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The urban wage growth premium: evidence from British cities.

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Abstract:

We use data from British Cities to examine the extent of the urban wage growth premium. We demonstrate the existence of a premium for wage levels, but not for wage growth. City living does have some impact on wage growth, however. Specifically, we show that workers who have at some point lived in a city experience faster wage growth than those who have never lived in a city.

¹ We are grateful to participants at the London School of Economics, Queen Mary University and the 2012 annual meeting of the Urban Economics Association for their comments. This work contains statistical data from ONS which is Crown copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates. Copyright of the statistical results may not be assigned, and publishers of this data must have or obtain a licence from HMSO. The ONS data in these results are covered by the terms of the standard HMSO "click-use" licence.

1. Introduction

The urban economics literature provides ample evidence on the existence of an urban wage premium: wages are higher in large urban areas, by between 1% and 11% depending on the sample considered. See, for example, Glaeser and Maré (2001), Yankow (2006), Combes, Duranton and Gobillon (2008), Di Addario and Patacchini (2008), Mion and Naticchioni (2009), Melo and Graham (2009), Fu and Ross (2009) and Carlsen et al (2012). Rosenthal and Strange (2004) and Puga (2010) provide a review. Despite this research, the field has still not reached a consensus on three central issues. First, the extent to which sorting of high ability workers into urban areas can explain observed wage premiums. Second, which of the different agglomeration economies might generate this wage premium. Third, whether workers receive this wage premium immediately, or through faster wage growth over time (which in turn may tell us something about the sources of agglomeration economies). This paper is concerned with all three of these questions.

To consider these issues we use individual level data for a large panel of British workers for the period 1998 to 2008. We begin by documenting the existence of an urban wage premium for Britain which persists when we control for both observed and unobserved time invariant characteristics of workers (using the panel dimension of our data). We also provide evidence of an urban premium on wage growth, but show that this is driven purely by the increase in wage that occurs in the year that a worker moves from a rural to an urban area. When we exclude move years, we find no evidence of an urban premium for wage growth. If, as Glaeser and Maré (2001) argue, an urban wage *growth* premium is evidence of faster human capital accumulation in cities, then for Britain either this mechanism is not at work or faster accumulation is for some reason *not* reflected in wage growth. Wheeler (2006) suggests that human capital accumulation as an explanation of an urban wage growth premium might be particularly important for younger workers. Again, in the British context we find little evidence to support this hypothesis. When we restrict our sample to male workers who were ‘young’ (between 16 and 21) at the beginning of our time period we continue to find no strong evidence of an urban wage growth premium, other than that coming from the one-time effect of moving across locations of different sizes.

We next turn to the issue of whether living in an urban area affects the extent to which wage growth occurs on the job (‘within jobs’) or as a result of moving jobs (‘between jobs’). It is possible that the absence of an effect overall might hide opposing effects on these two different components (which some have argued might be useful in distinguishing between

learning and matching explanations of the urban wage premium). Once again, however, when we control for unobserved characteristics of workers we find no evidence that working in a larger urban area has an effect on either of these two components of wage growth. Again, this contrasts with some of the existing literature for the US, although in this instance the problem appears to be more one of the interpretation of available estimates.

Finally, we consider whether past city ‘experience’ (i.e. having worked in a city at some point) affects longer-term wage growth. In order to do this, we change our comparison group to those rural workers with no prior experience in cities. We find that in comparison, all workers – those currently working in cities as well as rural workers with past experience in cities – enjoy a wage growth premium.

The rest of this paper is structured as follows. The next section reviews related literature. Section 3 outlines our data and provides basic summary statistics. Section 4 provides evidence on the urban wage premium in the UK, while section 5 considers wage growth. Section 6 then turns to the issue of between versus within job moves, while section 7 considers the long term effects of urban work experience. Section 8 concludes.

2. Existing literature

A number of explanations have been offered for the existence of an urban wage premium. According to the productivity hypothesis, market size may facilitate sharing, learning or matching (Duranton and Puga, 2004), increasing productivity in larger locations. Alternatively, according to the selection hypothesis, the direction of causality may be reversed: workers move to productive areas (for reasons that are nothing to do with size) so that productivity increases density (and not vice-versa). Once we allow for heterogeneous workers, it may be that higher ability workers self-select into larger locations driving a link between size and wages, assuming that higher ability workers are better paid (Combes, Duranton and Gobillon, 2008).

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This paper explores the dynamic aspects of the productivity and the selection hypotheses. If wages are higher in larger cities because of better learning (Glaeser, 1999) or better matching (Zenou, 2009), this implies that not only wage levels but also wage growth may be higher in larger locations.

Wheeler (2006) estimates the impact of density on annual wage growth and on the within-job and the between-job components of annual wage growth. A positive effect of city size on within-job wage growth is evidence in favour of better learning in larger labour markets, whereas a positive effect of city size on between-job wage growth is evidence of better matching opportunities in larger labour markets. However if more productive individuals select into larger labour markets, as indicated in Combes, Duranton and Gobillon (2008) and in De la Roca (2011), and these individuals have inherently faster wage growth than average, then this would explain the higher wage growth in larger cities. In order to evaluate the role of selection, we include worker fixed effects as in Wheeler (2006) and Yankow (2006). If selection or spatial sorting explains all the relationship between city size and wage growth, then once we include worker fixed effects the effect of city size on wage growth should disappear.

Using a sample of young male workers in the US, and without controlling for selection using worker fixed effects, Wheeler (2006) finds that wage growth is positively associated with labour market size, and that this is due to job changes rather than growth experienced within jobs. However, once fixed effects are introduced, he finds no significant effect of labour market size either through job changes or within jobs.

Also using a rather young sample of US workers from the NLSY, and controlling for worker heterogeneity, Yankow (2006) finds that workers moving into cities experience a wage growth in the first year after the move that is 6 percentage points higher than workers remaining in non-urban areas. He also finds a symmetric effect for out of city migrants, such that these experience a wage growth that is 6 percentage points lower than those staying in non-urban areas.

An additional complexity arises from the selection hypothesis. As highlighted by Combes, Duranton and Gobillon (2011), worker fixed effects estimation is done on the subsample of movers, who differ in their characteristics from non-movers. In particular they may have higher skill levels than non-movers and may be more likely to gain from moving. We can therefore worry that the estimates obtained from that non-representative sample will be different from the true effects on the whole population.

For example Peri (2002) shows how in a model based on learning externalities young educated workers move to dense urban areas and mature workers move out, resulting in the overrepresentation of young educated workers in urban areas. On the empirical side, the

escalator region literature based on data from the UK has provided descriptive evidence of such migration patterns and the characteristics of workers moving into “escalators”. This literature focuses on social or occupational classes rather than earnings, and uses data at a large spatial scale (broad regions of the UK) rather than cities. More importantly, it does not make use of panel data by including fixed effects. Fielding (1989, 1992) uses two years of Census records from the Longitudinal Study to create tabulations of in and out migration flows between South East England and the rest of England and Wales. Focusing on social change, he finds that the South East attracted a disproportionate share of young and qualified workers and that it was a region of upward social mobility for some of those it attracted - an “escalator region” - while some in-migrants became part of the South East’s “underclass”. He also identifies a pattern of out-migration of middle-aged professionals and managers. There have been refinements to this literature² notably by tracking individuals over time (Champion 2004). Champion (2004) comes to the conclusion that most individuals who leave the escalator region have stayed there for little time.

As hinted above, the selection hypothesis also has dynamic implications. First, the fact that larger labour markets are composed of more productive individuals implies that they experience faster wage growth (what we call the “pure” growth effect). Second, the differing composition of labour markets depending on their size itself implies that more productive individuals move geographically from smaller to larger labour markets (what we call the mobility effect). Looking at wage levels, Glaeser and Maré (2001) find that the urban wage premium is due in part to wages rising faster in urban areas and in part to workers’ wages jumping up when they move to an urban area. They build on the literature stemming from Topel and Ward (1992) that established that job changes drive the wage growth of young workers and ask whether geographical mobility plays a similar role. We analyse further the role of geographical mobility of workers and ask to what extent it explains the higher wage growth in larger labour markets, as opposed to the “pure” growth effect.

3. Data³

Our analysis is based on the Annual Survey of Hours and Earnings (ASHE) and its predecessor the New Earnings Survey (NES) and covers 1998-2008. ASHE/NES is constructed by the Office of National Statistics (ONS) based on a 1% sample of employees on

² See *Manchester Independent Economic Review*, Understanding labour markets, skills and talent (2009) for a review.

