



Department  
for Education



# London calling? Higher education, geographical mobility and early-career earnings

Research report

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Jack Britton, Laura van der Erve, Ben Waltmann and Xiaowei Xu

Institute for Fiscal Studies



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## Key findings

### **Higher education is associated with greater geographical mobility.**

- At age 27, around 35% of graduates and 15% of non-graduates have moved away from the travel to work area (TTWA) where they lived at age 16.
- Around two-fifths of the difference in mobility between graduates and non-graduates can be explained by differences in their background characteristics, such as socio-economic status, prior educational attainment and area of origin. All else equal, graduates are 10 percentage points more likely to have moved by age 27 than non-graduates.
- Graduates of more selective universities are more mobile, even controlling for background characteristics and subject choice.

### **Graduates move to places with better labour market opportunities.**

- Graduates tend to move to large cities, especially to London. Around a quarter of graduates who move go to London. In contrast, non-graduates do not disproportionately move to London and other large cities.
- In general, places with high average earnings attract graduates through migration. Graduates who grew up in places with low average earnings are more likely to move away.
- For a given level of average earnings, cities attract and retain more graduates than other areas. In addition to London, Brighton, Bristol and Leeds all gain large numbers of graduates through migration.
- By enabling people to move to labour markets that offer better career opportunities, higher education appears to reduce inequality of opportunity between people who grow up in different areas.

### **Ethnic minorities and those from low socio-economic backgrounds are less likely to move, and the effect of higher education on mobility is much weaker for these groups.**

- People from the bottom socio-economic status (SES) quintile are 16 percentage points less likely to have moved by age 27 than people from the top SES quintile, though most of this difference can be explained by differences in prior attainment and other background characteristics.
- Young adults of Indian and Pakistani ethnicity are around 7 percentage points less likely to have moved by age 27 than White British people, even controlling for differences in background characteristics.

- Higher education appears to have a much smaller impact on mobility for low SES and ethnic minority groups. All else equal, young people from the poorest families are only around 4 percentage points more likely to move if they graduate from university. Black and Asian graduates are no more mobile than Black and Asian non-graduates.
- Of those who do move, low-SES graduates are less likely to move to major cities than graduates from higher-SES backgrounds, even controlling for background characteristics.

### **Graduates gain higher earnings from moving.**

- On average, male graduates who move earn 10% more at age 27 than otherwise similar graduates who do not move. For women, the estimated gain to moving is 4%.
- Estimated 'moving premiums' are very similar across SES and ethnic groups, with the exception of Asian women, for whom movers earn less than stayers.
- There is large variation in moving premiums across subjects. Moving is associated with little or no gain in earnings (controlling for background characteristics) in nursing, education and social care, but very large gains among graduates of law, technology, languages, business and economics – particularly for graduates who move to London.
- This suggests that moving to certain areas might be necessary to take full advantage of the returns to some degrees.

### **Patterns of mobility exacerbate regional inequality in skills.**

- Rates of higher education participation vary hugely across the country. Less than 20% of people born in the late 1980s who grew up in Grimsby and Wisbech went on to get degrees, compared with over 40% of those from Tunbridge Wells and High Wycombe.
- Many cities that gain large numbers of graduates through migration – such as London, Brighton, Leeds and Bristol – already have relatively high levels of higher education participation.
- In contrast, many places with low levels of higher education participation, such as Grimsby and Wisbech, further lose graduates through migration.

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# 1 Introduction

Economic opportunities vary across the country, with London and other cities offering greater prospects for career progression (Gordon, Champion and Coombes, 2015; Social Mobility Commission, 2017). Prospects for social mobility for young people from disadvantaged backgrounds are also higher in some areas than others (Bell, Blundell and Machin, 2019; Carneiro et al., 2020). As such, moving to an area that offers better opportunities can be a way for individuals to move up in life (Papoutsaki et al., 2020).

Previous research has found that graduates are more mobile than non-graduates, and that those who move experience better employment outcomes (Faggian, McCann and Sheppard, 2007; Kidd, O’Leary and Sloane, 2017; Papoutsaki et al., 2020). To the extent that the relationship is causal, higher education could enable people to access opportunities in affluent areas, and thus reduce inequality of opportunity between people who grow up in different areas. However, if some groups – for example, those from low-income backgrounds or certain ethnicities – are less able or willing to move, differences in geographic mobility could exacerbate inequalities. Patterns of mobility could also exacerbate spatial disparities in skills and thus increase regional inequality.

In this report, we study the link between higher education, geographical mobility and outcomes for individuals and regions. First, we examine whether higher education is associated with greater geographical mobility even when we control for confounding factors, such as the fact that graduates tend to be wealthier and have higher educational attainment. We examine how mobility – and the relationship between higher education and mobility – differs across socio-economic and ethnic groups. Second, we consider whether graduates do indeed seem to be ‘moving to opportunity’ by analysing the types of areas graduates move to and from and the earnings gains associated with moving. Third, we consider the effect of mobility patterns on regional inequality.

We make use of a novel administrative dataset that links school records, higher education records and early-career earnings, referred to as the Longitudinal Education Outcomes (LEO) dataset. The LEO data have previously been used to estimate returns to higher education (Belfield et al., 2017, 2018; Britton et al., 2020*a,b*; Britton, Dearden and Waltmann, 2021). Crucially, we add to this a new linkage that includes information on geographical location of people after they leave education. This facilitates this first extensive study of the geographical mobility of graduates in

the UK.

The LEO dataset allows us to expand on previous research in a number of ways. It contains information on prior educational attainment and background characteristics, which allows us to control for a rich set of confounding factors when examining the relationships between higher education and mobility and between mobility and subsequent earnings. The sample size is much larger than previous datasets that have been used to study graduate mobility in the UK, such as the Labour Force Survey or the Destination of Leavers from Higher Education survey. This means that we are able to study moves at a more granular level than previous research – looking at moves across travel to work areas rather than government office regions – and investigate how effects differ across demographic groups, subjects and universities.

We find that higher education is associated with greater mobility, even controlling for differences in background characteristics between graduates and non-graduates. Graduates who move tend to move to London and other affluent cities, away from more deprived areas. Those who move experience large gains in earnings relative to otherwise similar graduates who stay in their area of origin. This suggests that higher education does indeed allow individuals to move to opportunity.

However, effects vary substantially across groups. Those from lower socio-economic backgrounds and ethnic minorities are less likely to move overall, and the effect of higher education on mobility is much weaker for these groups. Low-income graduates who do move are less likely to move to big cities, and many ethnic minority graduates move away from London. As result, while graduate mobility appears to reduce inequality of opportunity between individuals who grow up in different areas, it may exacerbate inequalities between socio-economic and ethnic groups.

Finally, the patterns of mobility we observe have profound implications for spatial inequality. Cities such as London, Bristol and Brighton, which already have high rates of higher education participation, further gain graduates through migration. In contrast, graduates leave places such as Grimsby and Wisbech, where higher education participation is already low. Moving patterns concentrate skills in affluent cities and result in a brain drain from the North and coastal areas, exacerbating regional inequalities.

The report is set out as follows. Section 2 describes the data and measures we use. Section 3 discusses patterns of mobility and how these vary by graduate status, background characteristics,

subject and university. Section 4 looks at where graduates move to and from, and estimates their earnings gains from moving. Section 5 considers the implications for regional inequality. Section 6 concludes.

## 2 Data

### 2.1 Overview

We use a set of linked administrative datasets which include:

- school records from the National Pupil Database (NPD);
- university records from the Higher Education Statistics Agency (HESA);
- earnings records from Her Majesty’s Revenue and Customs (HMRC);
- home address records from the Department for Work and Pensions (DWP).

These data are linked for all students who attended school in England and took their GCSE (age 16) exams from 2002 onwards.<sup>1</sup> The latest HMRC and DWP data we currently have access to are from the 2016/17 tax year, hence our oldest cohort – those who took their GCSEs in 2002 – will be approximately 30 in the last year of our data.<sup>2</sup> In order to focus on as late an age as possible while having sufficient sample sizes for robust analysis, we pool the four oldest cohorts (GCSE cohorts 2002–05) and focus on mobility at age 27, which is the oldest age at which we observe all four of these cohorts in our data.<sup>3</sup>

We discuss our main background and prior attainment measures, as well as the newly linked DWP address records, below. More detail on each of the NPD, HESA and HMRC datasets is

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<sup>1</sup>The NPD is hard-linked to HESA through a unique individual identifier. It is linked to HMRC records based on a fuzzy match on name, postcode and date of birth. Match rates to HMRC are typically around 95%, although they are lower for women and for some ethnic minority groups.

<sup>2</sup>Individuals in this cohort are mostly born between 1 September 1985 and 31 August 1986. Students could be born outside this period if they skipped or resat a year, but this is uncommon.

<sup>3</sup>As shown in Britton et al. (2020b), lifetime earnings profiles vary considerably between graduates and non-graduates, and between graduates of different groups, so differences in early-career returns to degrees do not fully reflect differences in lifetime returns. It is possible that the differential patterns of mobility and attendant differences in earnings that we identify in this report may also not fully reflect lifetime differences. However, the evidence we present in Section 3 suggests that, if anything, differences in mobility between groups grow with age. The gains from moving we find in Section 4 are similarly likely to understate the lifetime gains, as other work has shown that those who work in cities early in their careers acquire more valuable work experience (Roca and Puga, 2017) and experience higher wage growth later in life (D’Costa and Overman, 2014).

provided in our previous reports (Belfield et al., 2018; Britton et al., 2020b).

## **2.2 Prior attainment measures and other background characteristics**

The school records contain rich information on the student's test scores at ages 11, 16 and 18, as well as other background characteristics. We make use of these data to control for relevant differences between groups. Specifically, we separately control for age 11 (Key Stage 2) test scores in English, maths and science; age 16 (Key Stage 4) scores in English, maths and overall; and age 18 (Key Stage 5) scores for vocational subjects and overall.<sup>4</sup> To adjust for variation in background characteristics, we control for socio-economic background, ethnicity, free school meals and special needs status, English as an additional language, and – for university graduates – whether they entered university after age 18.

Unfortunately, we do not observe parental income directly, so we need to infer socio-economic status (SES) based on free school meals status and local area deprivation measures. Following previous research in this area (e.g. Chowdry et al., 2013) and our own previous work with the LEO data (e.g. Belfield et al., 2018), we generate a continuous SES index based on these measures using principal components analysis. We then divide this continuous index into quintiles that range from most deprived to least deprived.<sup>5</sup>

Our measure of the ethnicity of students is taken from the NPD. We use the information from the school census at age 16 and group students into 10 broad ethnic groups: White British, White Other, Black African, Black Caribbean, Black Other, Bangladeshi, Chinese, Indian, Pakistani and Other.

## **2.3 Location data**

The school census included in the NPD provides us with the lower layer super output area (LSOA) of residence at age 16 for each student. Unfortunately, the school census information is only available for students in state schools, which means that we are not able to include the approximately

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<sup>4</sup>To handle cases where no test scores are observed from age 11 or age 18 exams, we set the score to zero; in each case, we add an indicator variable to account for the effect of a missing score. Individuals with missing age 16 scores are dropped from the sample.

<sup>5</sup>We drop the control for free school meals in all cases where we report the effects of SES quintile in order to retain an intuitive interpretation of these effects.



7% of students who attended private secondary schools in any of our analysis.

To obtain individuals' place of residence in adulthood, we make use of the address records from the DWP Customer Information Spine (CIS). Individuals are added to the DWP CIS when a child benefit claim is made for them, at which point their family address is also recorded in the database. If their parents did not claim child benefit, an individual is instead added to the CIS when their National Insurance number is generated at age 15. This address is then updated throughout an individual's life as they claim benefits or start work. Addresses recorded by employers on their HR systems are fed through to the DWP, which then updates the recorded address on the CIS. One concern is that young adults who move around frequently might keep their parents' address for all formal work- and tax-related correspondence, even if they live independently. In this case, the DWP CIS will record their parents' address and mismeasure their residence. The next section discusses this issue in more detail, quantifying the likely extent of mismeasurement and what this implies for our analysis.

Live regional data were added to the DWP CIS in October 2012, when the dataset was populated with individuals' known address at that point in time as well as the start date of that address. After October 2012, all changes in address were recorded and retained in the dataset. This means that we will only have an address for an individual prior to 2012 if they still lived at that address in October 2012. As our data run until the 2016/17 tax year, we therefore have five years of complete address records. If an individual moved during a tax year, we only observe the address at which the individual was registered for most of the tax year.

While we know where individuals live at age 16 and in adulthood at the LSOA level, this unit of analysis is too small for robust analysis. As we are primarily interested in individuals' career prospects, we aggregate up the more than 30,000 LSOAs to around 150 travel to work areas (TTWAs). TTWAs are defined by the Office for National Statistics (ONS) using census data to approximate self-contained local labour markets, such that at least 75% of people living in an area also work in the area, and that also at least 75% of those who work in the area live in the area. As a result, these areas vary in size across the country, being larger in places where people commute further to work.

## 2.4 Misrecording of post-graduation locations

As mentioned above, one potential downside of the location data from the DWP CIS is that some young adults may not update their records to reflect their actual address – for example, because they prefer to receive work- and tax-related correspondence at their parents’ address. It is impossible to know precisely how accurate the DWP CIS information is, as no perfect data source exists that can reveal where young people actually live. In this section, we attempt to get a rough sense of the scale of potential misrecording by comparing our administrative measures with information from the Family Resources Survey (FRS) on the share of people living with their parents.<sup>6</sup>

The key measure that we look at is the share of people living with their parents in each *year after leaving full-time education*.<sup>7</sup> While we cannot observe directly whether people live with their parents in our administrative data, we can observe whether their recorded address is in the same LSOA as when they were 16. As LSOAs are very small and people move much less frequently in middle age than when they are younger, the share of people in the administrative data whose addresses are in the same LSOA as at age 16 is likely to be a good approximation to the share of those whose address is recorded as their parents’ home.

Using a simple model, we then estimate what share of people must be retaining their age 16 address in the DWP data based on the discrepancies in the shares of people who appear to be living with their parents according to the two data sources.<sup>8</sup> Our findings suggest that around 30% of young adults who have moved out of their parental home may not update their address to reflect this. This implies that the DWP address data used in this report would underestimate the true number of movers by around 30%. Other features of the data such as moving rates across regions and trends in moving rates across ages suggest that this is likely to be an upper bound for the true scale of misrecording in the DWP location data. In the rest of the report, we proceed as if there was no misrecording, because any adjustment would need to rely on strong assumptions about which individuals misrecord their address (for example, by assuming that misrecording is random). However, we highlight the potential effects of misrecording on our findings in the text throughout and present alternative versions of a selected set of figures in Appendix A3, where we

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<sup>6</sup>It may be possible to improve on this in future work using confidential census data.

<sup>7</sup>Note that this is different from the rest of the report, where we report results by age.

<sup>8</sup>Details of our model and estimation procedures are given in Appendix A2.

make a simple adjustment based on the estimated misrecording rates to give the reader a sense of the potential scale of the problem.

### 3 Who moves?

We start by describing who moves, using a simple measure of mobility: whether a person lives in a different area as a young adult from when they were in their final year of compulsory secondary school. We first investigate how this measure of mobility varies by graduate status, socioeconomic background and ethnicity. Focusing on graduates, we then consider how mobility varies by the university they attended and the subject they studied.<sup>9</sup>

#### 3.1 Differences in mobility by background characteristics

Previous research has highlighted the fact that graduates are much more geographically mobile than non-graduates, especially at the start of their careers (Faggian, McCann and Sheppard, 2007; Bosquet and Overman, 2019; Papoutsaki et al., 2020). We start by confirming this result for our dataset in Figure 1. The figure plots the share of people living in a different travel to work area from when they were 16 by age, gender and graduate status. We see that the share living outside their area of origin increases over time for all groups, but much more so for graduates.<sup>10</sup>

For both men and women, only 20% of non-graduates live in a different TTWA at age 30 from where they lived at age 16, while roughly 40% of graduates do. There are almost no discernible differences by gender. As shown in Figure A2 in Appendix A1, the same patterns also hold when only looking at moves to London, with graduates much more likely to move to London than non-graduates, and few differences between men and women.<sup>11</sup>

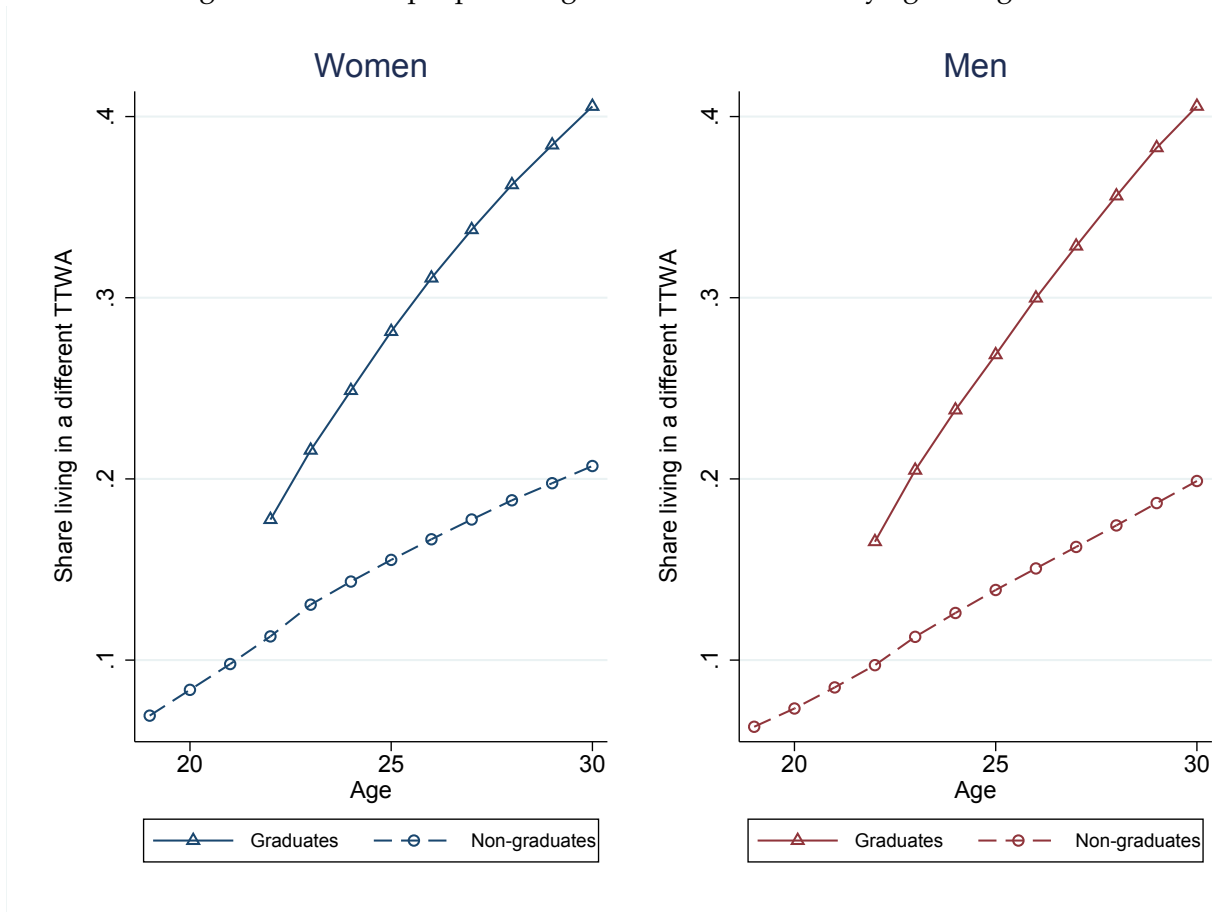
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<sup>9</sup>We generally consider individuals ‘graduates’ if they have obtained a standard undergraduate degree by the beginning of the tax year, and all others ‘non-graduates’. We exclude from the analysis those for which we observe a postgraduate degree but not an undergraduate degree (but retain those for whom we observe an integrated Master’s degree, which we count as an undergraduate degree). We also exclude individuals that we observe to be in full time education at any time during the respective tax year, and non-graduate part-time students in the tax year in which they graduate. The main rationale behind these sample restrictions is that the status of individuals falling into these categories in a given tax year is either on the border between ‘graduate’ and ‘non-graduate’ or otherwise *sui generis*. One caveat is that our data on higher education only extends to the 2015/16 academic year, so we cannot exclude those in full time education in the 2016/17 tax year.

