
Public sector	0.030*	0.006	0.030*	0.006	0.030*	0.006	0.035*	0.006	**0.035***	**0.006**
Ethnicity dummies	Yes		Yes		Yes		Yes		**Yes**	
Year dummies	Yes		Yes		Yes		Yes		**Yes**	
No qualifications	-0.155*	0.010	-0.148*	0.011	-0.144*	0.011	-0.153*	0.011	**-0.175***	**0.010**
NQF Level 1	-0.060*	0.008	-0.057*	0.008	-0.056*	0.008	-0.052*	0.008	**-0.061***	**0.008**
NQF Level 2	-0.093*	0.013	-0.090*	0.013	-0.088*	0.013	-0.087*	0.013	**-0.097***	**0.013**
NQF Level 4	0.063*	0.011	0.060*	0.011	0.059*	0.011	0.060*	0.011	**0.075***	**0.011**
NVQ Level 5	0.187*	0.045	0.184*	0.045	0.183*	0.044	0.183*	0.044	**0.195***	**0.045**
Other Degree	0.240*	0.026	0.237*	0.026	0.236*	0.026	0.229*	0.027	**0.255***	**0.027**
Other Postgraduate	0.234*	0.035	0.237*	0.035	0.234*	0.035	0.241*	0.035	**0.284***	**0.035**
Year x Bachelors										
1997	0.171*	0.018	0.163*	0.018	0.164*	0.018	0.158*	0.018	**0.209***	**0.017**
2005	0.154*	0.017	0.148*	0.017	0.151*	0.017	0.140*	0.017	**0.186***	**0.016**
2013	0.127*	0.017	0.123*	0.017	0.125*	0.017	0.124*	0.017	**0.166***	**0.016**
Year x PGCE										
1997	0.184*	0.043	0.177*	0.044	0.180*	0.043	0.180*	0.044	**0.233***	**0.043**
2005	0.127*	0.039	0.122*	0.039	0.126*	0.039	0.114*	0.039	**0.166***	**0.039**
2013	0.119*	0.039	0.118*	0.039	0.121*	0.039	0.124*	0.039	**0.173***	**0.039**
Year x Masters										
1997	0.226*	0.034	0.221*	0.034	0.224*	0.033	0.219*	0.034	**0.275***	**0.034**
2005	0.229*	0.026	0.225*	0.026	0.229*	0.026	0.215*	0.026	**0.259***	**0.025**
2013	0.169*	0.031	0.170*	0.031	0.173*	0.031	0.171*	0.032	**0.215***	**0.031**
Year x Doctorate										
1997	0.221*	0.052	0.227*	0.052	0.247*	0.052	0.235*	0.053	**0.310***	**0.052**
2005	0.244*	0.050	0.252*	0.050	0.269*	0.049	0.251*	0.051	**0.309***	**0.050**
2013	0.301*	0.046	0.313*	0.046	0.330*	0.046	0.310*	0.046	**0.369***	**0.046**
Occupation group dummies	Yes		Yes		Yes		Yes		**Yes**	
Region dummies	Yes		Yes		Yes		Yes		**Yes**	
_cons	1.299*	0.057	0.909*	0.130	-1.258	0.706	1.452*	0.143	**2.190***	**0.049**
Observations	18384		18384		18384		18384		**18384**	
Adjusted R-squared	0.531		0.531		0.532		0.523		**0.520**	

* Significant at 1% level

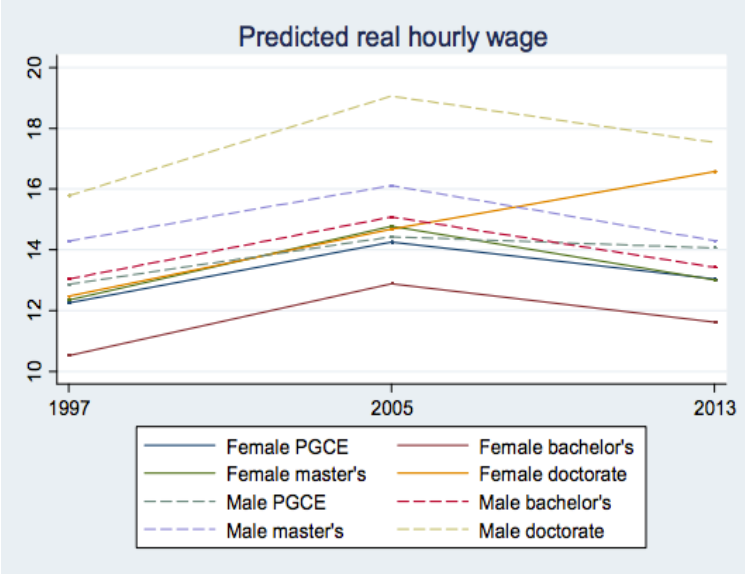
(11) **OLS Results. Dependent Variable: logged real wage (*lnrwage*)**

	(6)	Robust se(6)
Sex	0.089	0.098
Sex x ln(age)		
Male	0.047*	0.018
Female	-0.040	0.016
Time w/ employer dummies	Yes	
Public sector dummies	Yes	
Ethnicity dummies	Yes	
Year dummies	Yes	
Sex x Noqual		
Male	-0.176*	0.016
Female	-0.143*	0.014
Sex x NQF1		
Male	-0.050*	0.011
Female	-0.051*	0.011
Sex x NQF2		
Male	-0.114*	0.022
Female	-0.072*	0.017
Sex x NQF4		
Male	0.079*	0.016
Female	0.085*	0.015
Sex x NVQ5		
Male	0.155	0.063
Female	0.250*	0.062
Sex x Otherpg		
Male	0.249*	0.060
Female	0.307*	0.042
Sex x Otherdeg		
Male	0.237*	0.037
Female	0.288*	0.038
Sex x Year x Bachelors		
Male 1997	0.219*	0.023
Male 2005	0.178*	0.023
Male 2013	0.164*	0.024
Female 1997	0.213*	0.026
Female 2005	0.201*	0.022
Female 2013	0.174*	0.022
Sex x Year x PGCE		
Male 1997	0.147	0.063
Male 2005	0.075	0.067
Male 2013	0.112	0.087
Female 1997	0.272*	0.055
Female 2005	0.210*	0.047
Female 2013	0.192*	0.042
Sex x Year x Masters		
Male 1997	0.270*	0.041
Male 2005	0.231*	0.035
Male 2013	0.198*	0.042
Female 1997	0.310*	0.060
Female 2005	0.309*	0.035
Female 2013	0.243*	0.046
Sex x Year x Doctorate		
Male 1997	0.310*	0.058
Male 2005	0.345*	0.064
Male 2013	0.353*	0.062
Female 1997	0.370*	0.075
Female 2005	0.256*	0.076
Female 2013	0.402*	0.066
Occupation group dummies	Yes	
Region dummies	Yes	
_cons	2.042*	0.072
Observations	18384	
Adjusted R-squared	0.525	

(12)


Kernel density estimate
Density
0
.5
1
1.5
-2
-1
0
1
2
Residuals
Kernel density estimate
Normal density
kernel = epanechnikov, bandwidth = 0.0393

(13)


Predicted real hourly wage
10
12
14
16
18
20
1997
2005
2013
Female PGCE
Female master's
Male PGCE
Male master's
Female bachelor's
Female doctorate
Male bachelor's
Male doctorate