³ The basic description of the NES/ASHE data is taken from Gibbons, Overman and Pelkonen (2010).

the Inland Revenue Pay As You Earn (PAYE) register for February and April.⁴ ASHE provides information on individuals including their home and work postcodes, while the NES provides similar data but only reports work postcodes. The sample is of employees whose National Insurance numbers end with two specific digits (these have been the same since 1975), meaning ASHE/NES provides an individual level panel, in which workers are observed for multiple years (up to 12 years in our sample). The sample is replenished as workers leave the PAYE system (e.g. to self-employment) and new workers enter it (e.g. from school).

We allocate workers to locations according to their work postcode allowing us to use the whole sample. The National Statistics Postcode Directory (NSPD) provides a mapping from every postcode to higher-level geographic units. We assign individuals to Travel to Work Areas (TTWA) using each individual's work postcode. Given the way TTWA are constructed (so that 80% of the resident population also work within the same area) the work TTWA will also be the home TTWA for the majority of workers. We define cities as TTWAs with more than 100,000 workers in 1999. Sometimes, we further distinguish between small cities, big cities and the London TTWA. We define small cities as TTWAs with 100,000 to 250,000 inhabitants in 1999 and big cities as TTWAs with 250,000 to 1 million inhabitants.

NES/ASHE include information on occupation, industry, whether the job is private or public sector, the workers' age and gender and detailed information on earnings including basic pay, overtime pay, basic and overtime hours worked. We use basic hourly earnings as our measure of wages. NES/ASHE do not provide data on education but information on occupation works as a fairly good proxy for our purposes.⁵ NES/ASHE provide national sample weights but as we are focused on sub-national (TTWA) data we do not use them in the results we report below.

In some regressions, we include measures of two TTWA characteristics as additional controls. We define industrial diversity as the inverse of the Herfindahl index of industry shares of total employment in a TTWA. Data on aggregate employment and the industrial structure of a TTWA comes from the Business Structure Database (BSD). We define TTWA skill share as

⁴ We drop data for Northern Ireland because LFS data on skilled labour shares by TTWA is not available.

⁵ We used the LFS to check the median of years of education for each occupation category and we obtained similar results using the median years of education for an individual's occupation to our preferred proxy of occupation dummies.

the proportion of the TTWA labour force that has a level of education equal to or higher than NVQ level 4 using data from the Labour Force Survey (LFS).

We follow the existing literature and use a sample of male workers, in order to avoid concerns about the labour force participation and mobility of female workers. 118,420 workers are observed, on average, over 8.37 years. Our main outcome of interest is annual wage growth, defined so that wage growth in year t is the growth experienced between $t-1$ and t . Since workers can leave and re-enter the NES/ASHE sample, there are many gaps of more than one year in the data. We calculate annual wage growth when we have wage data for consecutive years, which leave us with 519,889 observations of annual wage growth. 41% of the workers move across TTWAs at least once in the period (we refer to these workers as ‘movers’).

Table 1 provides statistics on key explanatory variables for non-movers (i.e. those who never move), movers (i.e. those who move at least once) and the overall sample. In terms of age, the largest number of observations are for workers over 45 (41% of observations overall), while observations for young workers under the age of 24 represent only 7% of our data. 6% of observations are for part-time work, 21% for a public sector job and 56% for a job subject to a collective agreement. In terms of mobility, movers are slightly oversampled (43% of observations are for the 41% of individuals who move at some point during the study period). Overall, 9% of the wage growth observations are for a period when a worker moved across TTWAs. On average, 76% of the observations are for workers working in a city in year t . Of these, the largest category consists of observations for individuals working in small cities, representing 34% of the overall sample. The final three rows provide summary statistics for various measures of wage growth defined and discussed in more detail below. Average wage growth is 7.09% per annum, wage growth coming from within-job growth is lower, at 6.53% per annum, while wage growth coming from job changes is on average 9.19% per annum.⁶

Movers differ mainly in terms of their age and their wage growth. Movers are on average younger and less experienced than non-movers. They also have higher wage levels (basic

⁶ Unfortunately neither Yankow (2006) nor Wheeler (2006) provide comparable wage growth statistics for their samples. United States Bureau of Labour Statistics data report 3% per annum for the decade 1998-2008. As discussed in the text, our sample shows figures for the UK that are almost twice as high over the same period. Some of this difference may be real, some may reflect the fact that our wage growth figures are inflated because they reflect the growth for workers in continuous employment (assuming unemployed workers are more likely to experience lower wage growth).

hourly earnings are £12.53 compared to £11.75 for non-movers) and higher rates of wage growth (7.7% compared to 6.64%).

Table 1: Summary statistics (for non-movers, movers and overall sample)

	Overall	Non-movers	Movers
Age (years)	41.51	42.67	39.96
16-24 years	7%	7%	8%
25-34 years	23%	20%	27%
35-44 years	29%	27%	31%
45+ years	41%	45%	35%
Occupation class 1	18%	17%	21%
Occupation class 2	13%	12%	13%
Occupation class 3	13%	12%	14%
Occupation class 4	8%	8%	9%
Occupation class 5	14%	16%	12%
Occupation class 6	4%	4%	3%
Occupation class 7	5%	4%	6%
Occupation class 8	13%	15%	11%
Occupation class 9	12%	12%	11%
Part Time	6%	6%	5%
Public Sector	21%	21%	20%
Collective Agreement	56%	57%	55%
Basic Hourly Earnings	12.08	11.75	12.53
Move at least once	43%		
Change jobs	21%	13%	31%
Work in city	76%	77%	74%
Work in small city	34%	32%	36%
Work in big city	28%	29%	27%
Work in London	14%	16%	11%
Rural with past city experience	5%		11%
Rural with past small city experience	3%		7%
Rural with past big city experience	2%		5%
Rural with past London experience	1%		1%
In-city moves	1%	0%	3%
Out-of-city moves	1%	0%	3%
TTWA diversity	40.27	40.28	40.26
TTWA high skill share	26%	26%	26%
Wage growth	7.09	6.64	7.70
Within wage growth	6.53	6.36	6.82
Between wage growth	9.19	8.44	9.62

Notes: Authors own calculations based on ASHE/NES and LFS data using 519,889 observations for 118,420 workers. One-digit occupation classes as defined in the Standard Occupation Classification of the Census. Wage growth variables described in section 5. Other variables as described in the text.

4. The urban wage premium

In this section we estimate the size of the urban wage premium for British cities. That is, we consider the effect of working in a city on wage levels. We have panel data on wages w_{it} for individual i at time t . To estimate the average urban wage premium we start by running the following regression for individual wages:

$$w_{it} = x'_{it}\beta + d_{it}\gamma + \lambda_t + \varepsilon_{it} \quad (1)$$

where x_{it} is a vector of individual and job-specific variables measuring gender, age and other characteristics, d_{it} is a dummy variable that takes value 1 if the individual works in a city at time t , λ_t are a set of time dummies and ε_{it} is the error. β is a vector of coefficients that capture the “returns” to different individual characteristics, while γ is the coefficient which captures the urban wage premium. We define cities as TTWAs with more than 100,000 inhabitants in 1999. All other TTWAs are considered rural.

Regression (1) correctly estimates the urban wage premium allowing for the sorting of workers with different characteristics across areas, providing that we have data on all individual characteristics that affect wages.⁸ In the absence of very rich data on individuals it is always possible that sorting occurs based on some unobserved characteristic of individuals and that the urban dummy captures the effect of this sorting rather than the effect of working in a city. To address this problem we follow Glaeser and Maré (2001) and use the panel dimension of our data by including fixed effects for each individual i and estimating:

$$w_{it} = \alpha_i + x'_{it}\beta + d_{it}\gamma + \lambda_t + \varepsilon_{it} \quad (2)$$

where α_i is the fixed effect for worker i and everything else is as before. Note that we cannot rule out the possibility that something unobserved changed for the individual that both affected their wage and their place of work. In the absence of random allocation (or something that as good as randomly assigns people) tracking individuals and observing the change in wages experienced when they move between areas is the best we can do to identify the urban wage premium.