<sup>10</sup>Figure A15 in Appendix A3 is the equivalent figure adjusting for misrecording using the parameters estimated from our misrecording model. True overall mobility is likely to be somewhat higher than indicated in Figure 1, but the large differences between graduates and non-graduates appear to be roughly unaffected by misrecording.

<sup>11</sup>One small difference emerges between graduate men and women at ages 27–30: graduate women at that age are

Figure 1: Share of people living in a different TTWA by age and gender



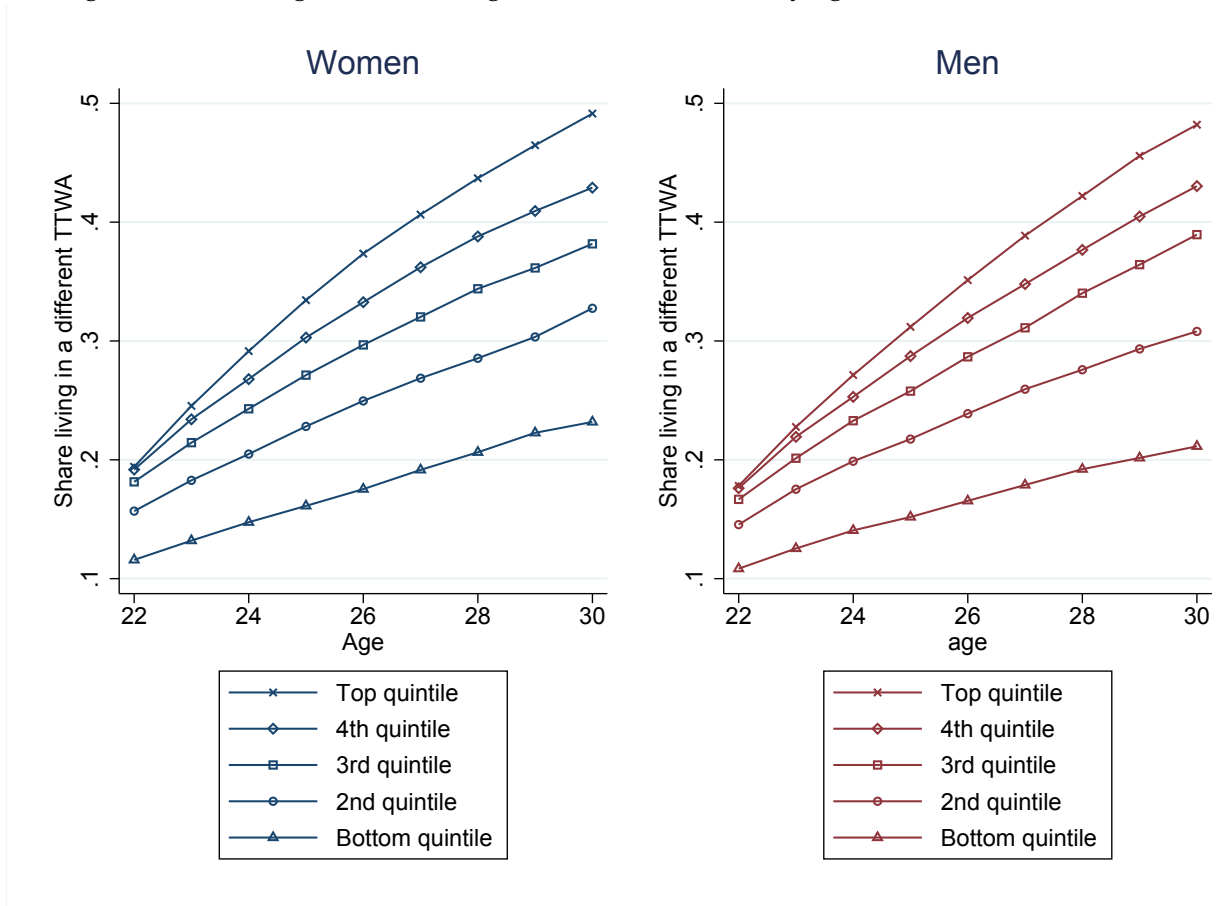
Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

Focusing on graduates, we see that those from higher socio-economic backgrounds are much more likely to move than those from more deprived backgrounds. This is shown in Figure 2, which plots mobility rates by socio-economic status among graduates only.<sup>12</sup> Just over half of those from the highest SES quintile still live in their area of origin at age 30, while nearly 80% of those from the lowest SES group do. Notably, the curves for graduates in the lowest SES group look remarkably similar to the non-graduate groups from Figure 1. Again, patterns of mobility look very similar across men and women.

slightly less likely to live in London than graduate men. This may be related to the fact that women tend to have children at slightly younger ages than men, and families with children may be more likely to move out of London.

<sup>12</sup>As described in Section 2, SES is based on information on free school meal eligibility and the local area where the individual lived in their final year of secondary school (the school year they turned 16).

Figure 2: Share of graduates living in a different TTWA by age and socio-economic status



Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time. SES quintiles are set based on the whole population. Therefore, there are fewer people in the bottom quintile group than the top quintile group here as we are only looking at graduates (and higher SES groups are much more likely to go to university).

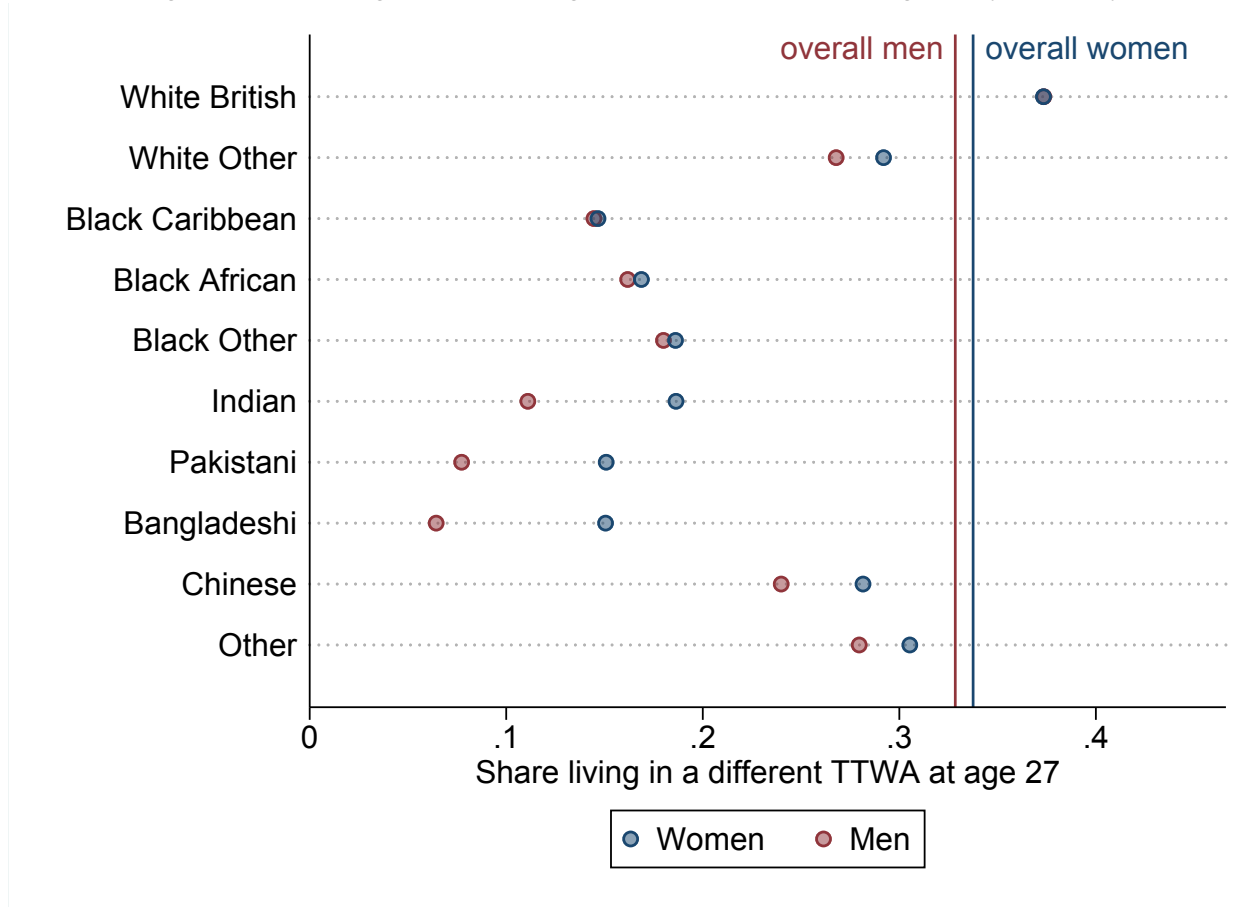
There are also large differences in the mobility of graduates by ethnicity. Figure 3 plots the share of graduates not living in their area of origin at age 27 by ethnic group and gender. We focus on outcomes at age 27, which allows us to pool across the four cohorts in our data and use a larger sample.<sup>13</sup>

Figure 3 shows that Black and Asian graduates are considerably less likely to have moved by age 27 than White graduates. There are also very striking gender differences across ethnic groups. Although male White British graduates are as likely to have left their area of origin as female White British graduates, male Asian graduates are much less mobile than their female counterparts. In

<sup>13</sup>Figure A1 in Appendix A1 shows that mobility patterns are very similar across cohorts.

fact, some of these groups are extremely immobile, with only around 5% of Bangladeshi male graduates living in a different TTWA at 27 from when they were 16.

Figure 3: Share of graduates living in a different TTWA at age 27 by ethnicity

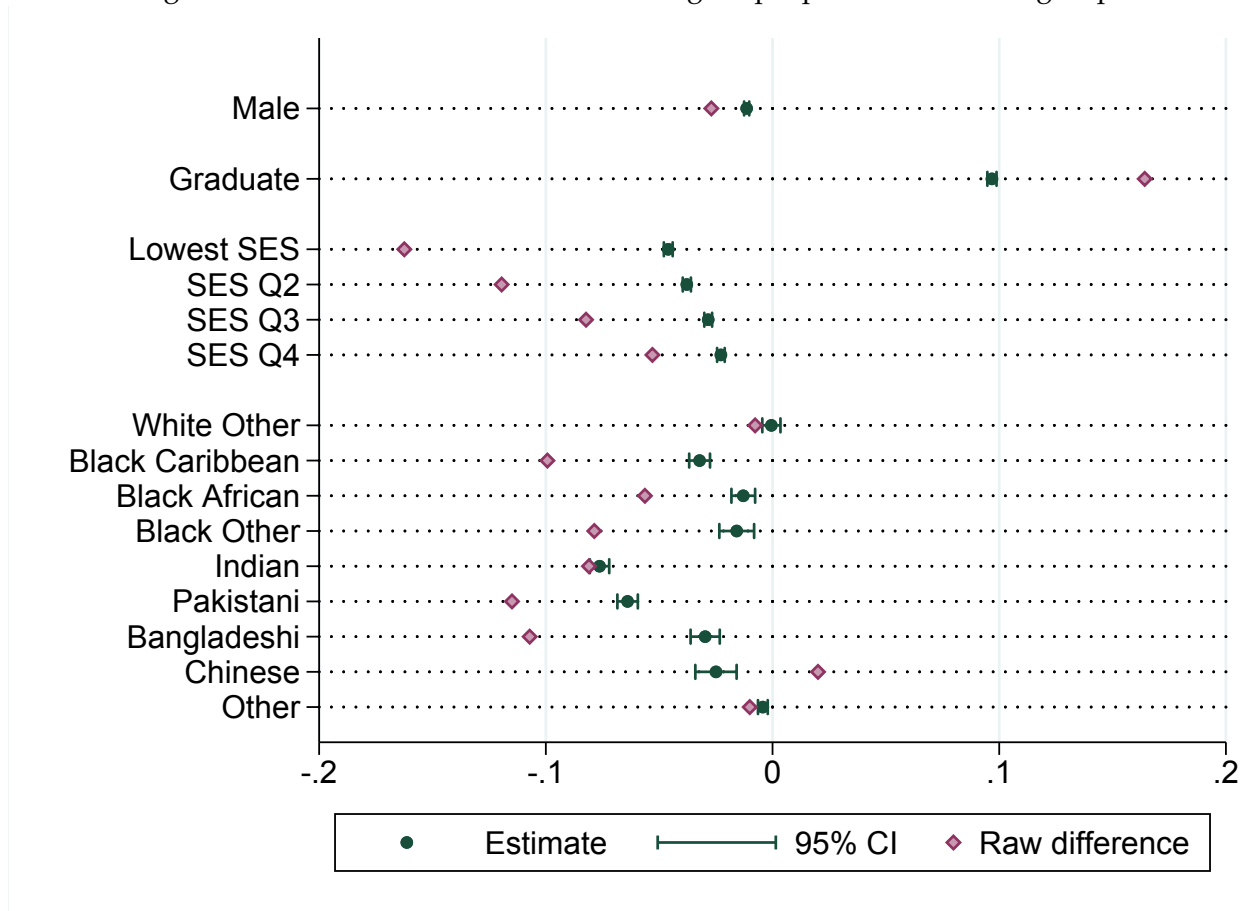


Note: Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

While the patterns presented above are interesting in their own right, it is important to emphasise that some of the differences between groups may be driven by factors other than the specific characteristic being investigated. For example, we know that graduates typically come from wealthier families and do better in school, which could make them more geographically mobile regardless of whether they went to university. Similarly, lower SES groups have lower prior attainment on average, which might make them less geographically mobile regardless of their socio-economic background. They also tend to come from urban areas and are therefore less

likely to need to move to access graduate jobs.

Figure 4: Difference in likelihood of moving for people from different groups



Note: Shows coefficients from a linear probability regression model with 2,193,100 observations. The model regresses an indicator for ‘moving’ – defined as living in a different TTWA at age 27 from at age 16 – on all of the observable characteristics shown in the figure, prior attainment, TTWA of origin fixed effects and other controls listed in Section 2.2. The reference categories are female, non-graduate, highest SES and White British. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

We attempt to disentangle these conflating factors to get a better sense of the drivers of mobility in Figure 4. It shows the relationship between demographic characteristics (gender, graduate status, SES and ethnicity) and mobility, holding all other observable characteristics constant. This is based on a regression model that includes all these factors, plus a rich set of prior attainment measures and area of origin.<sup>14</sup> We note that although we control for a wide range of observable

<sup>14</sup>Specifically, we run a linear probability model that regresses a binary indicator of whether an individual lives in a different TTWA at age 27 from at age 16 on all of the observable characteristics shown in the figure, prior attainment, TTWA of origin fixed effects and other controls listed in Section 2.2.

characteristics, there will be other differences we do not observe. For example, perhaps people who choose to go to university (which we observe) are also those who have low psychological attachment to their local area (which we do not observe). In this example, we would attribute higher mobility among these individuals to them having been to university, and so overstate the effect of higher education on mobility. While we do not claim that there are no biases of this type (which would be required to warrant a causal interpretation of our results), we discuss results using causal language – talking about the effect of higher education on mobility, for example – to give the reader a sense of what we are trying to approximate.

The figure highlights some important results. We see that controlling for other characteristics reduces the difference in mobility between graduates and non-graduates by 40%, from 16 percentage points to 10 percentage points. That is, around two-fifths of the raw difference in mobility between graduates and non-graduates can be explained by differences in their socio-economic backgrounds, prior attainment, TTWA of origin fixed effects and the other characteristics listed in Section 2.2. However, the fact that graduates are still substantially more likely to move than non-graduates, after adjusting for differences in background characteristics, is important. It suggests that going to university might make people more mobile – something that has also been found in *causal* studies of mobility outside the UK (Malamud and Wozniak, 2012; Böckerman and Haapanen, 2013).

Controlling for confounding factors significantly reduces socio-economic gaps in mobility, with those from the bottom SES quintile being 5 percentage points less likely to move than similar individuals from the top SES quintile (the omitted category in the regression). This compares with a raw difference of 16 percentage points. The implication is that the vast majority of socio-economic gaps in mobility can be explained by factors other than SES.