Once we have this estimate of the urban wage premium controlling, as far as possible, for individual-level characteristics, we may be interested to see whether these effects persist once

⁸ More precisely we need data on all individual characteristics that affect wage and that are correlated with the city dummy.

we control for specific characteristics of larger cities that might explain this wage premium. To do this, we supplement our regression by including variables that capture characteristics of cities that might affect wages and estimate:

$$w_{it} = \alpha_i + x'_{it}\beta + d_{it}\gamma + c_{it}\varphi + \lambda_t + \varepsilon_{it} \quad (3)$$

where c_{it} are the characteristics of cities that might affect wages and everything else is as before. We include the industrial diversity of the city, *TTWA diversity*, defined as the inverse of the Herfindahl index of industry shares and *TTWA skill share*, the share of labour force with skills at least equivalent to NVQ level 4. These two measures seek to capture the two sources of agglomeration economies (other than the sheer size of the city) most frequently discussed in the literature. TTWA diversity reflects urbanisation economies, whereby workers are more productive in locations with a wide mix of industries. The TTWA skill share reflects the importance of the skills of the workforce in cities.⁹

Results reported in column 1 of Table 2 show that, in the absence of any individual controls, the city premium is quite large at 14.1%. Introducing worker and job characteristics (age, experience, part-time status, collective agreement, public sector job as well as occupation and industry dummies) reduces the city wage premium to 8.4%. Results are reported in column 2. Results in column 3, control for the possibility of sorting across locations on the basis of unobservable worker characteristics by introducing worker fixed effects. Controlling for the sorting of workers further reduces the city wage premium to 2.3%. Finally, we control for two city characteristics, diversity and skill share, that may influence wages, which again reduces the city wage premium to 1.9%.

⁹ See Moretti (2004) for a survey of the role of skills in economic performance in cities.

Table 2: Urban wage premium

	(1) OLS	(2) OLS	(3) FE	(4) FE
City	0.141*** (0.003)	0.084*** (0.002)	0.023*** (0.002)	0.019*** (0.003)
Age		0.032*** (0.000)	0.028*** (0.002)	0.028*** (0.002)
Age ²		-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Part time		-0.093*** (0.004)	-0.023*** (0.004)	-0.023*** (0.004)
Collective agreement		-0.002 (0.002)	0.005*** (0.001)	0.005*** (0.001)
Public sector		0.054*** (0.004)	0.034*** (0.005)	0.034*** (0.005)
TTWA diversity				0.001*** (0.000)
TTWA high skill share				0.099*** (0.011)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	No	Yes	Yes	Yes
Industry dummies	No	Yes	Yes	Yes
Worker fixed effects	No	No	Yes	Yes
N	519,889	519,889	519,889	519,889
R ²	0.051	0.569	0.498	0.499
Number of workers			118,420	118,420

Note: Robust standard errors in parentheses. Standard errors are clustered by worker.
 ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is log annual basic hourly earnings.

Given that the results in table 2 suggest that an urban wage premium persists even after controlling for individual and job characteristics it is of interest to know whether the effects differ according to labour market size. The theories we rely on relate to the role of large and dense agglomerations rather than small settlements, and predict that the agglomeration effects should be strongest in the largest cities. In line with Glaeser and Maré (2001), Yankow (2006), Gould (2007) and Baum-Snow and Pavan (2012), we therefore focus on estimating the effects of working in cities of different sizes rather than the effect of size or density. Details of the city size distribution are provided in the appendix, while in Table 3 we report results when we replicate the previous analysis, separating cities into the three size categories described in section 3.

Table 3: Urban wage premium by city size category

	(1)	(2)	(3)	(4)
	OLS	OLS	FE	FE
Small city	0.083*** (0.004)	0.048*** (0.002)	0.014*** (0.003)	0.011*** (0.003)
Big city	0.106*** (0.004)	0.062*** (0.003)	0.025*** (0.003)	0.020*** (0.003)
London	0.355*** (0.005)	0.235*** (0.003)	0.071*** (0.004)	0.066*** (0.004)
Age		0.032*** (0.000)	0.028*** (0.002)	0.028*** (0.002)
Age ²		-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Part time		-0.095*** (0.004)	-0.023*** (0.004)	-0.023*** (0.004)
Collective agreement		0.001 (0.002)	0.005*** (0.001)	0.005*** (0.001)
Public sector		0.052*** (0.004)	0.034*** (0.005)	0.034*** (0.005)
TTWA diversity				0.001*** (0.000)
TTWA high skill share				0.057*** (0.010)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies		Yes	Yes	Yes
Industry dummies		Yes	Yes	Yes
Worker fixed effects			Yes	Yes
N	519,889	519,889	519,889	519,889
R ²	0.080	0.582	0.500	0.500
Number of workers			118,420	118,420

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is log annual basic hourly earnings.

Results in column 1 (from a specification including only year dummies) show that working in London is associated with a 35.5% higher wage than working in a rural area. The comparable figures are 10.6% for big cities and 8.3% for small cities. The city size premium drops considerably as we introduce explanatory variables. The London premium drops to 23.5% once we control for individual and job characteristics (column 2), and then to 7.1% once we control for unobservable time-invariant worker characteristics (column 3). Including city characteristics makes little difference, with the estimated London premium falling slightly to 6.6%. The ranking of the wage premium (largest in London, smaller in big cities, smallest in small cities) is unchanged across specifications. Finally, the reduction in the estimated

premium for big and small cities changes in the same way as that of London as we move across specifications.¹⁰

Our results are comparable to the urban wage premia estimated in Glaeser and Maré (2001) and in Yankow (2006) from U.S. data. With worker fixed effects, Glaeser and Maré (2001) find a premium of 2.6% in non-dense metropolitan areas and 4.5% in dense metropolitan areas using the PSID, and 7% in non-dense metropolitan areas and 10.9% in dense metropolitan areas using the NLSY. Yankow (2006) finds a wage premium of 5% in large cities and 4% in small cities.

5. The urban wage *growth* premium

We turn now from the issue of an urban premium for wage levels to the question of whether such a premium is also observed for the growth of individual wages. We estimate the following equation for wage growth:

$$wg_{it} = \alpha_i + x'_{it}\beta + d_{it}\gamma + c_{it}\varphi + \lambda_t + \varepsilon_{it} \quad (4)$$

where wg_{it} is the percentage change in basic hourly wages between $t-1$ and t and all other variables are as before. Results in column 1, of Table 4 (from a specification including only year dummies) show that working in London in year t is associated with wage growth between $t-1$ and t that is 1.4 percentage points greater than that experienced by workers living in rural areas. Working in a big city is associated with 0.44 percentage point higher growth, while working in a small city is associated with a 0.35 percentage point higher growth rate. Column 2 reports results when we introduce worker and job characteristics. The London wage growth premium drops to 0.6 percentage points, that of big cities to 0.1 and that of small cities to 0.12 percentage points. Column 4 allows for individual fixed effects to control for the sorting of individuals on the basis of unobserved characteristics. This substantially increases the estimated urban growth premium and effect that is only slightly attenuated when we introduce other city characteristics: Once we control for location characteristics (column 5), the wage growth premium of London is 1.9%, that of large cities is 0.45% and that of small cities 0.42%.

¹⁰ Results available on request show that this pattern for small, big cities and London are consistent with those where the city dummies are replaced by the size of the city and its square (the estimated coefficients predict that the wage premium is maximised at a TTWA size of 3.7m, 400,000 above the size of the London TTWA).

Taken at face value, this suggests that wages grow *much* faster in cities (with a particularly strong effect in London). However, the analysis of the effect of city size on individual wage growth is complicated by the coexistence of three effects that we refer to as the “pure” growth effect, the mobility effect, and the sorting effect. A pure growth effect occurs if wage growth is faster when working in an urban labour market. A mobility effect occurs if wage growth is faster in the year when a worker moves to a larger labour market. As with wage levels, a sorting effect occurs if higher ability individuals who experience higher wage growth tend to sort into larger labour markets. These three effects were recognised by Wheeler (2006) in his study for a US sample of young workers. Note that regressing individual wage growth on individual characteristics and the size of the labour market where they work at the end of the period confounds the pure and the mobility effects. As a result, the existence of an urban wage premium for wage levels should automatically generate a mobility effect when workers move from rural to urban unless some other factor works in the opposite direction (e.g. negative shocks to wages lead to rural urban moves).

In order to identify the pure effect of urban location on wage growth, one option is to follow Wheeler (2006) and drop movers from our sample. We prefer an alternative approach which drops observations corresponding to the years when workers move across locations. This approach maximises the number of observations used to estimate the effects and allows us to better exploit the panel nature of our data when including individual fixed effects. If instead we focus only on non-movers, then with fixed effects it is impossible to estimate the effects of city size dummies and the identification of the effects of time-varying location characteristics comes only from time variation in those characteristics. By including movers, but dropping the years when workers move, identification of the effects of location characteristics comes from both time series and cross-section variation for movers, and it is possible to estimate the effects of city size dummies from the movers.

Dropping observations for move years leaves us with a sample of both movers and non-movers, but we only use wage growth for years when workers remained in the same labour market. The number of observations drops by 9% from 520,000 to 473,000. OLS results for London and small cities, reported in column 3, are similar to those obtained in column 2 with the full sample including the move years. But once we both drop move years and include individual fixed effects we no longer detect any effect of city size on wage growth, as can be seen in column 6. In Britain, the higher wage growth rates observed in cities appear to be

driven by the sorting of higher ability individuals experiencing ‘one-off’ higher wage growth in the year when they move into larger labour markets.¹¹

These results help explain the very large jump in coefficients that we see when we move between columns 2 and 4 (i.e. introduce fixed effects for samples including observations for all years). With individual fixed effects, the identification of the coefficients on the city dummies in the fixed effects specifications comes only from movers and so observations from move years represent a high proportion of observations used to identify the city size effects. When there is a significant urban wage premium for levels this biases estimated urban wage growth premiums upwards. In short, including fixed effects *and* dropping move years is necessary to isolate the pure growth effect from effects of mobility and sorting. In Britain, at least for the entire sample of workers, we find no evidence of a pure growth effect once we make both these corrections.

¹¹ One worry might be that industry and occupation variables should be considered *city* rather than *individual* characteristics. However, replicating the fixed effects results in column 6 omitting these variables leaves results essentially unchanged.

Table 4: Urban wage growth premium by city size category

	(1)	(2)	(3) OLS – no move year	(4) FE	(5) FE	(6) FE - no move year
	OLS	OLS				
Small city	0.352*** (0.052)	0.120** (0.050)	0.124** (0.052)	0.536*** (0.185)	0.416** (0.188)	0.179 (0.208)
Big city	0.402*** (0.054)	0.097* (0.052)	0.085 (0.057)	0.650*** (0.199)	0.455** (0.207)	0.045 (0.226)
London	1.378*** (0.071)	0.615*** (0.068)	0.452*** (0.073)	2.117*** (0.270)	1.892*** (0.275)	0.287 (0.298)
Age		-0.640*** (0.009)	-0.585*** (0.009)	-0.572*** (0.098)	-0.573*** (0.098)	-0.567*** (0.110)
Age ²		0.009*** (0.000)	0.008*** (0.000)	0.012*** (0.000)	0.012*** (0.000)	0.011*** (0.000)
Part time		1.003*** (0.133)	1.411*** (0.135)	3.056*** (0.282)	3.058*** (0.282)	4.434*** (0.292)
Collective agreement		-0.146*** (0.045)	-0.040 (0.045)	-0.026 (0.079)	-0.026 (0.079)	0.067 (0.079)
Public sector		0.012 (0.072)	-0.037 (0.071)	0.764*** (0.295)	0.774*** (0.296)	0.458 (0.289)
TTWA diversity			-0.002 (0.003)		0.021*** (0.008)	0.012 (0.008)
TTWA high skill share			1.197*** (0.341)		2.333*** (0.835)	1.079 (0.838)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Occupation dummies	No	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	Yes	Yes	Yes	Yes	Yes
Worker fixed effects	No	No	No	Yes	Yes	Yes
N	519,889	519,889	473,088	519,889	519,889	473,088
R ²	0.004	0.032	0.031	0.012	0.012	0.012
Number of workers				118,420	118,420	114,836

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual growth in basic hourly earnings.

As usual, one concern in introducing fixed effects is that movers may differ systematically from non-movers. As discussed above, descriptive statistics in Table 1 suggest that differences are mostly small. However, movers are on average younger and less experienced than non-movers. In addition, some studies, including Wheeler (2006) have focused on younger workers suggesting that urban wage premiums may be particularly pronounced for the young. For both reasons, it is interesting to repeat our analysis focussing only on younger workers and it is to this issue that we now turn.

We restrict the sample to male workers who were aged between 16 and 21 in 1998, the first year of our dataset.¹² Over the study period, these individuals provide us with 52,000 wage growth observations for workers aged between 16 and 32 (the mean age is 25 years old). As we would expect, given that movers are on average younger, the proportion of movers is slightly higher than that in the full sample, at 49%. The annual wage growth is much higher (11.25% vs. 6.95%).

Results in Table 5 replicate those in Table 4 using the sample of young workers. Consistent with the fact that annual wage growth is much higher for young workers, the OLS coefficients are consistently larger for this restricted sample. Once again, when we include fixed effects and remove the move years the effects of big cities and of London are insignificant. However small cities have a positive and significant effect on young workers' wage growth: they increase wage growth by 1.84 percentage points. So for younger workers, even after controlling for worker observable and unobservable characteristics, there seems to be a pure effect on wage growth of working in small cities compared to rural areas but no significant effect of working in larger cities.

¹² Wheeler (2006) uses a cohort panel which follows workers who were between 14 and 21 as of 31 December 1978, from 1978 until 1994.

Table 5: Urban wage growth premium by city size for a sample of younger workers

	(1)	(2)	(3)	(4)	(5) FE - no move year
	OLS	OLS	FE	FE	
Small city	0.998*** (0.216)	0.635*** (0.209)	1.690** (0.727)	1.221* (0.741)	1.840** (0.904)
Big city	0.796*** (0.222)	0.463** (0.216)	1.847** (0.762)	1.128 (0.794)	1.415 (0.965)
London	2.692*** (0.266)	1.898*** (0.262)	4.720*** (0.984)	3.926*** (1.015)	1.673 (1.155)
Age		-1.871*** (0.151)	-1.675** (0.656)	-1.645** (0.659)	-2.066*** (0.676)
Age ²		0.055*** (0.008)	0.088*** (0.012)	0.088*** (0.012)	0.098*** (0.012)
Part time		-2.134*** (0.341)	-2.449*** (0.690)	-2.420*** (0.690)	-0.193 (0.734)
Collective agreement		-0.457*** (0.177)	-0.089 (0.303)	-0.089 (0.303)	-0.111 (0.310)
Public sector		0.047 (0.391)	1.978* (1.174)	2.065* (1.176)	1.557 (1.156)
TTWA diversity				0.078** (0.035)	0.044 (0.036)
TTWA high skill share				7.220** (3.439)	5.787* (3.484)
Year dummies	Yes	Yes	Yes	Yes	Yes
Occupation dummies	No	Yes	Yes	Yes	Yes
Industry dummies	No	Yes	Yes	Yes	Yes
Worker fixed effects	No	No	Yes	Yes	Yes
N	51,789	51,789	51,789	51,789	45,496
R ²	0.016	0.044	0.035	0.035	0.035
Number of workers			17,037	17,037	16,043

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual growth in basic hourly earnings. Workers included in the sample were aged between 16 and 21 in 1998.

6. Between versus within job wage growth

Given that we observe workers in multiple time periods, we can distinguish two types of wage growth – within-job wage growth (when the worker stays in the same job) and between-job wage growth (when the workers changes jobs).

The size of a labour market can have an effect on both types of wage growth. Wheeler (2006) argues that better learning in cities is more likely to be reflected in higher within-job wage growth, while better matching of workers and jobs, is more likely to be reflected in between-

job wage growth. Even if one is not fully convinced by these assertions, the question of the impact on these different types of wage growth is still empirically interesting. In particular, in our context, it is interesting to consider whether our finding of no urban wage growth premium disguises offsetting effects on within-job and between-job wage growth. We investigate this possibility by estimating the same models as in the previous section, replacing annual wage growth with measures for the two different types of wage growth.

In our data we are not able to assign each worker to a particular employer identifier. We therefore define a job change if the work postcode changes from one year to the next. Because postcodes in the UK are very small, often corresponding to a single building, this should provide a good indicator of a job change. Since we only observe data annually, we face two further potential measurement issues. First, our within-job wage growth measure may miss some growth that occurs after the last time we observe the worker in a particular job but before they move to a new job. This would only affect our results, however, if wage growth differs towards the end of a job in different ways depending on area characteristics. This seems unlikely, although we cannot rule out this possibility. Second, our between-job wage growth includes the cumulative effect of all job changes in any given year. Again, it is not obvious that this creates any particular problems for us (other than the fact that it prevents us from studying the frequency of job changes).