Differences by ethnicity are also attenuated, which reflects the fact that people from most ethnic minorities are more likely to be from low SES backgrounds, have lower academic attainment on average, and are more likely to have grown up in London and other cities, and therefore have less need to move. However, large differences still remain. Individuals from Indian and Pakistani backgrounds are around 7 percentage points less likely to have moved by age 27 than White British individuals, who are the omitted category in the regression. Those from Black, Bangladeshi and



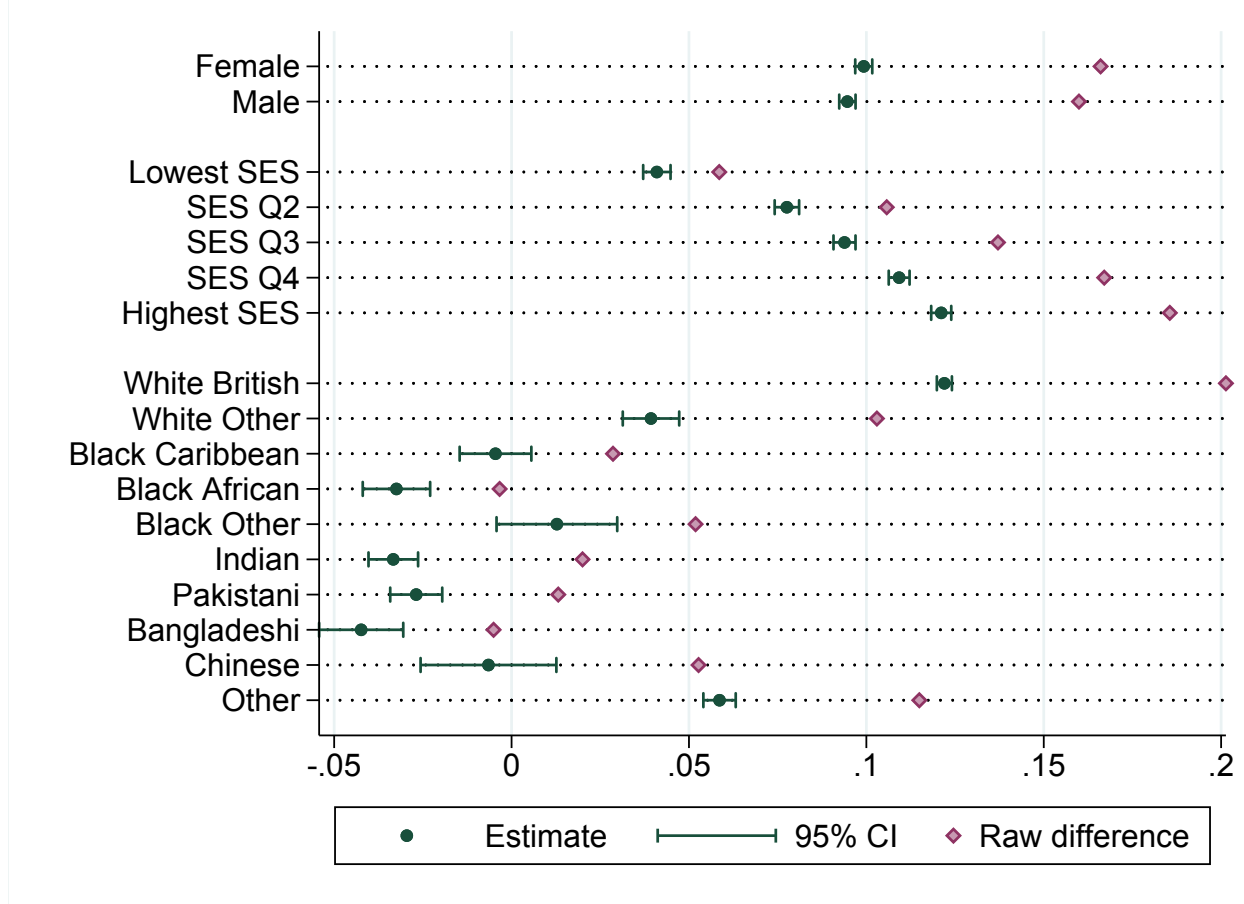
Chinese ethnicities are around 2 percentage points less likely to move.<sup>15</sup>

These regression results suggest that going to university is associated with higher early-career mobility. Figure 5 investigates whether this is true for people from all backgrounds by showing how the relationship between higher education and mobility varies across demographic groups. We again regress 'moving' on controls including gender, SES, ethnicity, prior attainment and TTWA of origin, but now add interactions of graduate status with gender, SES and ethnicity in three separate regressions. The coefficients on these interactions, shown in Figure 5, tell us how more likely graduates in each group are to have moved TTWA by age 27, relative to non-graduates in the same group, holding other characteristics constant. We interpret this as an approximation of how going to university affects the mobility of different sub-populations.

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<sup>15</sup>Interestingly, the raw difference for ethnic Chinese students is actually *higher* than the estimate. This largely reflects the exceptionally high educational attainment of this group.

Figure 5: Difference in likelihood of moving between graduates and non-graduates from different groups



Note: Shows coefficients from three linear probability regression models with 2,193,100 observations. Results shown are the coefficients on the interaction terms of the gender, SES or ethnicity shown and a dummy for being a graduate. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

We see that some interesting SES gaps emerge, with those from the highest SES group being around 12 percentage points more likely to move if they graduate from higher education, while the equivalent number for the lowest SES group is just 4 percentage points. There is a roughly linear relationship in between (which can be seen from the circles in the figure). This is quite a stark difference, as it holds all other factors such as initial location, ethnicity and prior attainment constant. It suggests that higher education may have less of an effect on mobility for students coming from poorer backgrounds than it does for their richer peers. The overall result of a 10 percentage point boost in mobility for graduates appears to be largely driven by graduates from

wealthier backgrounds, with much smaller effects for graduates from poorer families.<sup>16</sup>

There are also striking differences by ethnicity. White British graduates are 12 percentage points more likely to move than White British non-graduates, holding all else equal. Yet for those from Black and Asian backgrounds, the estimated gap in moving between graduates and non-graduates is close to zero or in some cases even negative. Taken at face value, this would imply that higher education does not increase – or even reduces – the geographical mobility of non-White ethnic groups.<sup>17</sup>

### **3.2 Differences in mobility by type of higher education degree**

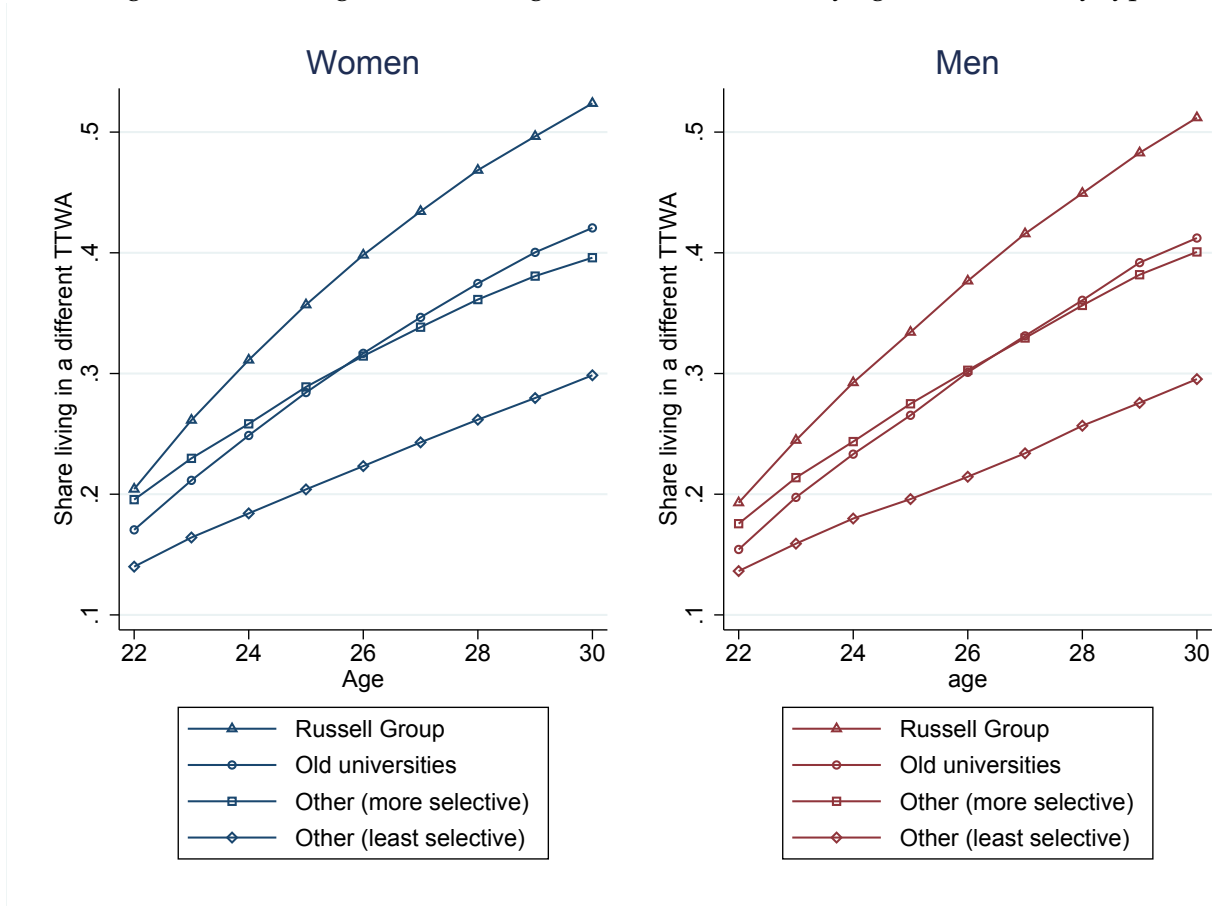
The relationship between higher education and mobility also depends on where and what graduates studied. Figure 6 shows how mobility patterns among graduates vary by the type of institution they attended. We see that graduates from the most selective group of universities, the Russell Group, are far more mobile than graduates from the least selective group of universities. Again, there are almost no differences between genders.

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<sup>16</sup>As shown in Figure A4 in Appendix A1, *both* graduates and non-graduates from poorer backgrounds are less mobile than those from wealthier backgrounds, but the gradient is much steeper for graduates. As a result, the difference in mobility between graduates and non-graduates is much larger for higher SES groups.

<sup>17</sup>For a comparison of graduate and non-graduate mobility rates of different ethnic groups, see Figure A5 in Appendix A1.

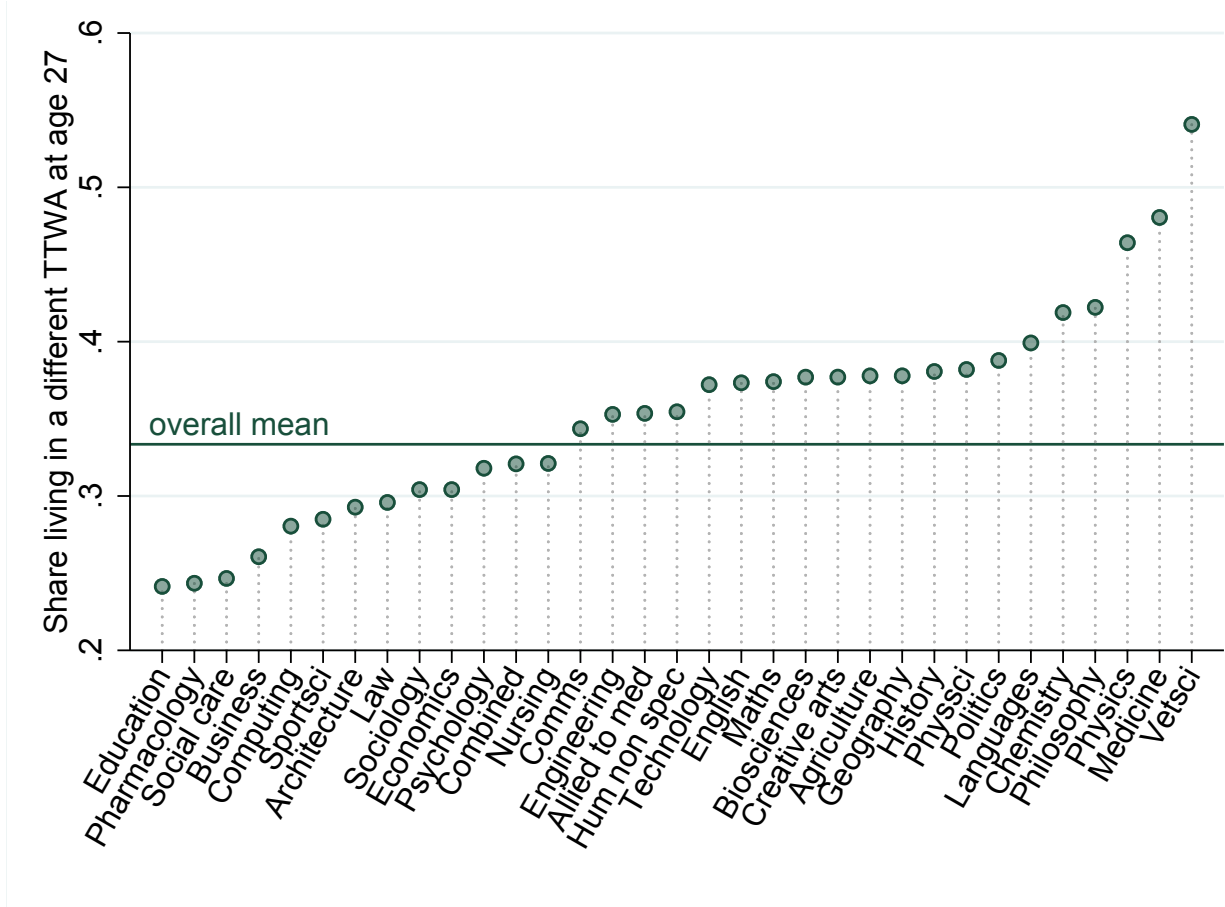
Figure 6: Share of graduates living in a different TTWA by age and university type



Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education at age 27 are dropped, and the graduation year is dropped for non-graduates studying part-time. A list of universities in each of the four categories can be found in Britton et al. (2020c).

Figure 7 shows that graduate mobility also varies a lot by subject (this time focusing on mobility by age 27), with around half of veterinary science, medicine and physics graduates living in a different TTWA by age 27, compared with around a quarter of social care, pharmacology and education graduates. This is not surprising and provides a useful sense-check of our data. For example, we know that medical students are posted all around the country to work during their 20s. Jobs in education, pharmacology and social care are also available throughout the country, so graduates of these subjects have less need to move to find work that is a good fit for their skills.

Figure 7: Share of graduates living in a different TTWA at age 27 by subject



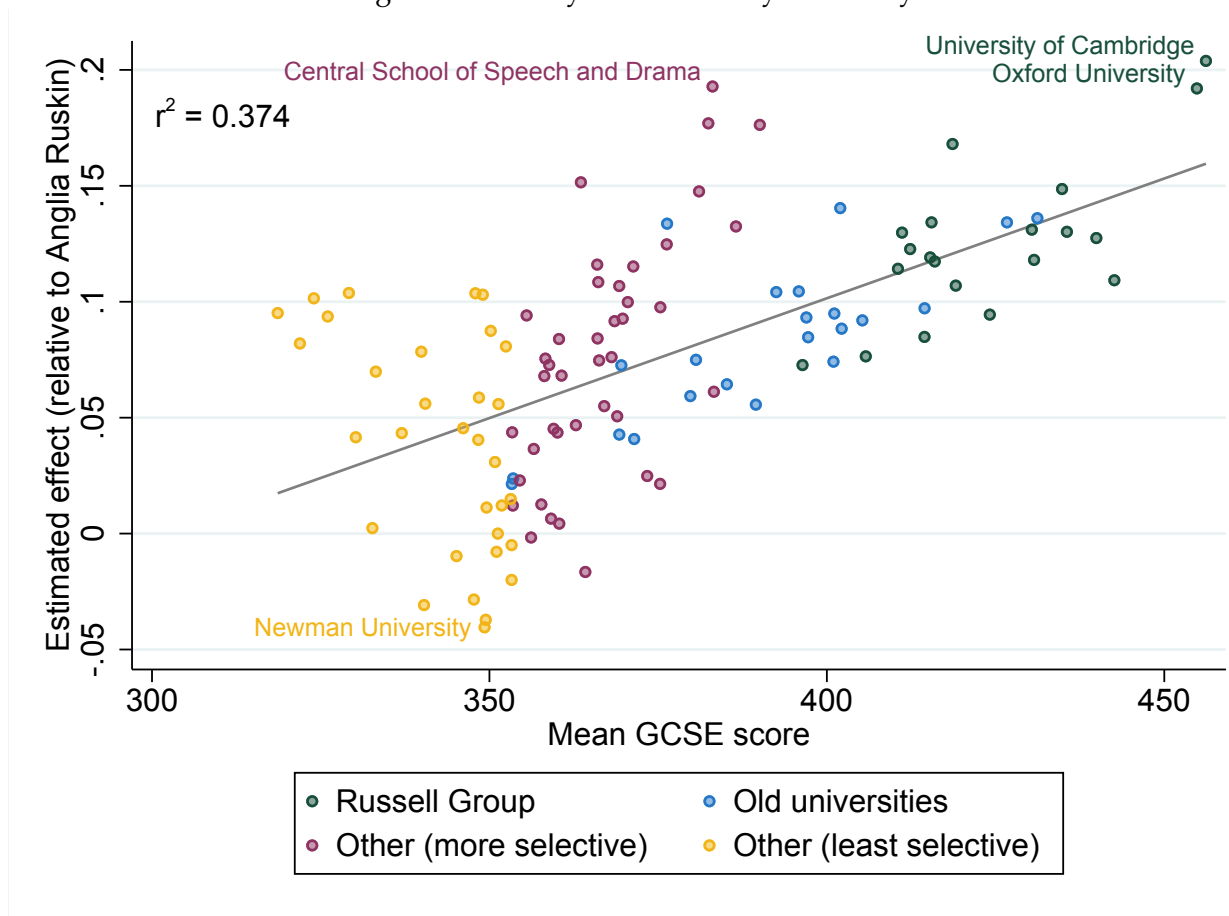
Note: Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education at age 27 are dropped, and the graduation year is dropped for non-graduates studying part-time.

As with the previous section, it is likely that some of the variation in raw mobility rates across institutions and subjects is driven by other factors. In Figures 8 and 9, we investigate the relationship between geographical mobility and institution and subject of study, holding other observable characteristics constant. Again, we include controls for prior attainment, area of origin and other characteristics as listed in Section 2.2.

Figure 8 shows that even when we control for observable differences between students, early-career mobility varies substantially across universities. All else equal, graduates of Oxford, Cambridge, and the Central School of Speech and Drama (the three universities with the largest estimated effect on mobility) are nearly 25 percentage points more likely to have moved by age 27

than graduates of Newman University (the university with the smallest effect on mobility). There is a positive correlation between the selectivity of the university (measured by the mean GCSE score of its intake) and the mobility of its graduates, even controlling for prior attainment and other factors. This could reflect the impact of universities on students' career ambitions and opportunities, either directly or through peer effects. That said, selectivity could also be acting as a proxy for unobserved differences in ability or motivation that are not captured by measures of prior attainment, which could independently affect mobility.