We report results from separate regressions of within-job wage growth and between-job wage growth in Table 6. All specifications include worker fixed effects and drop observations corresponding to years when a worker moves across locations. For comparison, column 1 replicates the results for overall wage growth taken from column 6 in Table 4. Columns 2 and 3 then report the specifications using within-job wage growth and between-job wage growth as the dependent variable, respectively. We find no evidence of an urban premium for either within-job or between-job wage growth. Results available on request show a positive effect of London on between-job growth if we include move years but, as for overall wage growth, it is the increase in wages when moving to London that drives this effect. Once there, the results in column 3 show that between-job wage growth is no higher than it would have been in other areas.¹³

¹³ Note that identification in column 3 relies on the sub-sample of people who move between jobs multiple times (and more times than they move between the different sizes of cities during our study period).

Table 6: Urban within and between-job wage growth premium by city size category

	(1) Overall wage growth FE - no move year	(2) Within	(3) Between no move year
Small city	0.179 (0.208)	0.192 (0.218)	-1.707 (1.570)
Big city	0.045 (0.226)	0.001 (0.235)	-2.671 (1.646)
London	0.287 (0.298)	-0.131 (0.309)	-0.256 (1.896)
Age	-0.567*** (0.110)	-0.460*** (0.132)	-1.249 (0.772)
Age ²	0.011*** (0.000)	0.009*** (0.000)	0.020*** (0.003)
Part time	4.434*** (0.292)	5.696*** (0.316)	0.038 (1.310)
Collective agreement	0.067 (0.079)	0.029 (0.080)	0.128 (0.484)
Public sector	0.458 (0.289)	-0.323 (0.293)	2.360 (1.559)
TTWA diversity	0.012 (0.008)	0.013 (0.008)	0.005 (0.040)
TTWA high skill share	1.079 (0.838)	0.952 (0.868)	0.591 (5.379)
Year dummies	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes
N	473,088	411,215	61,873
R ²	0.012	0.013	0.018
Number of workers	114,836	109,619	41,518

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variables are percentage annual growth, percentage within-job annual growth and percentage between-job annual growth in basic hourly earnings.

In short, when we include worker fixed effects and consider only the years without geographical moves, we find no evidence in favour of a "pure" effect of city size on either type of wage growth. This contradicts the results of Wheeler (2006) of positive effects of density on wage growth, particularly through between-job wage growth. That said, Wheeler's results of positive effects of density on wage growth, like ours, are not robust to the inclusion of worker fixed effects. As with overall wage growth, the absence of an effect once fixed effects are included suggests that the OLS results are due to the spatial sorting of more productive workers into larger markets, rather than the effects of larger markets *per se*.

Again, it is possible that these effects might be larger for younger workers who are more likely to switch jobs in the early years of their careers and to benefit from those job switches more than older workers (Topel and Ward, 1992; Chan and Stevens, 2004). When we focus on the subset of younger workers and remove the move years, as we did in Section 5, we find that as for the sample as a whole, cities provide no advantage in terms of within-job wage growth (even for younger workers). In contrast we find some evidence that big cities have a positive effect on between job wage growth. The significance of the coefficient is low and the effect is not evident for either small cities or London.

7. The long term effects of city experience

The analysis so far shows that wage growth does increase with city size, but that this effect of city size is a short term one driven by wage increases in move years. There is no evidence that this growth premium persists beyond the first year and no evidence that results for overall wage growth hide offsetting effects on within and between-job wage growth. In this section we consider one final channel through which city living may affect longer term wage growth by considering whether city ‘experience’ (i.e. having worked in a city at some point) affects wage growth.

From our results so far we know that working in a city brings no wage growth premium compared to working in a rural area but this does not rule out the possibility that city experience has an impact in the future. We cannot examine this possibility by looking at workers currently living in cities, but we can consider it by checking to see if rural workers with previous urban work experience have faster wage growth than rural workers with no previous urban work experience.

To do this we introduce an *Evercity* indicator which takes value one if a worker works in a rural area at time t and has at least one year of past work experience in a city. In Table 7 we report results from wage growth regressions including the *Evercity* variable and the *City* indicator (for workers *currently* working in a city), so that the omitted category is workers who have always worked in a rural area. The *Evercity* dummy therefore indicates the effect of past urban experience on the wage growth of rural workers compared to having always

worked in a rural area, while the *City* dummy indicates the effect of currently working in a city compared to having always worked in a rural area.¹⁴

The OLS without fixed effects results in column 1 indicate that past urban experience has a significant effect, increasing the wage growth of rural workers by 0.56%. We again explore the possibility that the effect identified in column 1 is due to worker heterogeneity as well as moves from cities to rural areas between $t-1$ and t , i.e. to a short-term effect of mobility out of cities. We include worker fixed effects and remove the move years (column 2). There is still a significant effect of 1% additional wage growth, which means that in the longer term there is a wage growth premium for rural workers who have had past urban work experience, when the comparison group is those having never had any city experience. In addition, we now find that compared to those having never had any city experience, current urban workers experience a wage growth premium of 0.8%. So when we consider this comparison group, there is an urban wage premium for all workers.

In fact, column 2 also provides some evidence of a hierarchy in wage growth: compared to rural workers with no city experience, those currently working in a city enjoy a wage growth premium (0.8%) which is lower than that of currently rural workers with some past urban experience (1%) (although these coefficients are not significantly different). This is consistent with the idea that in Great Britain “successful” urban workers relocate to rural areas. It also explains why using all rural workers as a comparison group, as we did in Section 5 in accordance with the rest of the urban wage premium literature, underestimates the urban wage growth premium.

¹⁴ The *Evercity* dummy is equal to 1 for those with two consecutive years in the same rural area at time t (in the specification without move years) with any city experience before $t-1$. But given that we have included fixed effects the *Evercity* effect is identified over those who have the above trajectory and have moved from a rural location to a city at some point before.

Table 7: Long-run effect of city experience

	(1)	(2)
	OLS	FE – no move year
Evercity	0.556*** (0.105)	1.013*** (0.322)
City	0.307*** (0.046)	0.788*** (0.284)
Age	-0.641*** (0.009)	-0.569*** (0.110)
Age ²	0.009*** (0.000)	0.011*** (0.000)
Part time	1.011*** (0.133)	4.435*** (0.292)
Collective agreement	-0.155*** (0.045)	0.069 (0.079)
Public sector	0.017 (0.072)	0.455 (0.289)
TTWA diversity		0.010 (0.008)
TTWA high skill share		1.147 (0.829)
Year dummies	Yes	Yes
Occupation dummies	Yes	Yes
Industry dummies	Yes	Yes
Worker fixed effects	No	Yes
N	519,889	473,088
R ²	0.032	0.012
Number of workers		114,836

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual wage growth.

We now break down the past city experience of rural workers into three categories: London experience indicated by the variable *Everlondon* and experience in big and small cities indicated by *Everbigcity* and *Eversmallcity*, respectively. These categories are not distinct as rural workers can have past experience in more than one type of city however the correlation between these indicators is very low. We also include separate dummies for workers currently working in small cities, big cities and London. Again the omitted category consists of rural workers with no prior urban experience.

Table 8: Long-run effect of city experience by city size category

	(1)	(2)
	OLS	FE – no move year
Eversmallcity	0.480*** (0.130)	1.026*** (0.358)
Everbigcity	0.667*** (0.158)	0.660* (0.398)
Everlondon	-0.230 (0.300)	0.171 (0.642)
Small city	0.228*** (0.051)	0.786*** (0.287)
Big city	0.208*** (0.053)	0.619** (0.299)
London	0.729*** (0.069)	0.830** (0.356)
Age	-0.641*** (0.009)	-0.569*** (0.110)
Age ²	0.009*** (0.000)	0.011*** (0.000)
Part time	1.004*** (0.133)	4.434*** (0.292)
Collective agreement	-0.147*** (0.045)	0.068 (0.079)
Public sector	0.011 (0.072)	0.454 (0.289)
TTWA diversity		0.011 (0.008)
TTWA skill share		1.058 (0.838)
Year dummies	Yes	Yes
Occupation dummies	Yes	Yes
Industry dummies	Yes	Yes
Worker fixed effects	No	Yes
N	519,889	473,088
R ²	0.032	0.012
Number of workers		114,836

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual wage growth.

Results in Table 8 indicate that, in comparison with having never had any city experience, current and past experience in a small city brings about the highest wage growth premium: rural workers with past experience in a small city enjoy a 1% premium, while those currently working in small cities enjoy a 0.8% premium. When we turn to big cities, we find that the wage growth premium is also significant but smaller: 0.7% for rural workers with some past experience in a big city, and 0.6% for those currently working in a big city. For London there

is a wage growth premium of 0.8% from currently working in London, but we do not find any effect of past experience in London.

Table 9: Long-run effect of city experience on within and between-job wage growth

	(1) Overall wage growth FE - no move year	(2) Within	(3) Between – no move year
Evercity	1.013*** (0.322)	0.904*** (0.339)	3.045 (2.152)
City	0.788*** (0.284)	0.674** (0.297)	-0.006 (1.973)
TTWA diversity	0.010 (0.008)	0.011 (0.008)	-0.002 (0.039)
TTWA high skill share	1.147 (0.829)	0.791 (0.857)	1.670 (5.342)
Age	-0.569*** (0.110)	-0.462*** (0.132)	-1.241 (0.767)
Age ²	0.011*** (0.000)	0.009*** (0.000)	0.020*** (0.003)
Part time	4.435*** (0.292)	5.695*** (0.316)	0.044 (1.309)
Collective agreement	0.069 (0.079)	0.029 (0.080)	0.135 (0.484)
Public sector	0.455 (0.289)	-0.329 (0.293)	2.370 (1.560)
Year dummies	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes
N	473,088	411,215	61,873
R ²	0.012	0.013	0.018
Number of workers	114,836	109,619	41,518

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variables are percentage annual growth, percentage within-job annual growth and percentage between-job annual growth in basic hourly earnings.

We now turn to the effect of past city experience on the separate within-job and between-job components of wage growth. The first column of Table 9 replicates the second column of Table 7, where for currently rural workers the overall effect of past city experience on wage growth for the years when workers do not move across locations is a 1% higher wage growth. This effect comes through higher wage growth within jobs, as can be seen by the coefficient in column 2 indicating that wage growth within jobs is 0.9% higher for rural workers with past city experience than for rural workers with no past city experience. We find no

significant effect on between-job wage growth (column 3). We interpret these results as showing that, after controlling for time-invariant unobserved ability, rural workers with past urban experience have acquired skills and capabilities that enable them to achieve higher wage growth on the job once they relocate to rural areas.

8. Conclusion

Using micro-level data on British workers, we show the existence of an urban wage premium which is increasing in city size and which persists after controlling for unobservable worker characteristics such as ability. We find an urban premium on wage growth, defined by contrasting workers currently working in cities to those working in rural areas. However this premium disappears when we exclude the years when workers move, meaning that in our data we cannot identify any wage growth premium from remaining in a city (as opposed to remaining in a rural location): the wage growth premium we identify is entirely attributable to the years when workers relocate from smaller to larger locations. However this does not mean that city experience has no effect. When compared to rural workers who have never had any urban experience, we find an urban wage premium for all workers who have either current or past urban experience. In particular, rural workers with past urban experience enjoy higher annual wage growth within jobs. We view this as evidence in favour of the learning in cities hypothesis, as workers with past urban experience carry their acquired skills with them after relocating to rural areas.

We have addressed three main issues in the urban wage premium literature: the role of sorting of high ability individuals into larger locations; which of the major agglomeration economies might explain this premium; and whether workers receive a wage growth premium immediately upon moving to a city or if there are long-lasting effects. We find that sorting of high ability workers into cities does play a role, but that there is also evidence of the role of learning in cities when we compare workers with no urban experience to all others with urban experience. Finally, there are both immediate effects of working in a city on wage growth and long-lasting effects, which can be seen when we compare the wage growth of workers with current and past urban experience to that of rural workers with no urban experience. This tells us that comparing currently urban to currently rural workers, as has been done widely in the literature on the urban wage premium is misleading and underestimates the urban wage premium.

References

Office for National Statistics, *Annual Survey of Hours and Earnings, 1997-2011: Secure Data Service Access* [computer file]. 3rd Edition. Colchester, Essex: UK Data Archive [distributor], June 2012. SN: 6689 , <http://dx.doi.org/10.5255/UKDA-SN-6689-2>

Baum-Snow, N. and R. Pavan (2012), Understanding the city size wage gap, *Review of Economic Studies* 79, 88–127.

Carlsen, F., Rattsø, J and H. Stokke (2012), Urban wage premium and the role of education: Identification of agglomeration effects for Norway, working paper.

Champion, T. (2004), Testing the return migration element of the ‘escalator region’ model: an analysis of migration into and out of South East England, 1966-2001, *LS 2001 Census Launch Conference*, London School of Hygiene and Tropical Medicine.

Chan, S. and A. Stevens (2004), How Does Job Loss Affect the Timing of Retirement?, *The B.E. Journal of Economic Analysis & Policy* 0(1), pages 5.

Combes, P.-P., Duranton, G. and L. Gobillon (2008), Spatial wage disparities: Sorting matters!, *Journal of Urban Economics* 63, 723–742.

De la Roca, J. (2011), Selection in initial and return migration: Evidence from moves across Spanish cities, IMDEA working paper.

De la Roca, J. and D. Puga (2012), Learning by working in big cities, CEPR discussion paper No. 9243.

Di Addario, S. and E. Patacchini, Wages and the City. Evidence from Italy, *Labour Economics* 15, 1040–1061.

Duranton, G. and D. Puga (2004), Micro-foundations of urban agglomeration economies, in J. V. Henderson and J. F. Thisse (ed.), *Handbook of Urban and Regional Economics* (Vol 4) p.2063-2117 Elsevier.

Fielding, A. (1989), Inter-Regional Migration and Social Change: A Study of South East England Based upon Data from the Longitudinal Study, *Transactions of the Institute of British Geographers, New Series*, 14(1), 24-36.

Fielding, A. (1992), Migration and Social Mobility: South East England as an Escalator Region, *Regional Studies* 26(1), 1-15.

Fu, S. and S. Ross (2010), Wage Premia in Employment Clusters: Agglomeration or Worker Heterogeneity?, Working Papers 10-04, Center for Economic Studies, U.S. Census Bureau.

Gibbons, S., Overman, H. and P. Pelkonen (2010), Wage disparities in Britain: People or place?, SERC/LSE discussion paper 0060.

Glaeser, E. (1999), Learning in Cities, *Journal of Urban Economics* 46(2), 254-277.

Glaeser, E. and D. Maré (2001), Cities and Skills, *Journal of Labor Economics* 19(2), 316-342.

Gould, E. (2007), Cities, Workers, and Wages: A Structural Analysis of the Urban Wage Premium, *Review of Economic Studies* 74(2), 477-506.

Manchester Independent Economic Review (2009) 'The Case for Agglomeration Economies', *Manchester Independent Economic Review (MIER)*.

Melo P. and D. Graham (2010), Agglomeration Economies and Labour Productivity: Evidence from Longitudinal Worker Data for GB's Travel-to- Work Areas., SERC/LSE Discussion Paper 31.

Mion, G. and P. Naticchioni (2009), The spatial sorting and matching of skills and firms, *Canadian Journal of Economics* 42(1), 28-55.

Moretti, E. (2004), Human capital externalities in cities, J. V. Henderson and J. F. Thisse (ed.), *Handbook of Urban and Regional Economics* (Vol 4), 2243-2291, Elsevier.

Peri, G. (2002), Young workers, learning, and agglomerations, *Journal of Urban Economics* 52, 582-607.

Puga, D. (2010), The magnitude and causes of agglomeration economies, *Journal of Regional Science* 50(1), 203-219.

Rosenthal, S. and W. Strange (2004), Evidence on the Nature and Sources of Agglomeration Economies, J. V. Henderson and J. F. Thisse (ed.), *Handbook of Urban and Regional Economics* (Vol 4), 2119-2171, Elsevier.

Topel, R. and M. Ward (1992), Job Mobility and the Careers of Young Men, *The Quarterly Journal of Economics* 107(2), 439-479.

Wheeler, C. (2006), Cities and the growth of wages among young workers: Evidence from the NLSY, *Journal of Urban Economics* 60, 162-184.

Yankow, J. (2006), Why do cities pay more? An empirical examination of some competing theories of the urban wage premium, *Journal of Urban Economics* 60, 139-161.

Zenou, Y. (2009), Search in cities, *European Economic Review* 53(6), 607-624.

Appendix

Appendix A1. Additional summary statistics and information on cities and occupations in our dataset

Table A1 provides additional descriptive statistics.