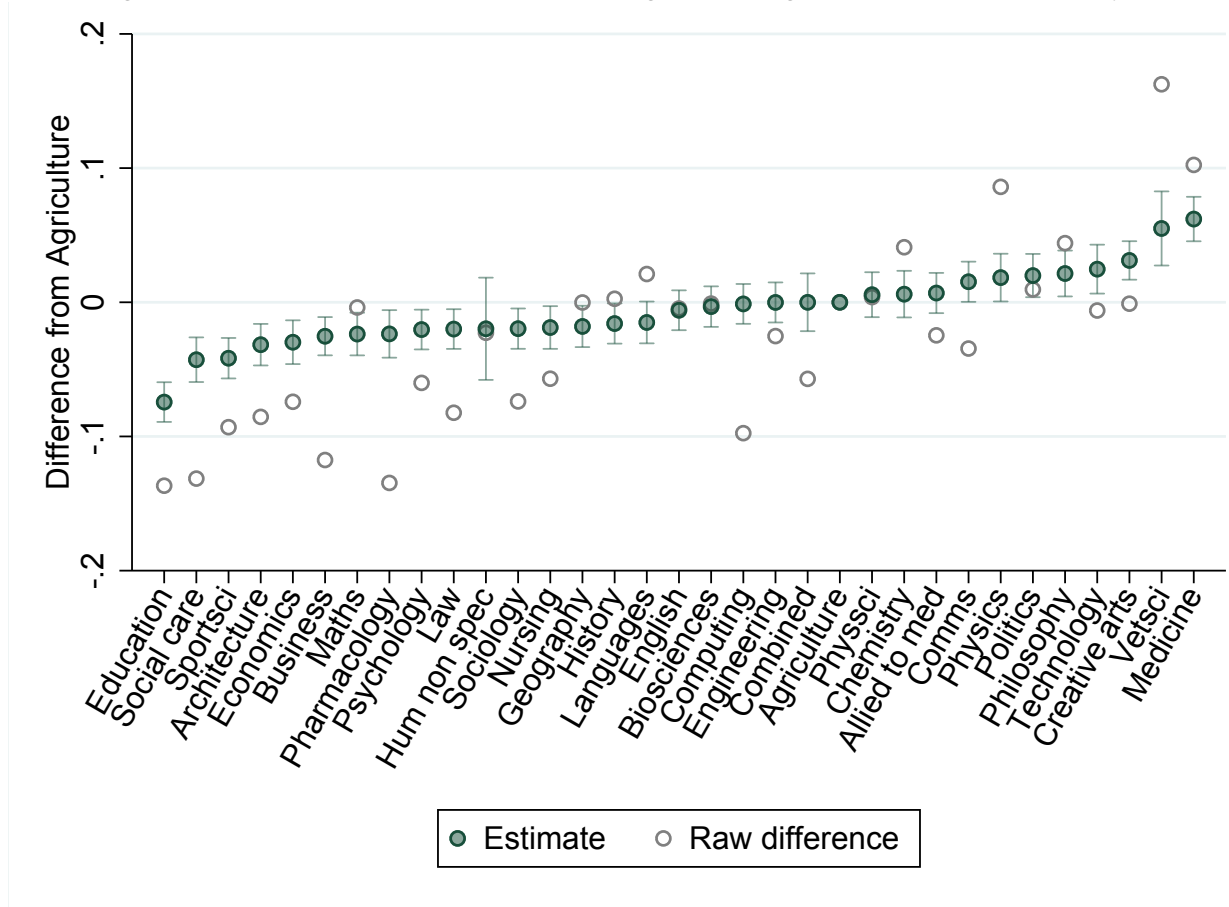
Figure 8: Mobility and university selectivity



Note: We regress a dummy for living in a different TTWA at age 27 from at age 16 on demographic characteristics, prior attainment, area of origin, subject and institution of study. The figure shows the estimates of the impact of each university on mobility relative to a base case, which is Anglia Ruskin University. Only graduates from the 2002–05 GCSE cohorts are included in the regression. Individuals observed to be in full-time education at age 27 are dropped. The University of Suffolk is excluded from this graph, because it only started accepting students for the 2007/08 academic year, potentially distorting our results.  $r^2$  is the proportion of the variance in the estimated mobility effects that is predictable by the mean GCSE score of a university's students and an intercept (this is the square of the Pearson correlation coefficient).

When we look at differences by subject, however, we find that most of the raw variation in mobility across subjects is explained by other factors. This is shown in Figure 9, which plots both raw differences in mobility and estimates of mobility differences by subject when we hold other factors constant. For the vast majority of subjects, differences in mobility estimates are very small – within a few percentage points of one another. There are a couple of exceptions to this, namely education, which has particularly low levels of mobility, and medicine and veterinary sciences, which both have particularly high levels of mobility.

Figure 9: Difference in likelihood of moving between graduates of different subjects



Note: We regress a dummy for living in a different TTWA at age 27 from at age 16 on demographic characteristics, prior attainment, area of origin, subject and institution of study. The figure shows the estimates of the impact of each subject on mobility relative to a base case, which is agriculture. Only graduates from the 2002–05 GCSE cohorts are included in the regression. Individuals observed to be in full-time education at age 27 are dropped.

## 4 Do graduates move to opportunity?

The previous section found that graduates are considerably more likely to move than non-graduates, and that this holds true even once we allow for the fact that graduates are typically from wealthier families and have higher prior attainment. In this section, we focus on the types of moves graduates are making. We are particularly interested in whether they appear to be moving in order to find job opportunities and boost their earnings, as previous research suggests (Social Mobility Commission, 2017; Papoutsaki et al., 2020). We examine what kinds of places graduates are moving to, what kinds of places they are leaving, and what they gain from moving – drawing out differences by background characteristics throughout.

### 4.1 Heading for major cities

Figure 10 describes where graduates move to and from at a high level. We consider moves between four types of areas: London, major cities, other cities (based on the Centre for Cities classification), and other TTWAs which we loosely call ‘rural’ areas. We class a TTWA as a city if it corresponds to a Primary Urban Area (PUA) listed by the Centre for Cities (2014).<sup>18</sup> We define the 10 largest cities in England according to the Centre for Cities as ‘major cities’ (Centre for Cities, 2021). All other areas are classed as ‘rural’, including TTWAs containing towns such as Grimsby or small cities such as Bath that are not included in the Centre for Cities list. The left-hand panel of Figure 10 shows the flows of all graduates between ages 16 and 27, while the right-hand panel focuses only on graduates who move.

The figure shows that graduates tend to move towards London and major cities and away from rural areas. Among graduates who move, a large proportion (around a quarter) move to London from all area types. That said, we do see substantial migration between other types of areas, especially for graduates from smaller cities or rural areas, who are almost as likely to move to another major city as to London. Put differently, around three-quarters of movers move to areas other than London, meaning that graduate mobility is by no means a story of everybody flocking to London.<sup>19</sup>

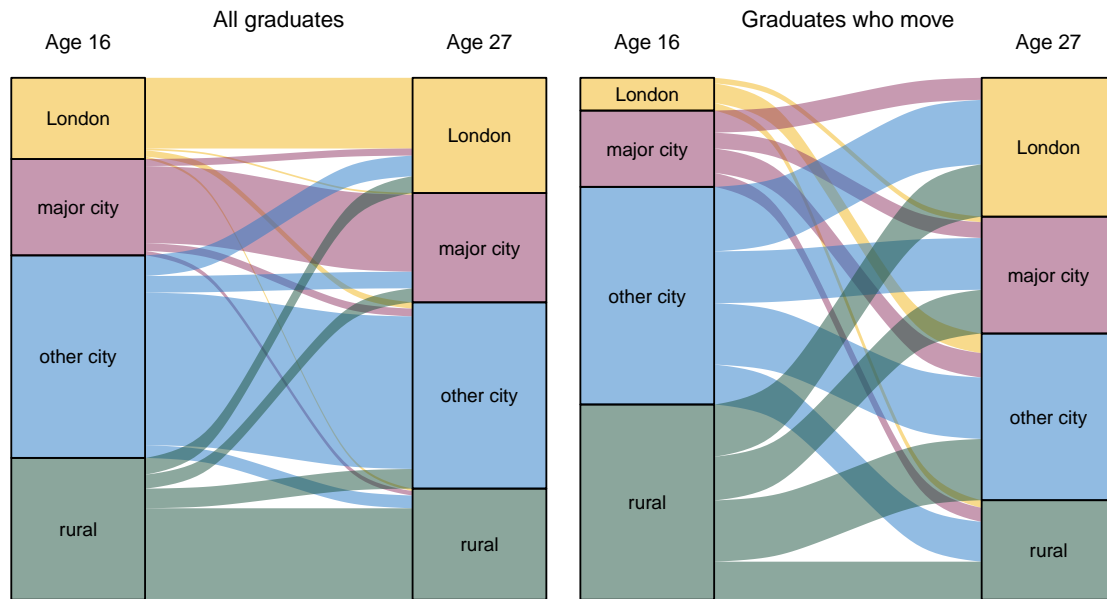
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<sup>18</sup>The list of PUAs excludes places (such as Bath) that have official city status but have small populations, and includes large urban areas without official city status such as Bournemouth.

<sup>19</sup>Figure A16 in Appendix A3 compares the left-hand panel of Figure 10 with a version adjusting for misrecording in the administrative data using the estimated parameters of our misrecording model (assuming that all graduate movers



Figure 10: Mobility patterns of graduates, age 16 to age 27



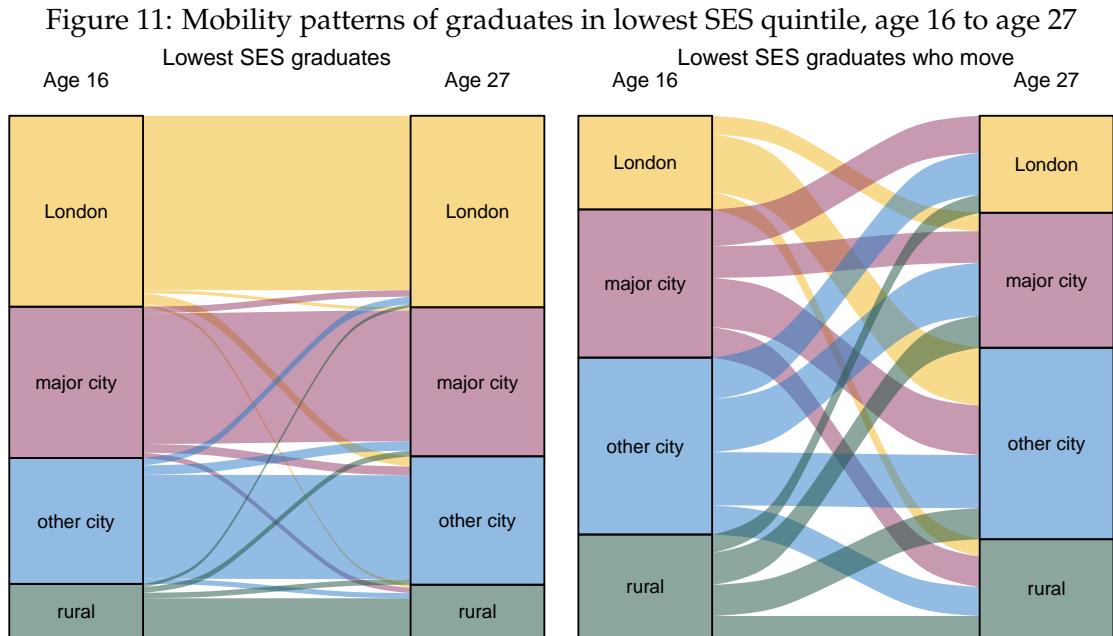
Note: The left-hand figure shows the area types where graduates lived at age 16, and compares these with where they live at age 27, showing the flows of graduates to and from each area type. The right-hand figure only shows origin and destination area type for graduates who move TTWA between ages 16 and 27. Those observed to be in full-time education at age 27 are excluded from the chart. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

In contrast, non-graduates do not disproportionately move to cities. Figure A3 in Appendix A1 shows that the distribution of non-graduates across area types is essentially the same before and after migration. The tendency of graduates to move to cities, coupled with their higher propensity to move overall, increases the concentration of graduate skills in cities – something we explore further in Section 5.

While graduates in general appear to move to opportunity, this is not true for all groups. In particular, graduates from lower socio-economic backgrounds do not disproportionately move to cities. Figure 11 shows flows across area types for graduates from the lowest SES quintile only. The left-hand panel re-emphasises the point that low-SES graduates are not very mobile, often staying to work in the same or similar areas to where they went to school. The right-hand panel reveals an interesting fact: among the low-SES graduates who do move, this movement is not dominated by moving to London and other major cities. In fact, there is a small net flow of low-SES graduates towards rural areas and smaller cities.

are equally likely to update their records). While misrecording likely leads to some moves being left out from Figure 10, the resulting age 27 distribution is unlikely to be substantially affected.

The lower propensity of low-SES graduates to move to major cities can largely be explained by background characteristics. However, an unexplained gap remains. This is true whether or not the sample is restricted to those who move.<sup>20</sup>



Note: The left-hand figure shows the area types where graduates lived at age 16, and compares these with where they live at age 27, showing the flows of graduates to and from each area type. The right-hand figure only shows origin and destination area type for graduates who move TTWA between ages 16 and 27. Those observed to be in full-time education at age 27 are excluded from the chart. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

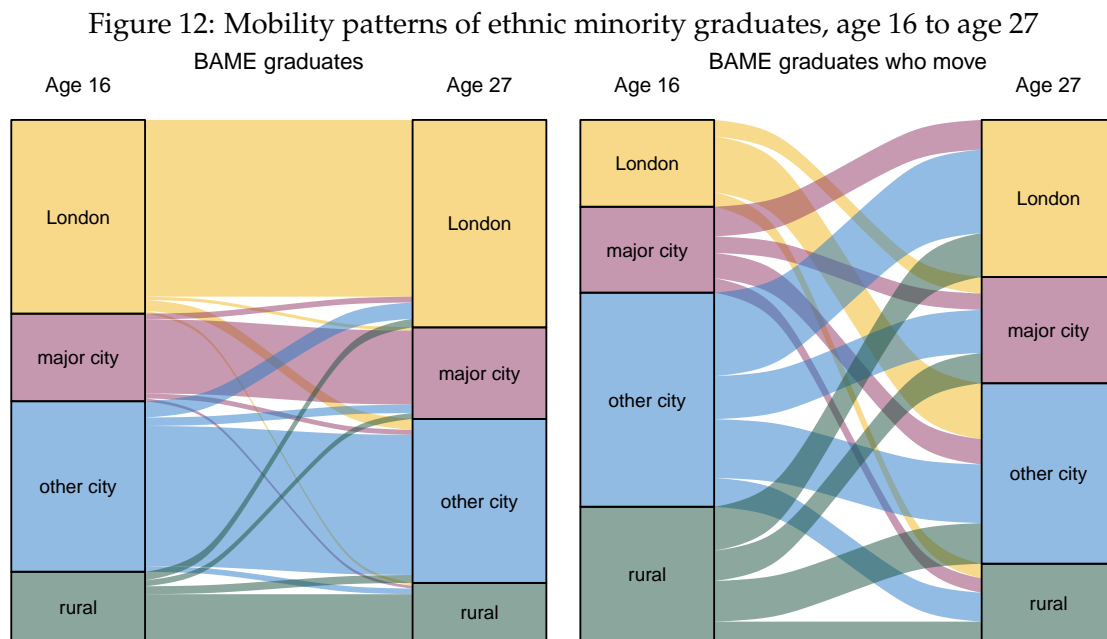
Ethnic minority graduates are also less likely to move, as shown in Figure 12. Comparing mover flows in the right-hand panel of this chart with those in Figure 10, we see roughly the same distribution over destination areas, even though more movers come from London and major cities. Notably, we see substantial flows *out* of London towards other types of areas.

However, when we control for background characteristics such as area of origin, prior attainment, HE institution and subject choice, these differences are reversed: comparing graduates with similar background characteristics, all ethnic minority graduates except South Asian graduates are actually *more* likely to move to major cities than White British graduates. This result becomes even sharper when we also restrict the sample to those who move: movers from *all* ethnic minority

<sup>20</sup>Regression results showing differences in the likelihood of moving to a major city for graduates from different groups are presented in Figure A6. Figure A7 shows results conditional on moving.

groups are more likely to move to major cities than otherwise similar White British students.

It is worth comparing these findings with those of Papoutsaki et al. (2020). Analysing migration flows between local authorities, they find that people tend to move between areas with similar levels of deprivation (as measured by the Index of Multiple Deprivation or IMD), and thus conclude that ‘internal migration might not be equalising opportunity’. The key difference in our analysis is that we consider flows between types of local labour markets, and while many parts of London are classed as highly deprived based on their IMD, we also know that London offers higher wages and better access to professional jobs (Gibbons, Overman and Pelkonen, 2014; Social Mobility Commission, 2019). As result, flows from deprived rural areas to deprived parts of London would count as moves between similar areas in their analysis, but as moves to opportunity in ours.



Note: The left-hand figure shows the area types where graduates lived at age 16, and compares these with where they live at age 27, showing the flows of graduates to and from each area type. The right-hand figure only shows origin and destination area type for graduates who move TTWA between ages 16 and 27. Those observed to be in full-time education at age 27 are excluded from the chart. ‘BAME graduates’ includes graduates of all ethnicities except White British and White Other. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

The evidence presented in this section, which we expand on in the following sections, shows that internal migration increases the concentration of graduates in major cities. This suggests that mobility *does* in general reduce inequality of opportunity between graduates who grew up in

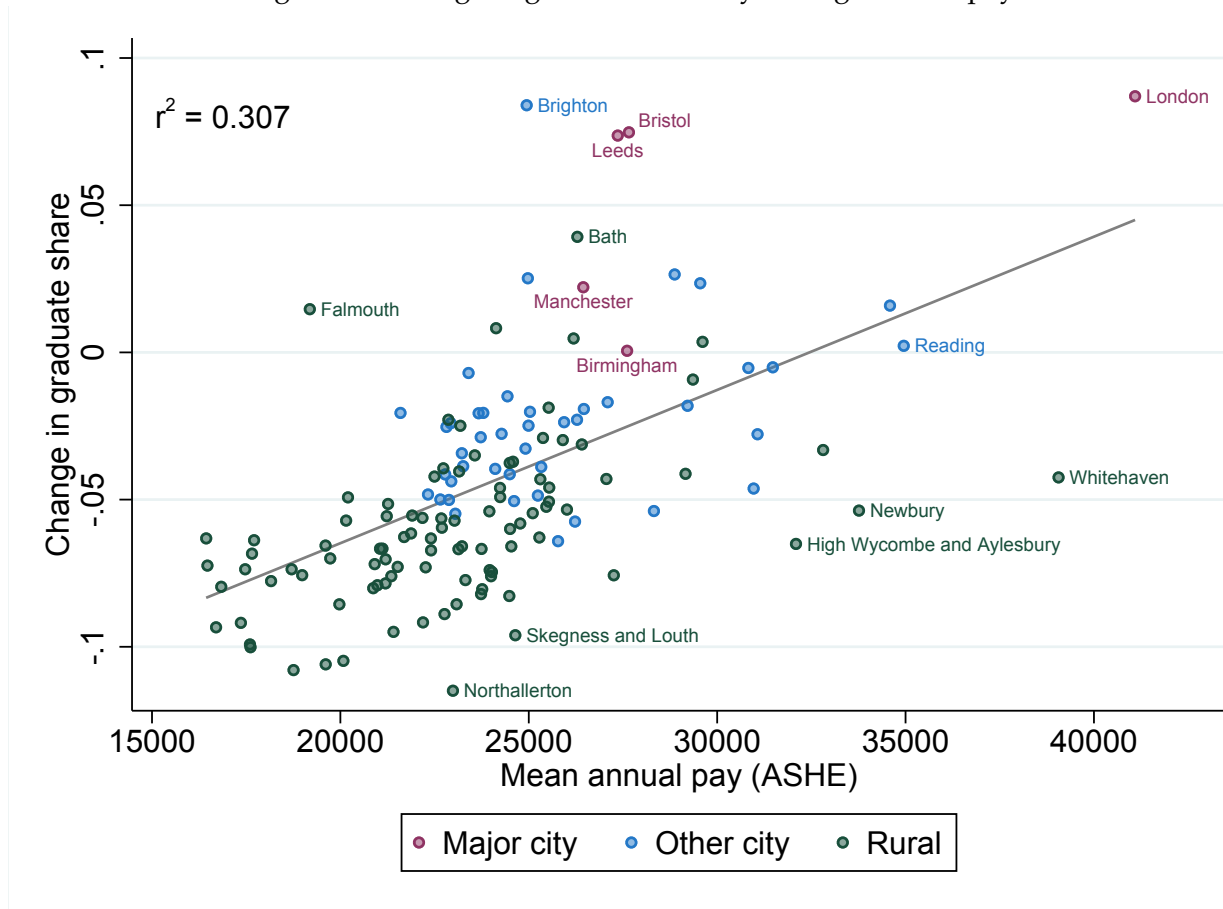
different areas – giving those from more deprived areas access to cities with better career opportunities. However, the relationship appears to be much weaker for people from disadvantaged groups. Specifically, Figures 11 and 12 show that graduates from lower SES or ethnic minority backgrounds are less likely to move overall, and when they do, this is often away from London and other major cities.