Table A1. Distribution of the data by category of the variables

	16- 24	25-34 years	35-44 years	45+ years	Occ class 2	Occ class 3	Occ class 4	Occ class 5	Occ class 6	Occ class 7	Occ class 8	Occ class 9
1999	0.07	0.26	0.28	0.38	0.11	0.09	0.09	0.16	0.07	0.05	0.15	0.08
2000	0.07	0.25	0.29	0.39	0.12	0.09	0.1	0.16	0.07	0.05	0.15	0.08
2001	0.07	0.24	0.3	0.4	0.12	0.09	0.1	0.16	0.07	0.05	0.14	0.07
2002	0.07	0.24	0.29	0.4	0.14	0.13	0.08	0.15	0.02	0.04	0.13	0.12
2003	0.07	0.23	0.3	0.41	0.14	0.14	0.08	0.15	0.02	0.04	0.13	0.12
2004	0.07	0.22	0.29	0.41	0.13	0.14	0.08	0.14	0.02	0.04	0.13	0.13
2005	0.08	0.22	0.29	0.41	0.13	0.15	0.08	0.14	0.03	0.05	0.12	0.13
2006	0.08	0.21	0.29	0.42	0.13	0.15	0.08	0.13	0.02	0.05	0.12	0.14
2007	0.08	0.22	0.28	0.42	0.13	0.15	0.08	0.12	0.02	0.06	0.11	0.14
2008	0.08	0.21	0.28	0.43	0.13	0.15	0.08	0.12	0.03	0.06	0.1	0.14
Overall	0.07	0.23	0.29	0.41	0.13	0.13	0.08	0.14	0.04	0.05	0.13	0.12

	Part time	Public sector	Coll. ag.	Ever move	TTWA change	City	Small city	Big city	London
1999	0.04	0.2	0.62	0.4	0.09	0.76	0.33	0.28	0.14
2000	0.04	0.21	0.62	0.41	0.09	0.75	0.34	0.28	0.13
2001	0.04	0.2	0.61	0.41	0.1	0.75	0.34	0.28	0.13
2002	0.05	0.19	0.6	0.42	0.09	0.75	0.34	0.28	0.14
2003	0.05	0.2	0.6	0.43	0.1	0.76	0.34	0.28	0.14
2004	0.06	0.21	0.6	0.43	0.09	0.76	0.34	0.28	0.14
2005	0.07	0.21	0.5	0.44	0.09	0.75	0.34	0.28	0.14
2006	0.08	0.21	0.51	0.44	0.09	0.76	0.34	0.28	0.13
2007	0.08	0.21	0.47	0.46	0.09	0.76	0.34	0.28	0.15
2008	0.09	0.21	0.48	0.45	0.08	0.76	0.33	0.28	0.15
Overall	0.06	0.21	0.56	0.43	0.09	0.76	0.34	0.28	0.14

	Evercity	Eversmallcity	Everbigcity	Everlondon
1999	0.01	0.01	0.00	0.00
2000	0.02	0.01	0.01	0.00
2001	0.03	0.02	0.01	0.00
2002	0.04	0.02	0.02	0.00
2003	0.05	0.03	0.02	0.01
2004	0.06	0.03	0.02	0.01
2005	0.06	0.04	0.03	0.01
2006	0.07	0.04	0.03	0.01
2007	0.07	0.04	0.03	0.01
2008	0.08	0.05	0.03	0.01
Overall	0.05	0.03	0.02	0.01

Table A2 provides a list of the urban TTWAs present in our dataset (with more than 100,000 workers). Our original data consists of 297 TTWAs, with average size of 91,000 workers.

Table A2. Lists of cities and their size by city size category

Small Cities	Size	Small cities (cont)	Size
Peterborough	102561	Brighton	187955
Warwick	104683	Wigan & St Helens	200208
Dundee	106552	Oxford	204280
Pontypridd & Aberdare	107454	Hull	204796
Poole	107856	Sunderland & Durham	210868
York	108396	Stoke	213546
Tunbridge Wells	108538	Middlesbrough & Stockton	217919
Chichester	110929	Dudley and Sandwell	220975
Huddersfield	113680	Cardiff	221505
Barnsley	115306	Crawley	222566
Crewe	121324	Guildford & Aldershot	235027
Swindon	123106	Wolverhampton & Walsall	235785
Ipswich	129300	Bradford	240386
Harlow	132063	Portsmouth	241156
Swansea	132343	Wirral and Chester	242895
Exeter	133857	Reading	248302
Milton Keynes	134828	Coventry	249331
Bolton	135505		
Mansfield	137628	Big cities	
Northampton	139636	Southampton & Winchester	278893
Blackburn	143660	Leicester	283809
Doncaster	145846	Maidstone & North Kent	310276
Luton	146119	Southend	317158
Cambridge	146490	Leeds	336464
Motherwell and Lanark	147605	Nottingham	349397
Blackpool	149035	Bristol	353477
Wakefield	153724	Sheffield & Rotherham	363643
Warrington	154424	Edinburgh	399116
Plymouth	159050	Liverpool	443340
Bournemouth	160063	Tyneside	488481
Stevenage	161270	Slough & Woking	641708
Derby	163753	Glasgow	648197
Colchester	164193	Birmingham	808982
Preston	166868	Manchester	976796
Aberdeen	167386		
Norwich	180881	London	
Aylesbury & Wycombe	181544	London	3462107

Table A3 lists the job categories represented by the one-digit SOC classification.

Table A3. One-digit SOC classification:

Code	Description
1	Managers and Senior Officials
2	Professional Occupations
3	Professional and Technical Occupations
4	Administrative and Secretarial Occupations
5	Skilled Trades Occupations
6	Personal Service Occupations
7	Sales and Customer Service Occupations
8	Process, Plant and Machine Operatives
9	Elementary Occupations

Appendix A2. Gender differences in the urban wage premium

Table A4 provides summary statistics by gender. The composition of the female sample is similar to that of the male sample in terms of age groups, distribution across cities of different sizes and past city experience. However in terms of occupation, they are overrepresented in occupation classes 4 (Administrative and Secretarial Occupations), 6 (Personal Service Occupations) and 7 (Sales and Customer Service Occupations) and underrepresented in classes 1 (Managers and Senior Officials), 5 (Skilled Trades Occupations) and 8 (Process, Plant and Machine Operatives). Females are also six times more likely to work part time than males and more likely to work for the public sector and in a job with a collective agreement. In terms of mobility, the female sample has a smaller proportion of movers (35% as opposed to 43% of observations in the male sample). The mean wages of females are considerably lower (£9.7 per hour as compared to £12.1 per hour for males) however their mean annual wage growth is about the same.

Table A4: Summary statistics by gender

	Males	Females
16-24 years	7%	8%
25-34 years	23%	22%
35-44 years	29%	28%
45+ years	41%	42%
Occupation class 1	18%	10%
Occupation class 2	13%	11%
Occupation class 3	13%	14%
Occupation class 4	8%	30%
Occupation class 5	14%	1%
Occupation class 6	4%	11%
Occupation class 7	5%	11%
Occupation class 8	13%	3%
Occupation class 9	12%	9%
Part time	6%	37%
Public Sector	21%	37%
Collective Agreement	56%	65%
Basic Hourly Earnings	12.08	9.7
Change Jobs	21%	21%
Move at least once	43%	35%
Change TTWA	9%	7%
Work in city	76%	75%
Work in small city	34%	33%
Work in big city	28%	28%
Work in London	14%	13%
Rural with past city experience	5%	4%
Rural with past small city experience	3%	2%
Rural with past big city experience	2%	2%
Rural with past London experience	1%	1%
In-city moves	1%	1%
Out-of-city moves	1%	1%
TTWA diversity	40.27	39.74
TTWA high skill share	0.26	0.26
Wage growth	7.09	7.16
Within wage growth	6.53	6.71
Between wage growth	9.19	8.83
N	519889	476,623

Notes: Authors' own calculations based on ASHE/NES and LFS data using 996,512 observations. One-digit occupation classes as defined in the Standard Occupation Classification of the Census. Wage growth variables described in section 5. Other variables as described in the text.

Table A5 replicates our fixed effects estimation of the urban wage premium shown in columns 4 of Tables 2 and 3. Our results on the urban wage premium for female workers are qualitatively similar to those obtained using the sample of male workers: there is a significant premium of 2.9% to working in cities (column 2) and column 4 confirms that the premium is larger for larger cities. Moreover, the urban wage premium is much larger for female workers than for males (2.9% vs. 1.9%).