## 4.2 Graduates move to wealthier places

The above figures show that graduates tend to move to London and other major cities. In general, larger cities offer higher wages and better career prospects (D’Costa and Overman, 2014), which suggests that graduates may be moving in search of better opportunities. Figure 13 explores this idea in more detail by plotting the relationship between net graduate migration at the TTWA level and average pay in the TTWA, taken from the Annual Survey of Hours and Earnings (ASHE). The vertical axis plots the change in each TTWA’s graduate share as a result of migration: it is the difference between the share of young people *from* the area who go on to get degrees and the share of young people who *end up living* in that area who have degrees. For example, looking at individuals in our four cohorts who lived in London at age 16, 35% went on to become graduates. But of those from the same cohorts who lived in London at age 27, 44% had a degree. The net gain in graduates for London is therefore 9 percentage points – shown in the top right corner of Figure 13.

The figure shows a strong positive correlation between the net graduate migration and average pay in an area. London is the biggest gainer of graduates through migration, and also the TTWA with the highest average earnings (measured across the whole working-age population). At the other end of the scale is Northallerton (in North Yorkshire), which is the largest net loser of graduates, with a change in the graduate share of –11 percentage points as a result of migration. It is also a relatively low-paid area with mean annual earnings of just £23,000, almost £20,000 lower than the equivalent figure for London.

Figure 13: Change in graduate share by average annual pay



Note: Change in the share of graduates is the percentage point difference between the share of 16-year-olds from the area who *go on to be* graduates and the share of 27-year-olds who live in the area who *are* graduates. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Mean annual pay for each TTWA is the simple average of reported mean earnings from the 2014 to 2017 vintages of the Annual Survey of Hours and Earnings (ASHE).  $r^2$  is the proportion of the variance in the change in the graduate share across TTWAs that is predictable by mean annual pay and an intercept (this is the square of the Pearson correlation coefficient).

The strong positive correlation suggests that graduates tend to move to areas with higher pay.<sup>21</sup> However, the relationship is by no means a perfect correlation, and there are several important counterexamples. In general, for a given level of average earnings, cities (in particular, major cities) are more likely to gain graduates through migration. Brighton, Bristol and Leeds (and, to a slightly lesser extent, Bath) all gain large numbers of graduates despite not standing out in terms of average earnings. Falmouth, a town on the Cornish coast and home to Falmouth University, a

<sup>21</sup>In theory, the same pattern could also be caused by non-graduates moving in the opposite direction. To rule this out, we have drawn Figure A9 (included in Appendix A1), a version of Figure 13 where we calculate the change in the graduate share holding the number of non-graduates constant at the age-16 level in each TTWA. The picture is nearly identical, confirming that the observed patterns are driven by graduate movers.

former arts college, also gains graduates despite having relatively low average earnings. A number of other places *lose* graduates through migration despite having high earnings, such as High Wycombe and Newbury (both wealthy commuter towns) and Whitehaven (where the Sellafield nuclear power plant is located). This suggests that the availability of social and cultural amenities also plays a role in young people's location decisions, which is consistent with previous research (Glaeser, Kolko and Saiz, 2001; Clark and Maas, 2015; Papoutsaki et al., 2020).<sup>22</sup>

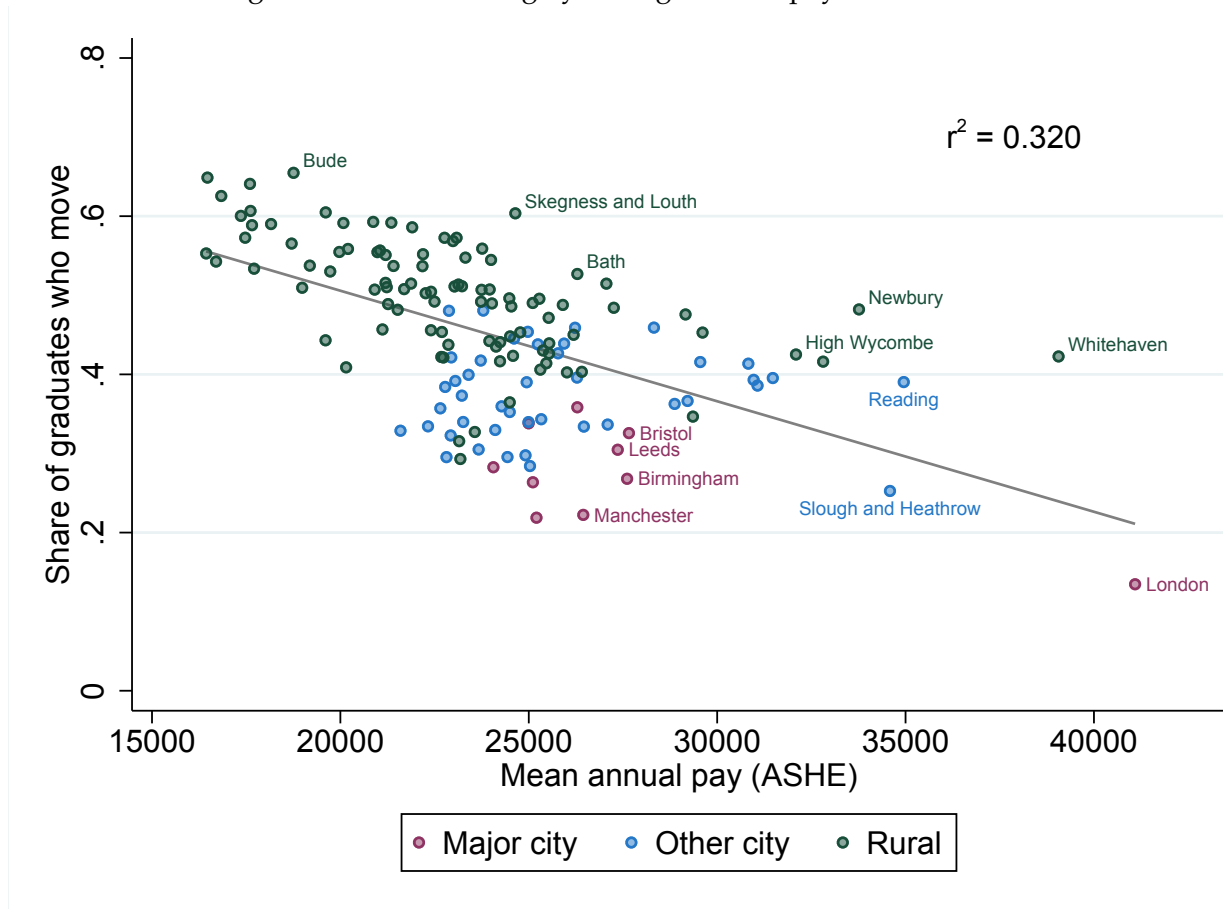
### 4.3 Graduates from poorer places leave

We have established that graduates tend to move towards London and other large cities, and higher-paid areas more generally. Figure 14 shows that graduates also tend to leave poorer areas. This figure, which plots the share of graduates who move away from their TTWA of origin by average earnings in that TTWA, shows a clear negative relationship between how wealthy an area is and how likely its graduates are to move away. Only 13% of graduates who grow up in London – the TTWA with the highest pay – leave London by age 27, while around 60% of graduates from the TTWAs with the lowest pay leave.

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<sup>22</sup>Another factor that likely affects the net gain or loss of graduates in an area is the share of young people *from* an area who go to university. All else equal, we would expect areas where more young people go to university to be 'exporting' graduates and those where fewer go to university to be 'importing' them. However, as shown in Figure 20, there is no clear empirical relationship between the share of young people *from* an area who go on to university and whether an area loses graduates. Areas with a substantial net loss of graduates (in percentage points) include areas with a very high proportion of young people going to university such as High Wycombe, Tunbridge Wells and Harrogate, but also areas with very low shares of university attendance such as Grimsby and Wisbech.

Figure 14: Share moving by average annual pay of home TTWA



Note: The vertical axis shows the share of graduates who live in a different TTWA at age 27 from their TTWA at age 16. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Mean annual pay for each TTWA is the simple average of reported mean earnings from the 2014 to 2017 vintages of the Annual Survey of Hours and Earnings (ASHE).  $r^2$  is the proportion of the variance in the share of graduates who move that is predictable by mean annual pay and an intercept (this is the square of the Pearson correlation coefficient).

The relationship is particularly striking since we know that pupils from poorer areas tend to have lower educational attainment, and are therefore less mobile in general. Figure A8 in Appendix A1 shows that the negative gradient is even steeper, and the correlation stronger, when we control for differences in prior attainment and other background characteristics.

We see that for a given level of average earnings, cities (in particular, major cities) are less likely to lose graduates through migration – the mirror image of Figure 13 above. Graduates from Manchester, Birmingham, Leeds and Bristol are quite a lot less likely to move away than the average earnings in those places would predict. This could point to the value of social and cultural

amenities that cities offer young graduates.

#### 4.4 Variation in the graduate premium across areas

So far, we have established that graduates tend to move away from poorer areas towards areas with higher pay, especially to London and other major cities. This suggests that graduates move to access better career opportunities. But there is some evidence that this is not the whole story, as cities such as Brighton and Bristol attract and retain graduates despite not having particularly high average earnings. Looking at the variation in the graduate earnings premium – the additional earnings graduates get compared with similar non-graduates<sup>23</sup> – in different parts of the country<sup>24</sup> also suggests that there are limits to the extent to which graduates move to opportunity. If anything, graduates do not move to London as much as we might expect.

The argument is slightly subtle. The graduate earnings premium can be seen as a measure of the relative demand for graduate skills. If all graduates stayed where they grew up, we would expect large variation in graduate premiums around the country, as demand for graduate skills varies dramatically across the country, and firms in areas with high demand for these skills relative to the supply of graduates would have to raise graduate salaries to attract workers. With migration, we would expect these differences to be equalised, as graduates move to areas where their skills are demanded and rewarded, increasing supply. At the extreme, if there were no costs to moving for either graduates or non-graduates, we would expect graduate premiums to be the same across the country.

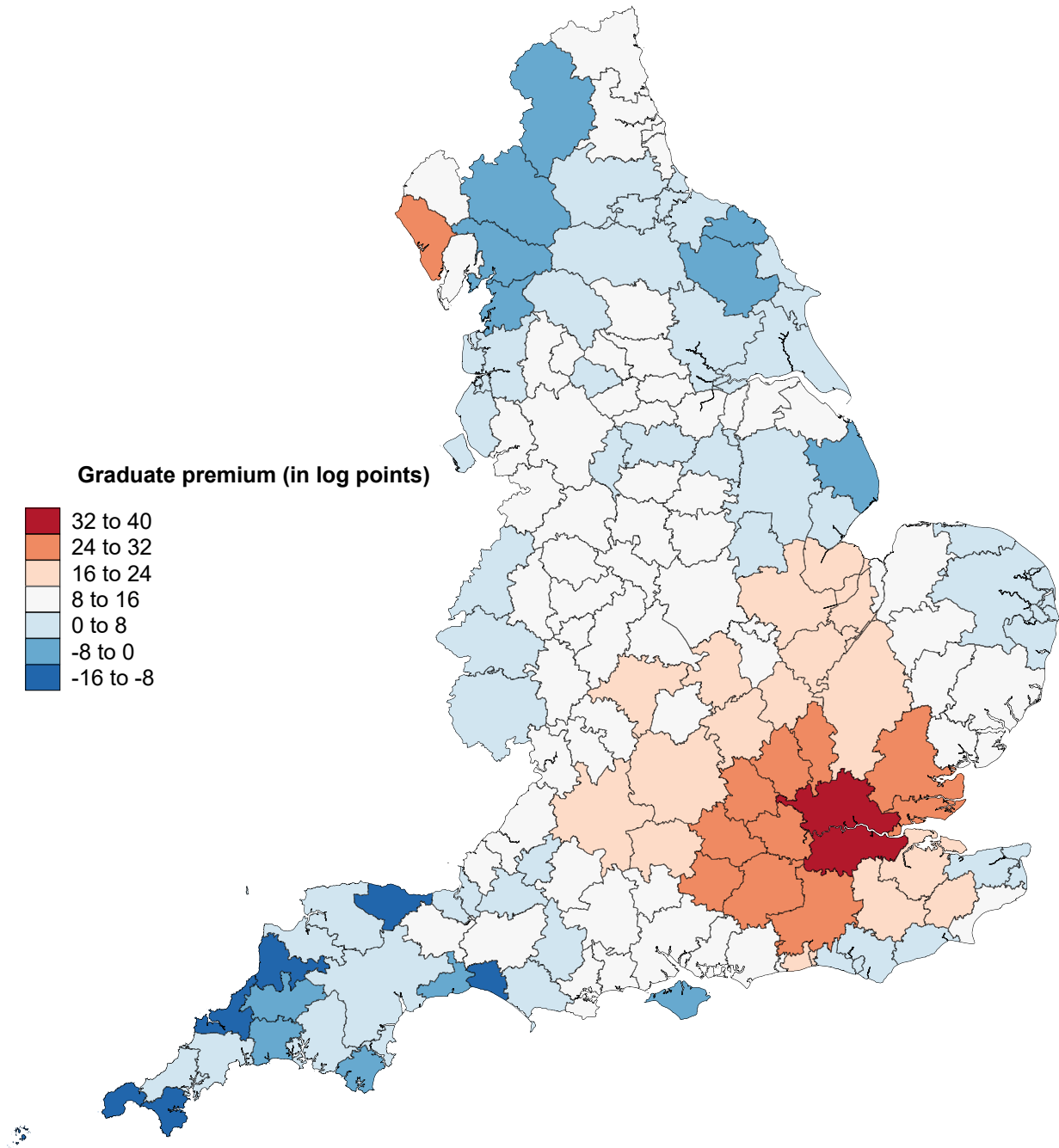
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<sup>23</sup>This is equivalent to the estimated return to higher education. We refer to it as the graduate premium here, in line with the literature on labour demand and geographical inequality (Dahl, 2002; O'Leary and Sloane, 2005; Walker and Zhu, 2011).

<sup>24</sup>Based on where people are living, rather than where they are from.



Figure 15: Graduate premiums by TTWA



Note: The map plots all 149 English TTWAs included in our analysis. TTWAs straddling two home nations are excluded from the analysis and therefore not plotted. 'Graduate premiums' are calculated using a regression of earnings on a graduate dummy, interacted with TTWA at age 27, plus controls for background characteristics and school attainment as listed in Section 2.2, fully interacted with a gender dummy. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

Figure A10 in Appendix A1 suggests that migration does indeed respond to demand – areas

with higher graduate premiums gain more graduates through migration. However, as Figure 15 shows, large differences in graduate premiums remain across TTWAs.<sup>25</sup> In particular, London and surrounding areas have very high graduate premiums, while estimated premiums in Cornwall, the North, and the East coast are low or even negative. The existence of such large variations in graduate premiums around the country suggests that non-wage factors also play a role in people's migration decision and/or that there are considerable (economic, social or psychological) costs to moving.

#### 4.5 Movers earn more than non-movers

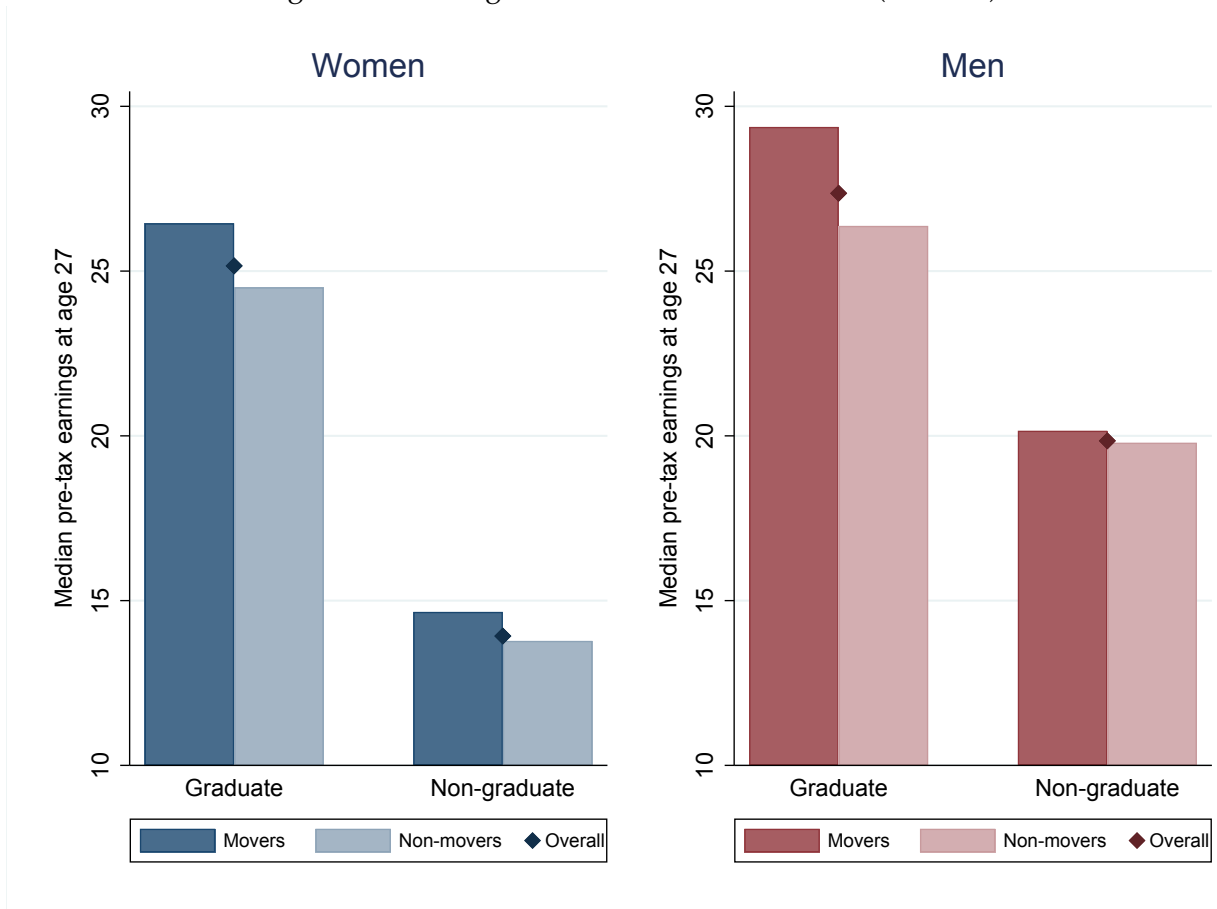
The analysis so far suggests that graduates are, at least to some extent, moving to boost their earnings opportunities. We now turn to consider how this bears out in terms of their actual earnings by asking whether, and how much, graduates typically gain from moving. We note that there may be other economic gains from moving – for example, higher chances of finding a job or better access to particular kinds of jobs – that are not captured by differences in earnings (Papoutsaki et al., 2020).