Table A5: Urban wage premium by gender

	(1)	(2)	(3)	(4)
	Males	Females	Males	Females
City	0.019*** (0.003)	0.029*** (0.003)		
Small city			0.011*** (0.003)	0.017*** (0.003)
Big city			0.020*** (0.003)	0.028*** (0.003)
London			0.066*** (0.004)	0.089*** (0.004)
Age	0.028*** (0.002)	0.021*** (0.001)	0.028*** (0.002)	0.021*** (0.001)
Age ²	-0.001*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)
Part time	-0.023*** (0.004)	0.002 (0.002)	-0.023*** (0.004)	0.002 (0.002)
Collective agreement	0.005*** (0.001)	0.003*** (0.001)	0.005*** (0.001)	0.002** (0.001)
Public sector	0.034*** (0.005)	0.041*** (0.004)	0.034*** (0.005)	0.042*** (0.004)
TTWA diversity	0.000*** (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
TTWA high skill share	0.099*** (0.010)	0.085*** (0.010)	0.057*** (0.010)	0.036*** (0.010)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	519,889	476,623	519,889	476,623
R ²	0.499	0.528	0.500	0.530
Number of workers	118,420	114,663	118,420	114,663

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is log annual basic hourly earnings.

Table A6 focuses on a younger sample of workers. The gap in urban wage premium between males and females is even more striking for young workers: columns 1 and 2 indicate that the premium for young females, after controlling for occupation, industry and unobserved ability is 3.2%, twice as large as that for young males. While young males seem to benefit exclusively from working in London (column 3), wages of young females are higher in all three categories of cities (column 4).

Table A6: Urban wage premium by gender for a sample of younger workers

	(1)	(2)	(3)	(4)
	Young Males	Young Females	Young Males	Young Females
City	0.015** (0.007)	0.032*** (0.006)		
Small city			0.004 (0.008)	0.019*** (0.007)
Big city			0.009 (0.008)	0.034*** (0.008)
London			0.087*** (0.011)	0.094*** (0.010)
Age	0.038*** (0.007)	0.019*** (0.006)	0.038*** (0.007)	0.019*** (0.006)
Age ²	-0.002*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.001*** (0.000)
Part time	-0.015** (0.007)	-0.036*** (0.004)	-0.016** (0.007)	-0.036*** (0.004)
Collective agreement	0.009*** (0.003)	-0.002 (0.003)	0.008** (0.003)	-0.002 (0.003)
Public sector	0.091*** (0.014)	0.078*** (0.010)	0.093*** (0.014)	0.078*** (0.009)
TTWA diversity	0.001** (0.000)	0.000 (0.000)	0.001*** (0.000)	0.001* (0.000)
TTWA high skill share	0.193*** (0.034)	0.224*** (0.033)	0.097*** (0.034)	0.140*** (0.032)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	51,789	52,092	51,789	52,092
R ²	0.673	0.684	0.675	0.686
Number of workers	17,037	17,450	17,037	17,450

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is log annual basic hourly earnings.

Turning to the wage growth of female workers, Table A7 replicates the last two columns of Table 4 comparing males and females. Again our results are qualitatively similar for females and for males: we find no evidence of an urban wage growth premium for females once we remove the years when workers move.

Table A7: Urban wage growth premium by gender

	Males		Females	
	(1)	(2)	(3)	(4)
	FE	FE - no move year	FE	FE - no move year
Small city	0.416** (0.188)	0.179 (0.208)	0.385* (0.229)	0.034 (0.265)
Big city	0.455** (0.207)	0.045 (0.226)	0.879*** (0.244)	0.400 (0.278)
London	1.892*** (0.275)	0.287 (0.298)	1.961*** (0.320)	-0.128 (0.345)
Age	-0.573*** (0.098)	-0.567*** (0.110)	-0.511*** (0.067)	-0.401*** (0.067)
Age ²	0.012*** (0.000)	0.011*** (0.000)	0.012*** (0.000)	0.010*** (0.000)
Part time	3.058*** (0.282)	4.434*** (0.292)	3.128*** (0.134)	3.510*** (0.137)
Collective agreement	-0.026 (0.079)	0.067 (0.079)	-0.250*** (0.091)	-0.152* (0.092)
Public sector	0.774*** (0.296)	0.458 (0.289)	1.410*** (0.252)	1.101*** (0.254)
TTWA diversity	0.021*** (0.008)	0.012 (0.008)	0.017** (0.008)	0.012 (0.009)
TTWA high skill share	2.333*** (0.835)	1.079 (0.838)	0.424 (0.912)	-0.301 (0.931)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	519,889	473,088	476,623	441,428
R ²	0.012	0.012	0.013	0.013
Number of workers	118,420	114,836	114,663	111,555

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual growth in basic hourly earnings.

In results not reported here, our analysis of within-job and between-job wage growth shows that as for their male counterparts, females workers do not particularly benefit from within-job wage growth or from between-job wage growth in the years when they do not move across locations.

Table A8 replicates the last two columns of Table 5 comparing males and females and shows that again, there is no evidence of a “pure” urban wage growth premium in big cities or in London for the sample of younger females either but that there is a premium in small cities.

Table A8: Urban wage growth premium by gender for a sample of young workers

	Young Males		Young Females	
	FE	FE - no move year	FE	FE - no move year
Small city	1.221* (0.741)	1.840** (0.904)	1.133* (0.679)	1.405* (0.807)
Big city	1.128 (0.794)	1.415 (0.965)	1.351* (0.727)	1.002 (0.830)
London	3.926*** (1.015)	1.673 (1.155)	4.318*** (1.011)	1.184 (1.067)
Age	-1.645** (0.659)	-2.066*** (0.676)	-1.016* (0.612)	-0.761 (0.636)
Age ²	0.088*** (0.012)	0.098*** (0.012)	0.069*** (0.011)	0.061*** (0.012)
Part time	-2.420*** (0.690)	-0.193 (0.734)	-0.650 (0.467)	0.297 (0.491)
Collective agreement	-0.089 (0.303)	-0.111 (0.310)	-0.664** (0.316)	-0.705** (0.326)
Public sector	2.065* (1.176)	1.557 (1.156)	2.237*** (0.866)	1.226 (0.921)
TTWA diversity	0.078** (0.035)	0.044 (0.036)	0.067** (0.033)	0.108*** (0.037)
TTWA high skill share	7.220** (3.439)	5.787* (3.484)	2.558 (3.344)	-1.629 (3.486)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	51,789	45,496	52,092	45,792
R ²	0.035	0.035	0.033	0.028
Number of workers	17,037	16,043	17,450	16,505

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual growth in basic hourly earnings.

Table A9 compares the long-term effects of city experience for females and males, using our fixed effects specification removing the move years. The estimates for Evercity and City are similar between males (column 1) and females (column 3). However comparing columns 2 and 4 reveals that past experience in London, with a highly significant coefficient of 1.77 for females, is crucial for females while it doesn't seem to have the same importance for males.

Table A9: Long-run effect of city experience by gender

	Males		Females	
	(1)	(2)	(3)	(4)
Evercity	1.013*** (0.322)		1.094*** (0.374)	
City	0.788*** (0.284)		0.842** (0.338)	
Eversmallcity		1.026*** (0.358)		0.890** (0.437)
Everbigcity		0.660* (0.398)		0.661 (0.471)
Everlondon		0.171 (0.642)		1.771*** (0.611)
Small city		0.786*** (0.287)		0.705** (0.347)
Big city		0.619** (0.299)		1.064*** (0.364)
London		0.830** (0.356)		0.675 (0.429)
Age	-0.569*** (0.110)	-0.569*** (0.110)	-0.407*** (0.067)	-0.405*** (0.067)
Age ²	0.011*** (0.000)	0.011*** (0.000)	0.010*** (0.000)	0.010*** (0.000)
Part time	4.435*** (0.292)	4.434*** (0.292)	3.509*** (0.137)	3.509*** (0.137)
Collective agreement	0.069 (0.079)	0.068 (0.079)	-0.153* (0.092)	-0.148 (0.092)
Public sector	0.455 (0.289)	0.454 (0.289)	1.102*** (0.254)	1.095*** (0.254)
TTWA diversity	0.010 (0.008)	0.011 (0.008)	0.013 (0.009)	0.011 (0.009)
TTWA high skill share	1.147 (0.829)	1.058 (0.838)	-0.394 (0.918)	-0.271 (0.931)
Year dummies	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	473,088	473,088	441,428	441,428
R ²	0.012	0.012	0.013	0.013
Number of workers	114,836	114,836	111,555	111,555

Note: Robust standard errors in parentheses. Standard errors are clustered by worker. ***, **, * indicate significant at 1%, 5% and 10% level respectively. Dependent variable is percentage annual growth in basic hourly earnings.