We start with some simple comparisons in Figure 16, which shows the average earnings of movers and non-movers, split by graduate status and gender. This shows that in all four cases, the median earnings of movers at age 27 exceed those of non-movers. The difference is clearly much larger for graduates than for non-graduates, and similar (in percentage terms) across male and female graduates. In contrast, non-graduate men who move earn very similar amounts to those who do not move. The difference for non-graduate women is also smaller than for graduate women. This suggests that graduates (and especially male graduates) gain more from moving than non-graduates.

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<sup>25</sup>We calculate the local graduate premium using a regression of earnings on a graduate dummy, interacted with TTWA at age 27, plus controls for background characteristics and school attainment as listed in Section 2.2, fully interacted with a gender dummy. We note that although we control for a rich set of observable characteristics, there may be unobservable differences between graduates and non-graduates in different areas that bias our results.

Figure 16: Earnings of movers and non-movers (in £000s)



Note: Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such if they have obtained their degrees before age 27. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time. Only includes graduates with positive earnings.

#### 4.6 The moving premium by background characteristics

Of course, non-movers might be different from movers in other important ways that affect earnings. We therefore investigate what happens to the ‘moving premium’ once we control for observable differences in the characteristics of movers and non-movers. As with our earlier analysis of the relationship between higher education and mobility, we use the language of ‘moving premium’ so as to give the reader a sense of what we are approximating, but do not claim these are causal effects. Our data allow us to control for a richer set of background characteristics, including multiple measures of prior educational attainment, than many previous studies (Kidd,

O’Leary and Sloane, 2017; Papoutsaki et al., 2020). Still, there are likely to be factors correlated with moving that we do not observe – for example, ambition or motivation – that directly affect earnings and therefore bias our estimates.

With this caveat in mind, Figure 17 shows what happens to the earnings difference between movers and non-movers when we control for differences in their observable characteristics.<sup>26</sup> We see that even when we control for these differences, graduates who move experience a large ‘moving premium’. This is especially true for male graduates, for whom movers earn 10% more than non-movers, all else equal. For women, the estimated premium is smaller at 4%.

These estimates are very large. For example, 10% is substantially higher than the estimated effect of going to university on earnings for men at age 27 (Belfield et al., 2018). This is especially notable as any misrecording in the DWP location data will have attenuated these estimates; true moving premiums may therefore be even higher.

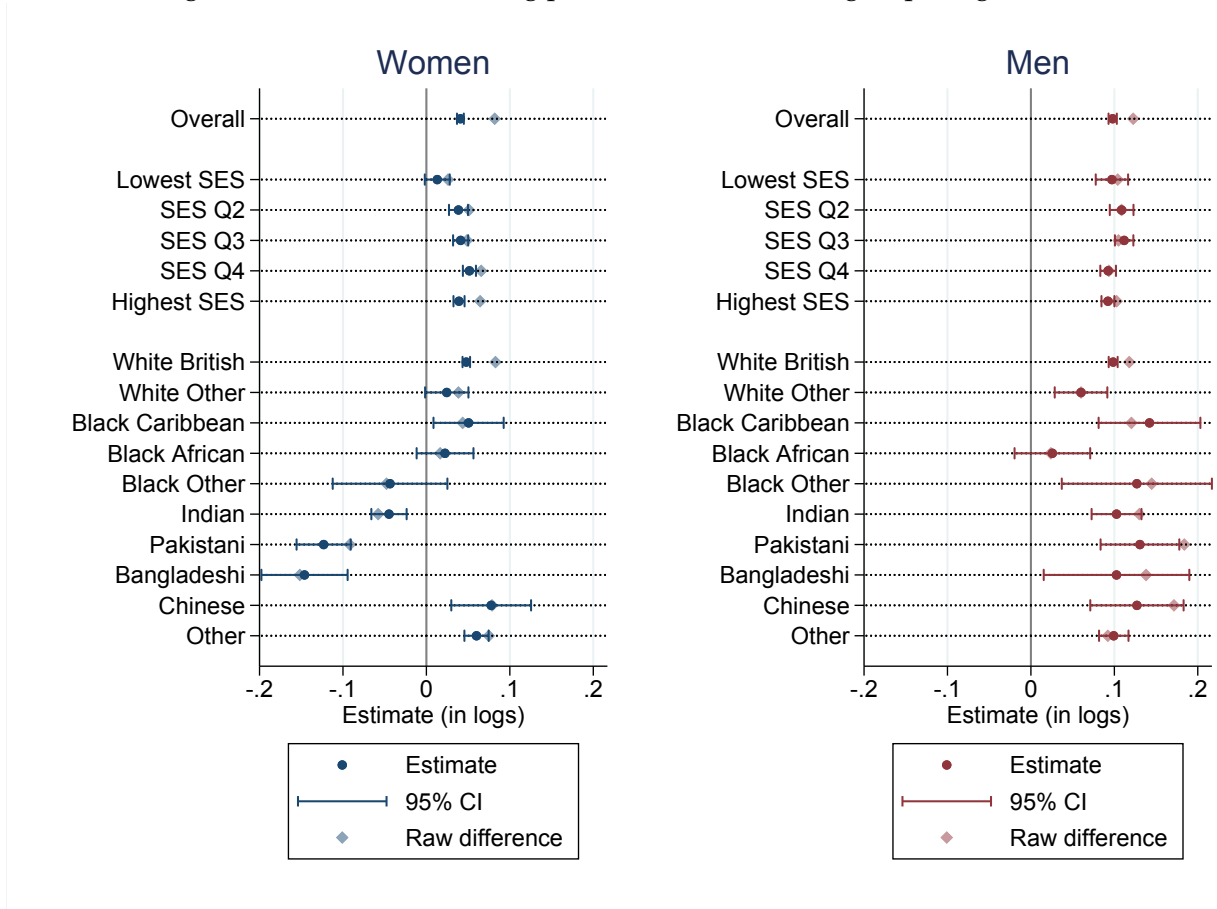
Large earnings premiums at age 27 are also likely to translate into even larger differences in later life. The reason is that earnings growth among graduates in middle age appears to be especially high among those who already have high earnings around age 30 (Britton et al., 2020*b*). There is also evidence that – controlling for individual differences – those who have experience working in cities see faster wage growth than those who have only worked in rural areas, even after they leave the city (D’Costa and Overman, 2014).

The moving premiums we estimate are remarkably stable across different subgroups, particularly for men. There is almost no variation in premiums across SES groups, and very little variation in the point estimates across ethnicities (some of these estimates are imprecise because of small sample sizes). Estimated moving premiums for women are also quite stable, with the exception of Indian, Pakistani and Bangladeshi women, for whom the premium is negative. One plausible explanation for this is unobservable differences in who moves: for example, South Asian women may primarily move for marriage, at the expense of their own career prospects, while women from other ethnic groups may move to further their careers. Similarly, if there are strong norms against moving for work in these communities, it is possible that only those who fail to find employment in their area of origin choose to move elsewhere.

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<sup>26</sup>As before, we control for prior attainment, SES, ethnicity, TTWA at age 16 and other background characteristics listed in Section 2.2. In regressions for graduates, we also control for HE institution and subject.

Figure 17: Estimated ‘moving premium’ for different groups of graduates



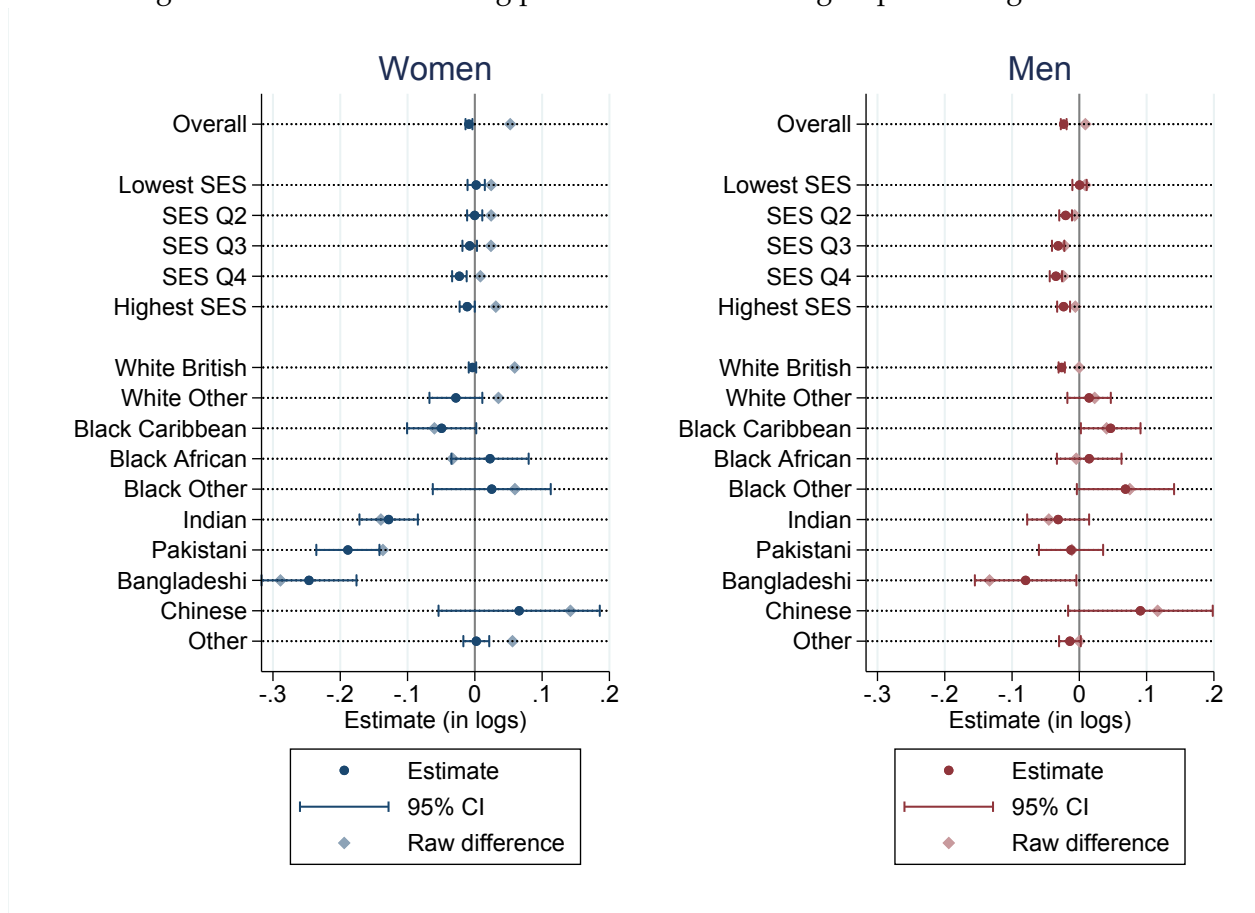
Note: In estimating the ‘moving premiums’, we control for prior attainment, SES, ethnicity, TTWA at age 16 and other background characteristics listed in Section 2.2, as well as HE institution and subject. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such if they have obtained their degrees before age 27. Individuals observed to be in full-time education at age 27 are dropped.

By way of comparison, Figure 18 presents estimates of the moving premium for non-graduates. The results are strikingly different: non-graduates who move earn no more than similar non-graduates who do not move. If anything, the overall estimate for men is slightly negative. As with the estimates for graduates, there is very little variation in the moving premium across SES and ethnic groups, again with the exception of South Asian women, for whom there is a large and significantly negative ‘premium’.

The finding that non-graduates do not appear to gain from moving might explain why they are less mobile. We know that wages at the bottom of the distribution are much more similar across regions than at the top (Agrawal and Phillips, 2020), and at the very bottom, the minimum wage

is the same everywhere. Our finding is also likely to reflect where non-graduates are moving – as we saw in Section 4.1, non-graduates do not tend to move to London and other major cities. We should note, however, that there may be economic benefits from moving that are not reflected in earnings. For example, Papoutsaki et al. (2020) find that people who move are more likely to be employed, and more likely to work in professional jobs. Non-graduates may thus benefit economically from moving even if they do not achieve higher earnings.

Figure 18: Estimated ‘moving premium’ for different groups of non-graduates



Note: In estimating the ‘moving premiums’, we control for prior attainment, SES, ethnicity, TTWA at age 16 and other background characteristics listed in Section 2.2. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals are counted as non-graduates unless they have obtained a degree before age 27. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for those studying part-time.

## 4.7 The moving premium by type of higher education degree

We have seen that the gains from moving are remarkably similar across graduates from different demographic groups. We now consider how they vary by where and what graduates study. Figure 19 presents moving premiums across different degree types, again holding the background characteristics of students fixed.

We see that there is very little variation in premiums across different types of institutions – graduates from Russell Group universities gain no more, or less, than otherwise similar graduates from less selective universities. However, estimated graduate premiums vary hugely by subject. All else equal, there are no large earnings differences between movers and non-movers who graduated in nursing, education and social care. This is likely to reflect the fact that wages in these occupations are set nationally. Perhaps unsurprisingly, graduates in education and social care are also least likely to move away from their area of origin, conditional on characteristics (as we saw earlier in Figure 9).

At the other end of the spectrum, there are large earnings premiums associated with moving for both male and female graduates of law, technology, languages, business and economics. Graduates of veterinary sciences also appear to see large gains from moving, though estimates for men are very imprecise. The starkest example is law, where men who move earn nearly 20% more than men who stay in their area of origin, controlling for differences in background characteristics.<sup>27</sup> This suggests that moving to certain areas might be necessary to fully take advantage of the returns to these degrees.

The large moving premiums in law, technology, languages, business and economics are intriguing and merit further investigation. Following similar logic to that set out in Section 4.4 on graduate earnings premiums in different parts of the country, we might expect graduates in these subjects to move more, thus increasing labour supply where their skills are demanded, driving down the average returns to moving. To elaborate on this, if law firms in one area were willing to pay very high salaries, we would expect large numbers of law graduates to move to that area. This, in turn, would bring down lawyers' salaries in the area, reducing the premium to moving.

One possible explanation is that high-paying jobs in these sectors are disproportionately con-

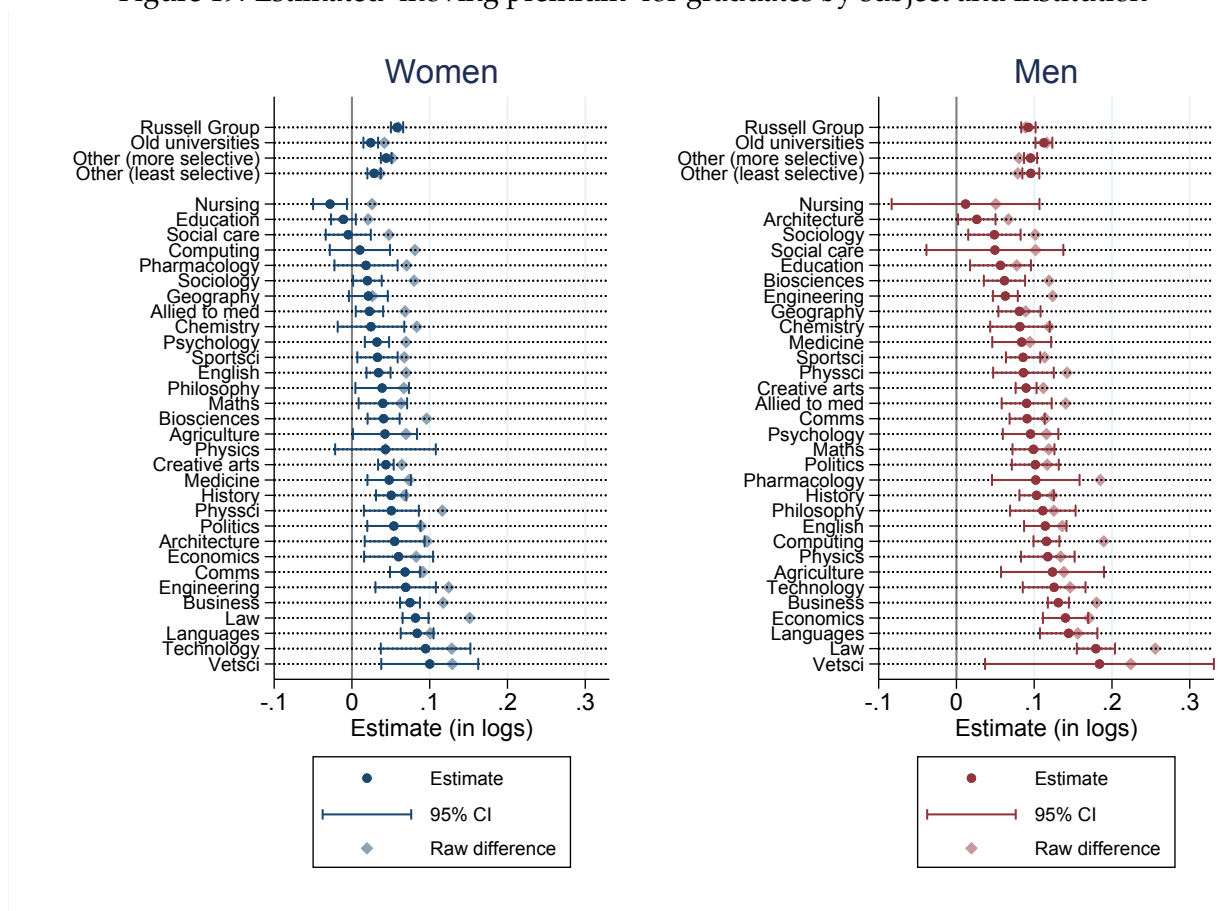
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<sup>27</sup>The equation is estimated in logs, and the estimated moving premium is around 0.18 log points. This implies a change of  $e^{0.18} - 1 = 19.7\%$ .

centrated in London. If people are particularly averse to moving to London for other reasons (such as the high cost of housing), this might prevent market forces from driving down the premiums from moving there. Figure A11 in Appendix A1 provides some evidence to support this hypothesis by showing that the moving premiums for many subjects are much higher for moves to London than for moves to other places.

Finally, there are a couple of interesting cases – notably, computing and pharmacology – where the payoff from moving is much larger for men than it is for women. It is unclear from our data why this would be the case, but it could be something that merits further investigation.

Figure 19: Estimated ‘moving premium’ for graduates by subject and institution



Note: In estimating the ‘moving premiums’, we control for prior attainment, SES, ethnicity, TTWA at age 16 and other background characteristics listed in Section 2.2, as well as HE institution and subject. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such if they have obtained their degrees before age 27. Individuals observed to be in full-time education at age 27 are dropped. A list of universities in each of the four categories can be found in Britton et al. (2020c).



## 5 What are the implications for regional inequality?

We have seen so far that higher education is associated with greater mobility, and that graduates on average move towards wealthier cities, away from poorer areas. This has important implications for the distribution of skills across the country and, in turn, for regional inequalities. In this section, we look more closely at which areas gain and lose graduates through migration, and the effect this has on the geographical concentration of skills.

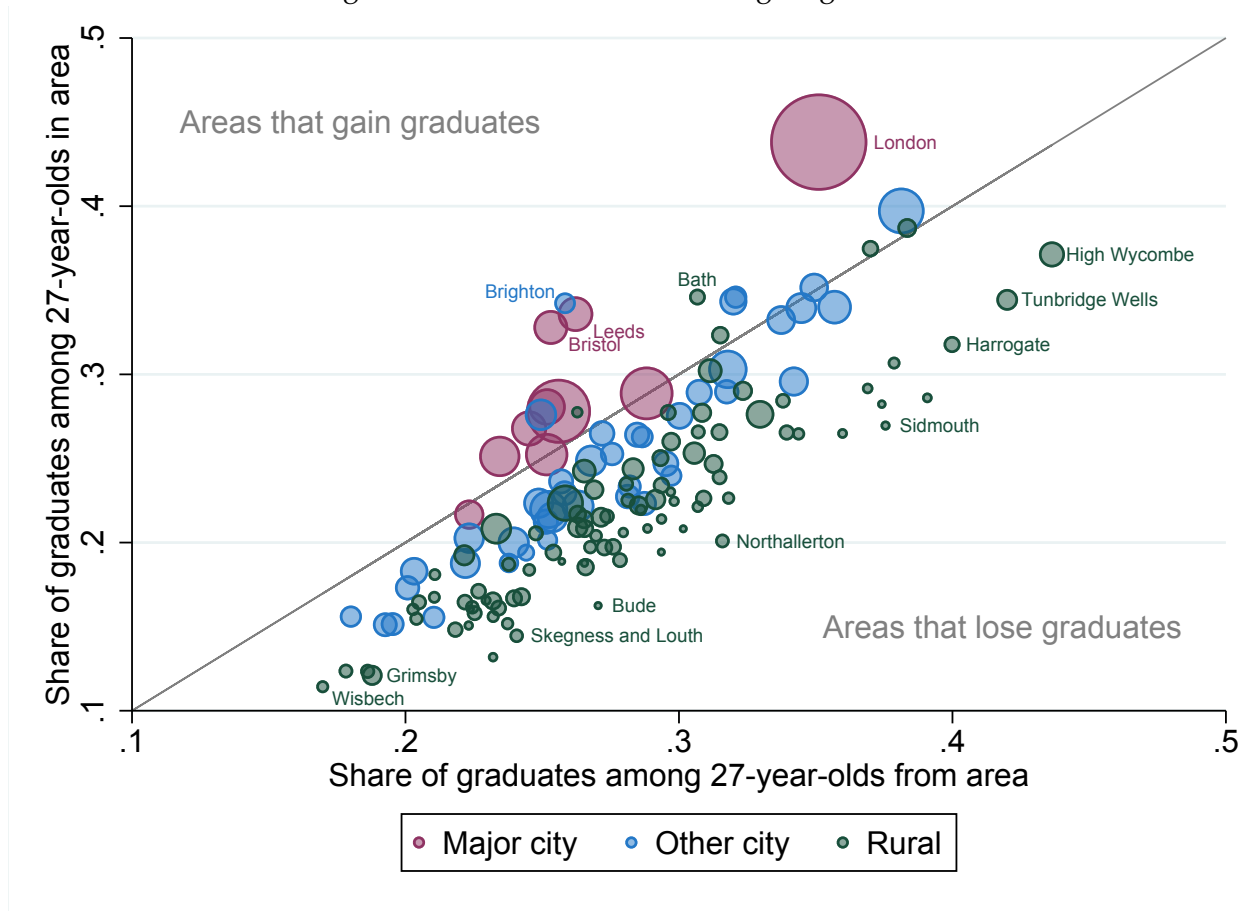
There are large differences in education and skills across the UK (Bell, Blundell and Machin, 2019), which are responsible for many of the spatial disparities in economic and social outcomes we see today (Lochner and Moretti, 2004; Cutler and Lleras-Muney, 2006; Gibbons, Overman and Pelkonen, 2014). These partly reflect differences in education outcomes across areas: children in more deprived areas are less likely to do well in school (Social Mobility Commission, 2017). But the migration patterns we have described above also play a role in exacerbating regional inequalities.

Figure 20 plots the share of individuals who obtained a degree among those who live in a TTWA at age 27 (on the vertical axis) against the share of graduates among those who *grew up* in a TTWA (on the horizontal axis). If no-one moved, the two measures would coincide, and all TTWAs would lie on the 45-degree line. Looking across the horizontal axis, we see that access to higher education varies substantially across TTWAs. Less than 20% of those in our cohorts who grew up in Wisbech (in North Cambridgeshire) and Grimsby (in North East Lincolnshire) went on to obtain a degree, compared with over 40% of children who grew up in Tunbridge Wells (in Kent) and High Wycombe (in Buckinghamshire). On top of this, Grimsby and Wisbech further lose graduates through migration. We see this looking at the vertical axis: only around 12% of individuals from our cohort of young adults living in these areas at age 27 have degrees.

In terms of numbers, the place that overwhelmingly gains the most graduates through migration is London – an area that already ‘produces’ a high share of graduates. Brighton, Leeds, Bristol and Bath are also relatively high-skilled places (with above-average higher education participation rates) that gain even more graduates through migration. In contrast, rural areas on average ‘produce’ fewer graduates and further lose graduates through migration. The overall effect of migration is to increase the geographical concentration of skills. Figure A12 in Appendix A1 shows that the concentration of graduates across TTWAs – based on the commonly used index of dissim-

ilarity and the Herfindahl–Hirschman index – substantially increases as a result of migration.

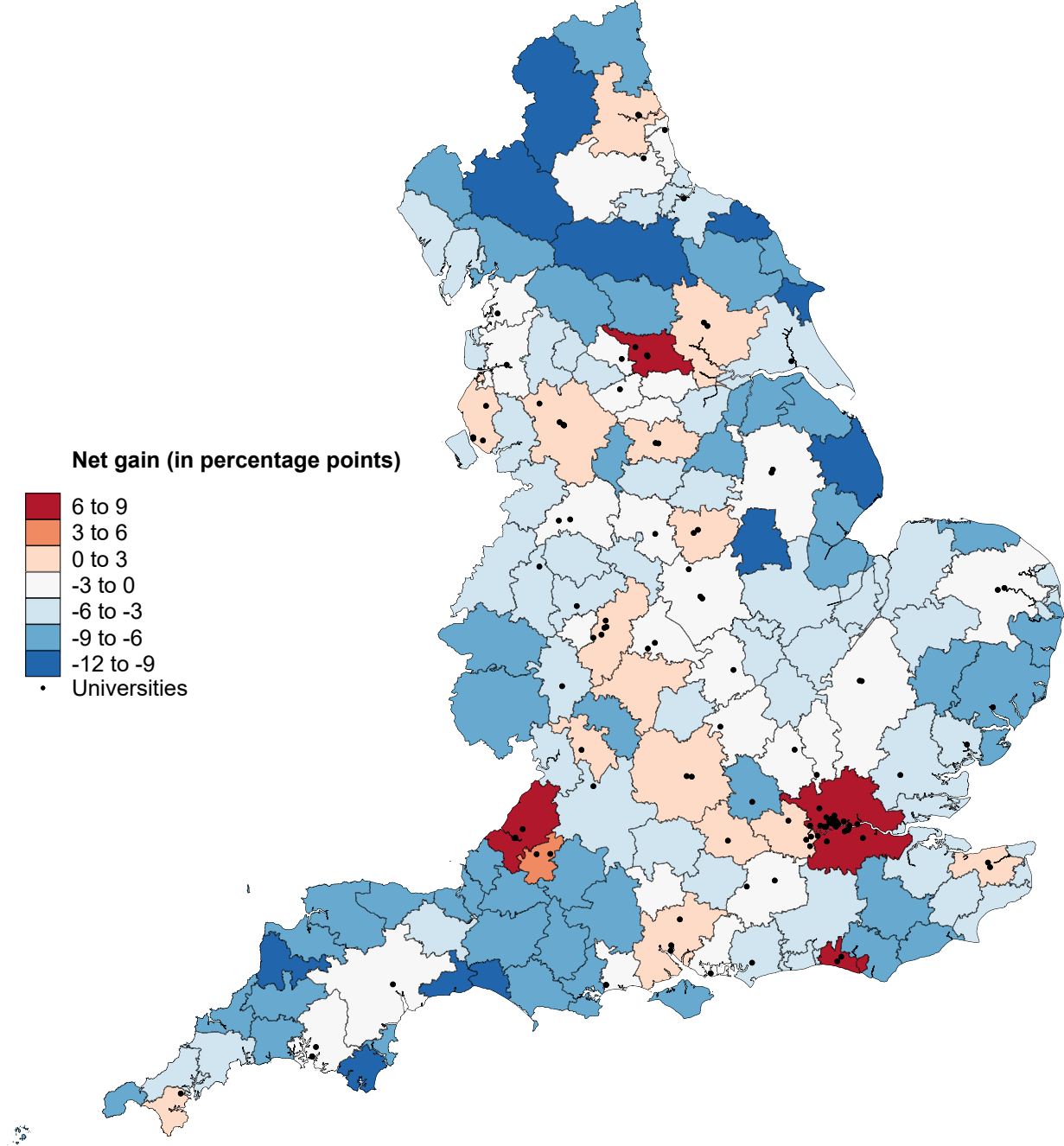
Figure 20: The areas that lose and gain graduates



Note: The figure plots the share of individuals who obtained a degree among those who live in a TTWA at age 27 (on the vertical axis) against the share of graduates among those who *grew up in* a TTWA (on the horizontal axis). Areas in the top left of the figure gain (future) graduates as a share of population, and areas in the bottom right of the figure lose graduates as a share of the population. The size of the circles represents the age 16 population of each TTWA. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

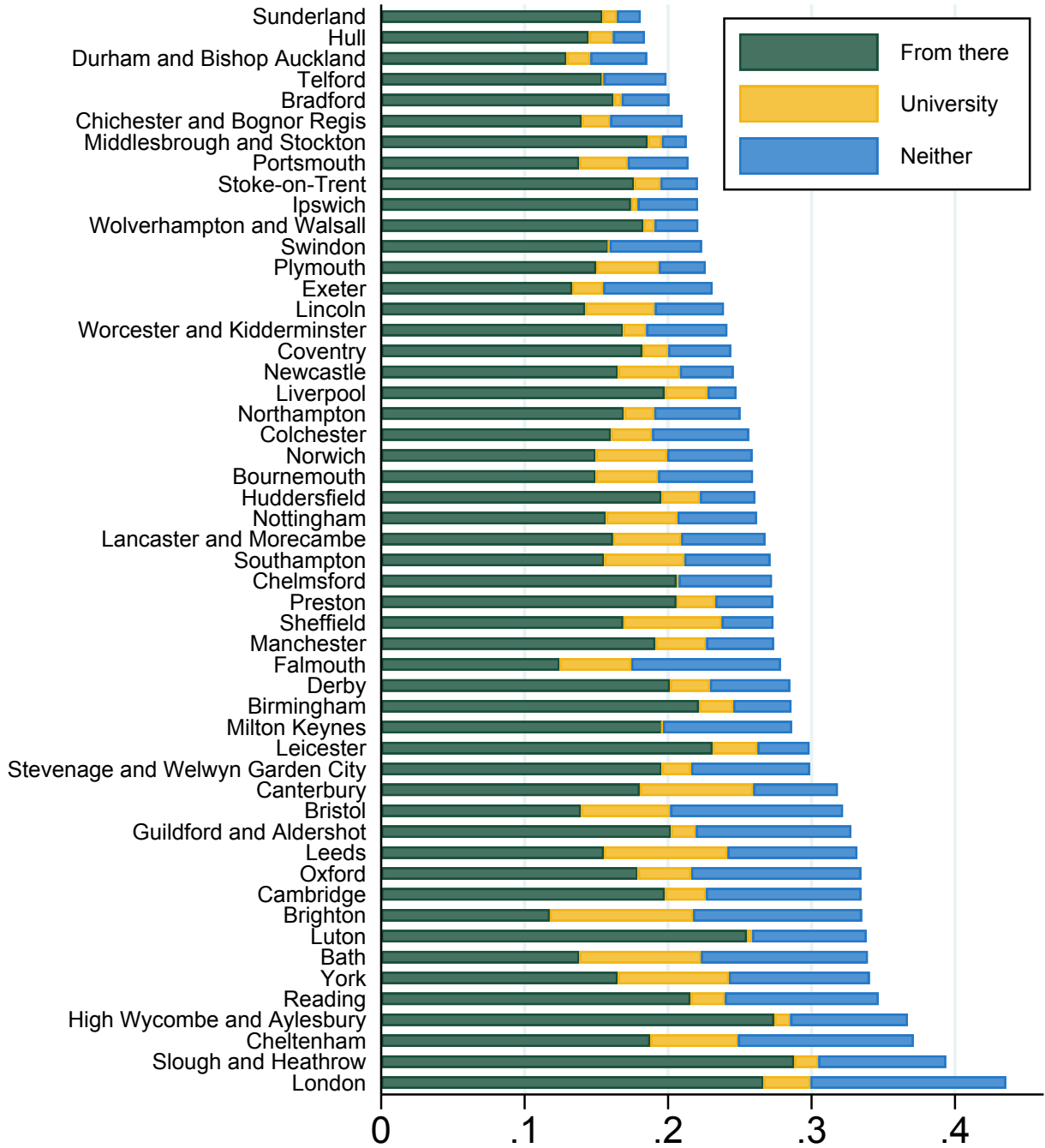
The areas that lose and gain graduates can be clearly seen in Figure 21, which maps the change in graduate share resulting from migration across TTWAs (the difference between the horizontal and vertical axis values from Figure 20). Graduates flow to London, Brighton, Bristol and Leeds – the areas marked in red. In contrast, migration reduces the graduate share in the North and coastal areas. Given that these places are already relatively deprived, migration further exacerbates regional inequalities.

Figure 21: Change in share of (future) graduates in TTWA, age 16 to age 27



Note: Net gain is the percentage point difference between the share of 16-year-olds from the area who *went on to be* graduates and the share of 27-year-olds who live in the area who *are* graduates. Black dots signify universities. A small number of institutions with campuses spread across multiple TTWAs are not shown.

Figure 22: Composition of graduate share in TTWAs with universities



Note: 'From there' refers to the share of 27-year-olds living in each TTWA who have obtained a degree and were living in the same TTWA at age 16. 'University' refers to the share of 27-year-olds living in each TTWA who have obtained a degree from a university in that TTWA and were *not* living in the same TTWA at age 16. 'Neither' refers to the share of 27-year-old graduates living in each TTWA who have not obtained a degree from a university in that TTWA *and* were not living in that TTWA at age 16. Only TTWAs that contain a university are included in the figure (a small number of institutions with campuses spread across multiple TTWAs are disregarded). Includes data from the 2002-05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

Individual universities are marked with dots in Figure 21. We see that the only area without a university to gain graduates is the Leamington TTWA, likely due to the proximity of Leamington Spa to the University of Warwick. This suggests that there may be some relationship between the presence of a university and an area's ability to attract and retain graduates. Indeed, among graduates who move away from their home TTWA for university and do not return by age 27, around a quarter stay in the TTWA of their university (see Table A1 in Appendix A1).

Figure 22 shows that graduates who attended university in the area can be an important source of graduate in-migration.<sup>28</sup> In Sheffield, Liverpool, Canterbury, Plymouth, Newcastle and Lincoln, more than half of graduate in-migrants also went to university in the area. That said, it is clear from Figure 21 that not all university towns attract graduates, and any correlation between place of study and subsequent place of residence could also reflect preferences for areas that drive both university choice and location decisions. How places can attract and retain graduates, and what role local universities can play, is an important avenue for further research.

## 6 Conclusion

We have shown that higher education is associated with greater mobility, even controlling for differences in background characteristics between graduates and non-graduates. Graduates tend to move to London and other affluent cities, away from poorer areas, and those who move experience large earnings gains relative to otherwise similar graduates who do not move. This suggests that higher education allows people to move to better labour markets, reducing inequality of opportunity between individuals who grow up in different areas.

However, individuals from lower socio-economic backgrounds and ethnic minorities are less mobile even controlling for background characteristics, and the relationship between higher education and mobility is much weaker for these groups. In addition, low-SES graduates who do move are less likely to move to London and other big cities, and many ethnic minority graduates move away from London. This suggests that graduate mobility may not reduce – and may even exacerbate – inequalities between groups. Patterns of graduate mobility also increase the concen-

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<sup>28</sup>Figure A17 in Appendix A3 gives the same figure when adjusting for misrecording using our estimated parameters. These results suggest that Figure 22 is likely to understate the share of in-migrants and overstate the share of graduates from a place substantially but not dramatically.

tration of skills in cities, where participation in higher education is often already high, thereby increasing geographical inequality.

In addition to our main findings, we uncover a number of interesting results that merit further research. First, we find that the graduate wage premium appears to vary substantially across the country. It is worth investigating whether this result is robust to further controls and procedures to account for selection on unobservable characteristics – and if so, what implications it may have for productivity or incentives for young people to invest in higher education in different places. Second, we estimate huge variation in gains from moving across subjects, and in some cases between male and female graduates in specific subjects. Further research is needed to understand the drivers of this variation, perhaps in relation to the level of wage inequality within sectors and the extent to which sectors are spatially concentrated. Third, while we find a general correlation between average earnings in an area and its ability to attract and retain graduates, some places stand out. Brighton, Leeds and Bristol in particular gain more graduates through migration than we might expect, while other cities such as Manchester and Birmingham do not. The presence of local universities might play a role, but does not seem to be sufficient. In the context of the ‘levelling up’ agenda, it is worth investigating what attributes of cities are attractive to graduates in order to better enable left-behind places to attract and retain skills.

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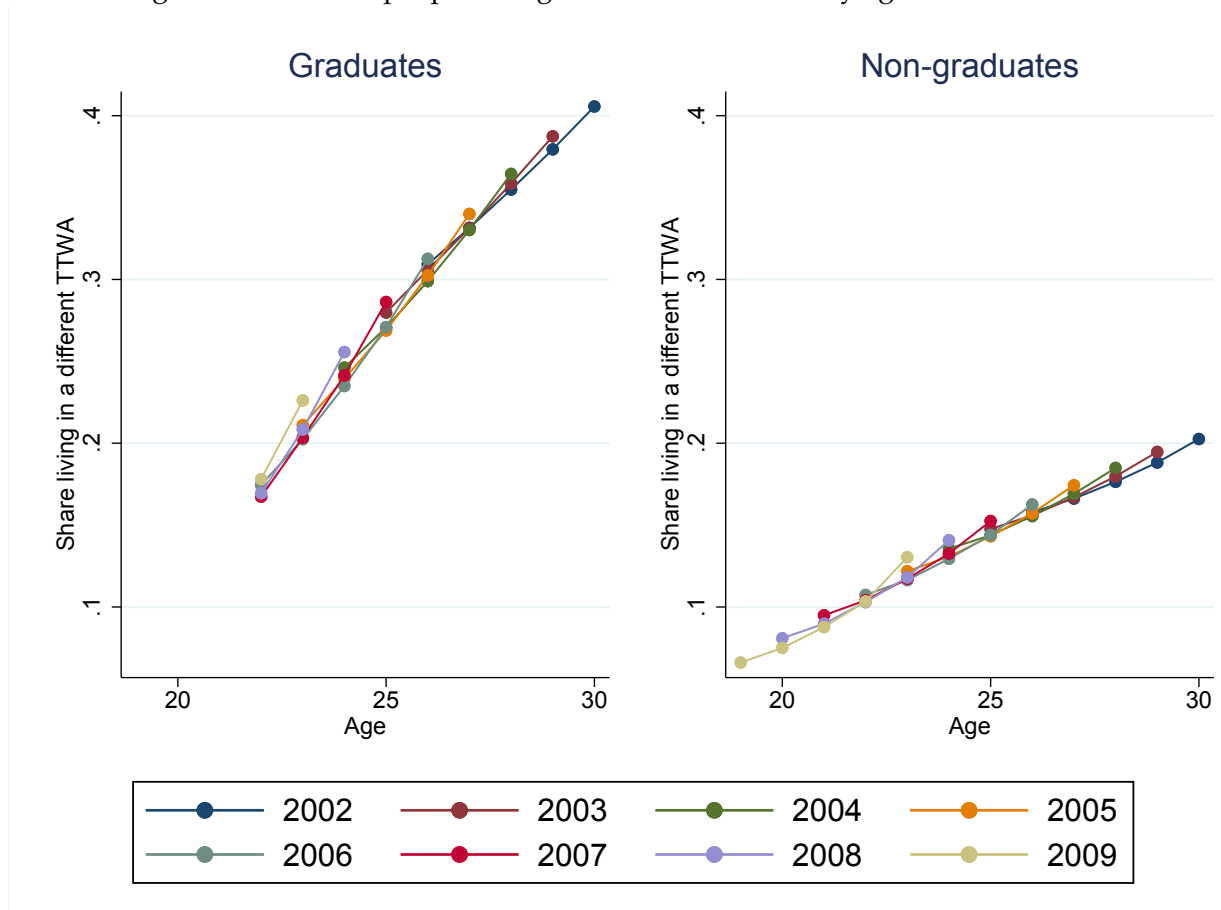


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# Appendix

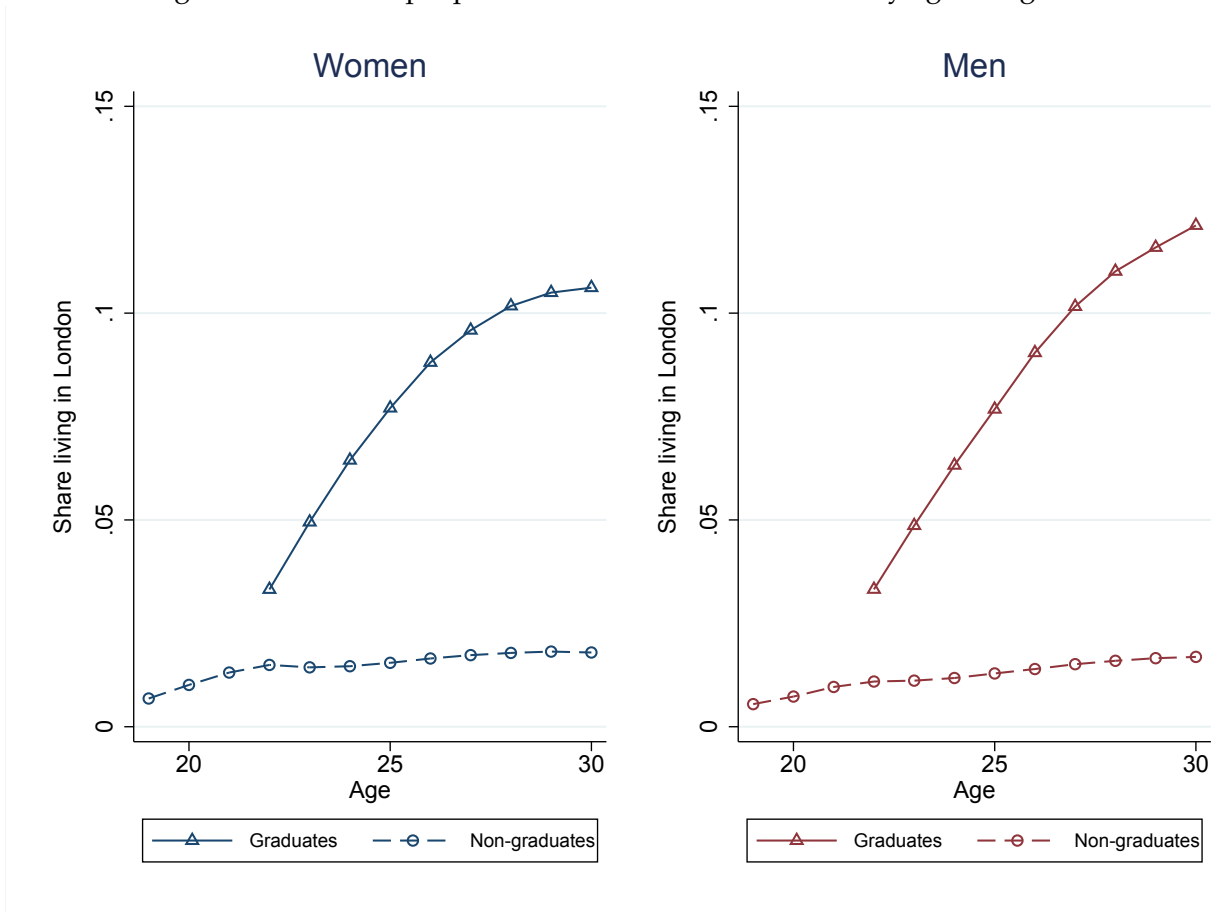
## A1 Additional figures and table

Figure A1: Share of people living in a different TTWA by age and GCSE cohort



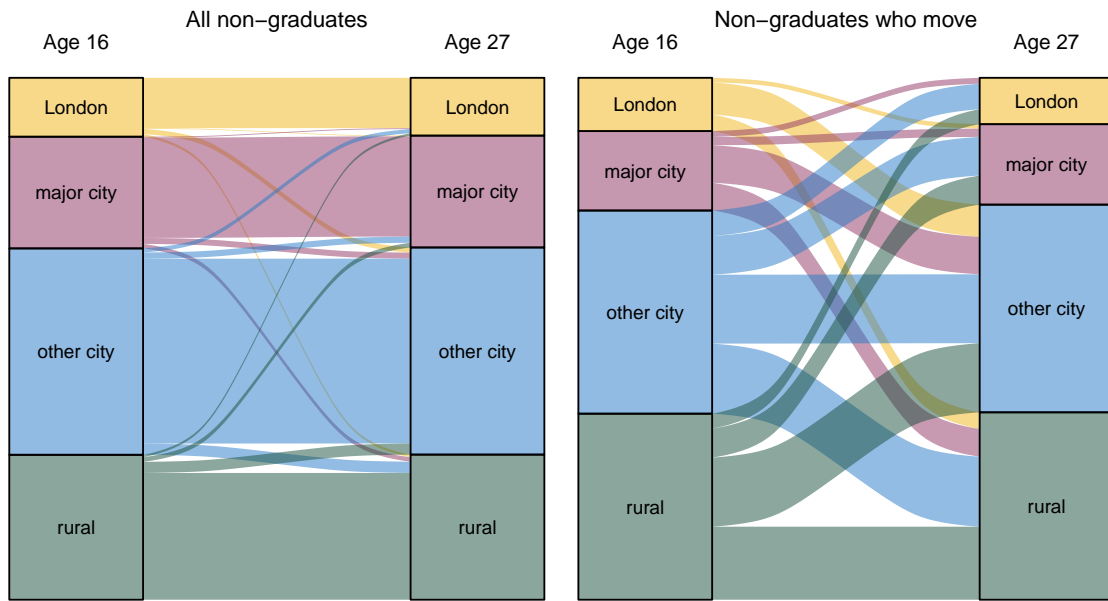
Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

Figure A2: Share of people who have moved to London by age and gender



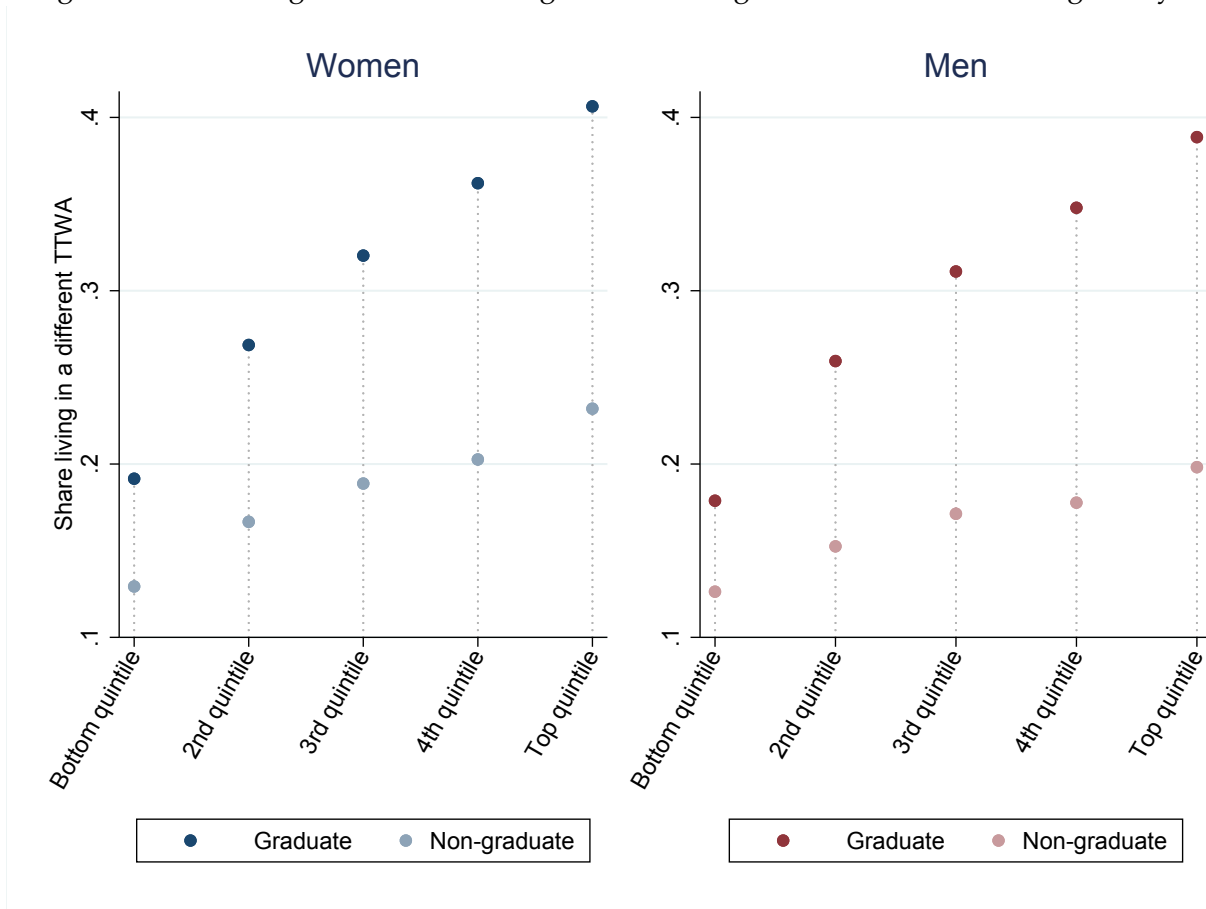
Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time. People living in London at age 16 are dropped.

Figure A3: Mobility patterns of non-graduates, age 16 to age 27



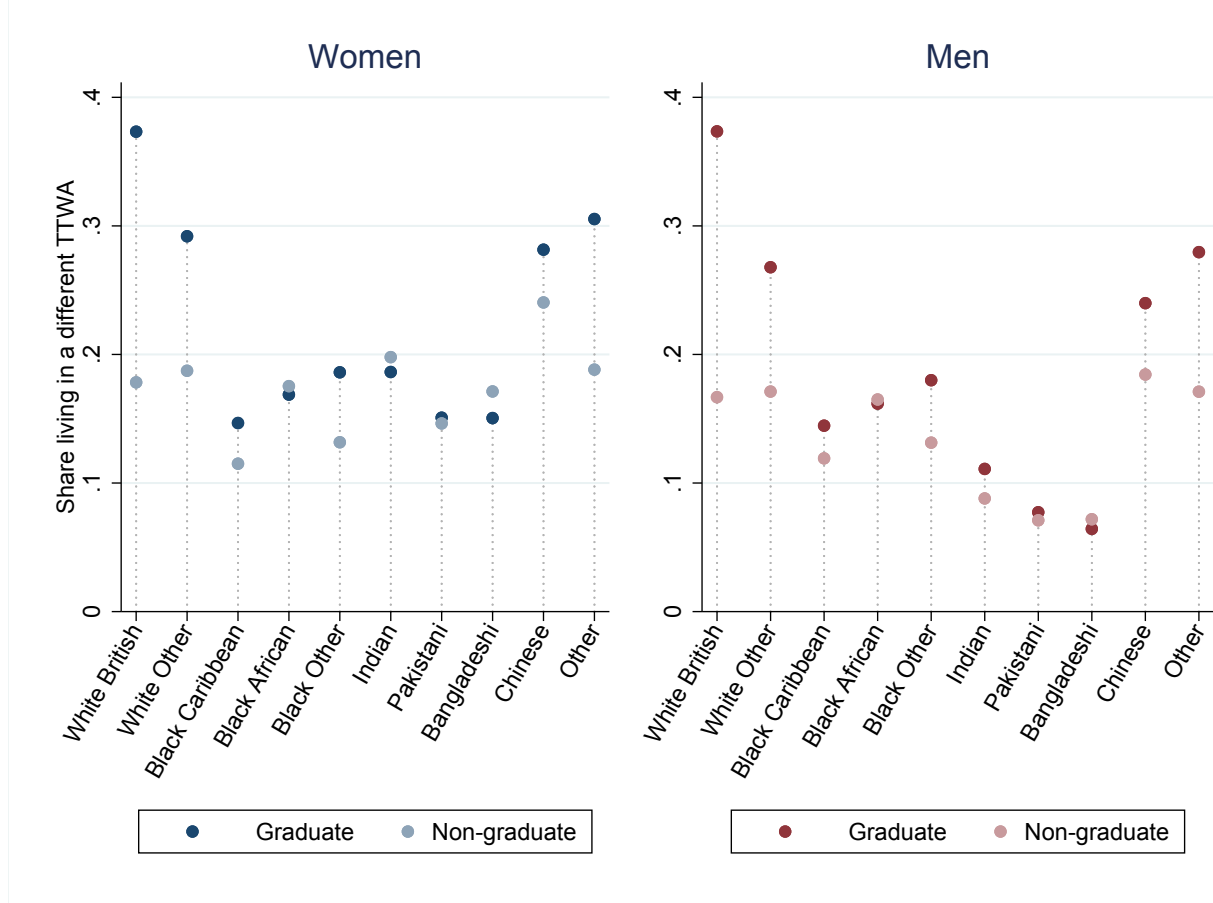
Note: The left-hand figure shows the area types where non-graduates lived at age 16, and compares these with where they live at age 27, showing the flows of non-graduates to and from each area type. The right-hand figure only shows origin and destination area type for non-graduates who move TTWA between ages 16 and 27. Individuals observed to be in full-time education at age 27 are dropped, as are observations for part-time students if they graduate at age 27. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.

Figure A4: Share of graduates and non-graduates living in a different TTWA at age 27 by SES



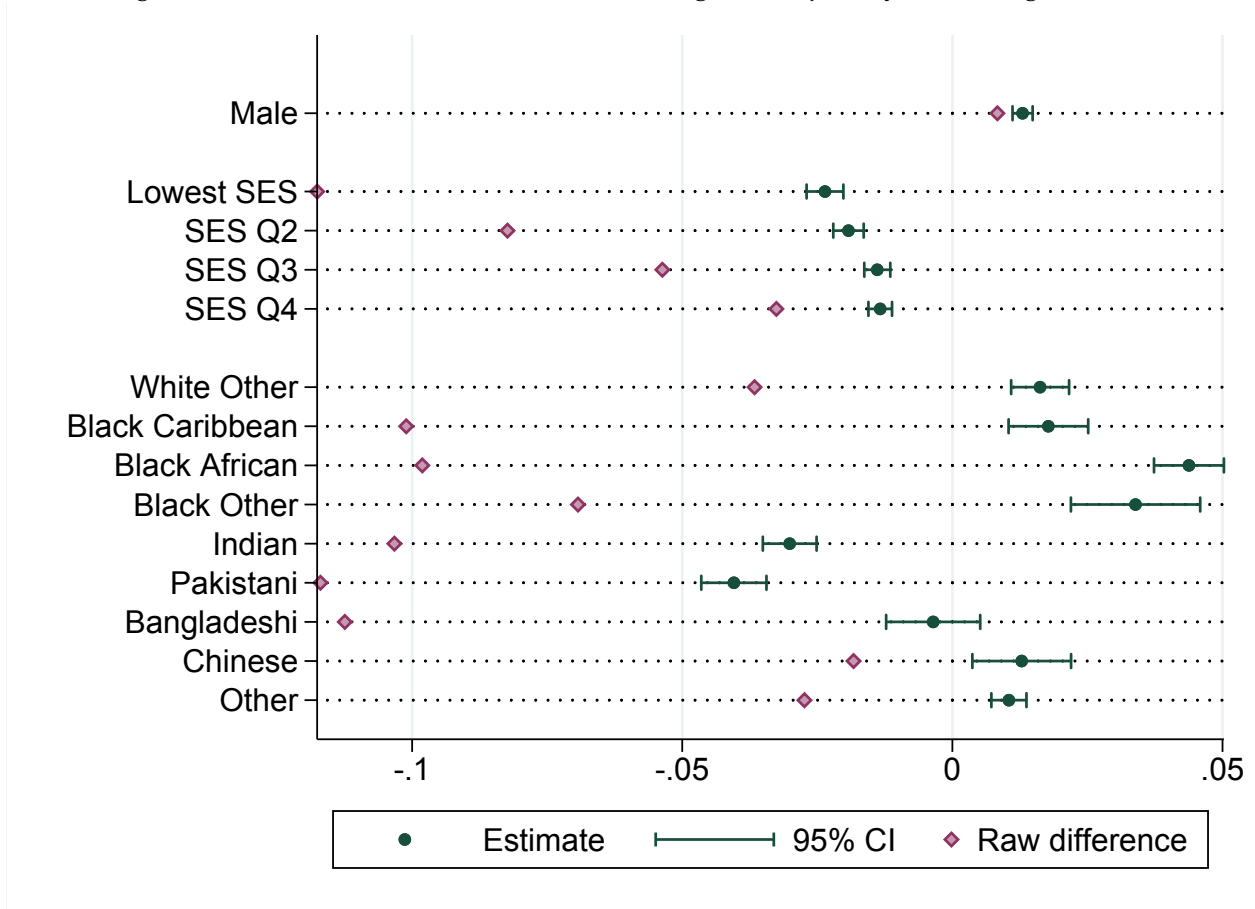
Note: Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

Figure A5: Share of graduates and non-graduates living in a different TTWA at age 27 by ethnicity



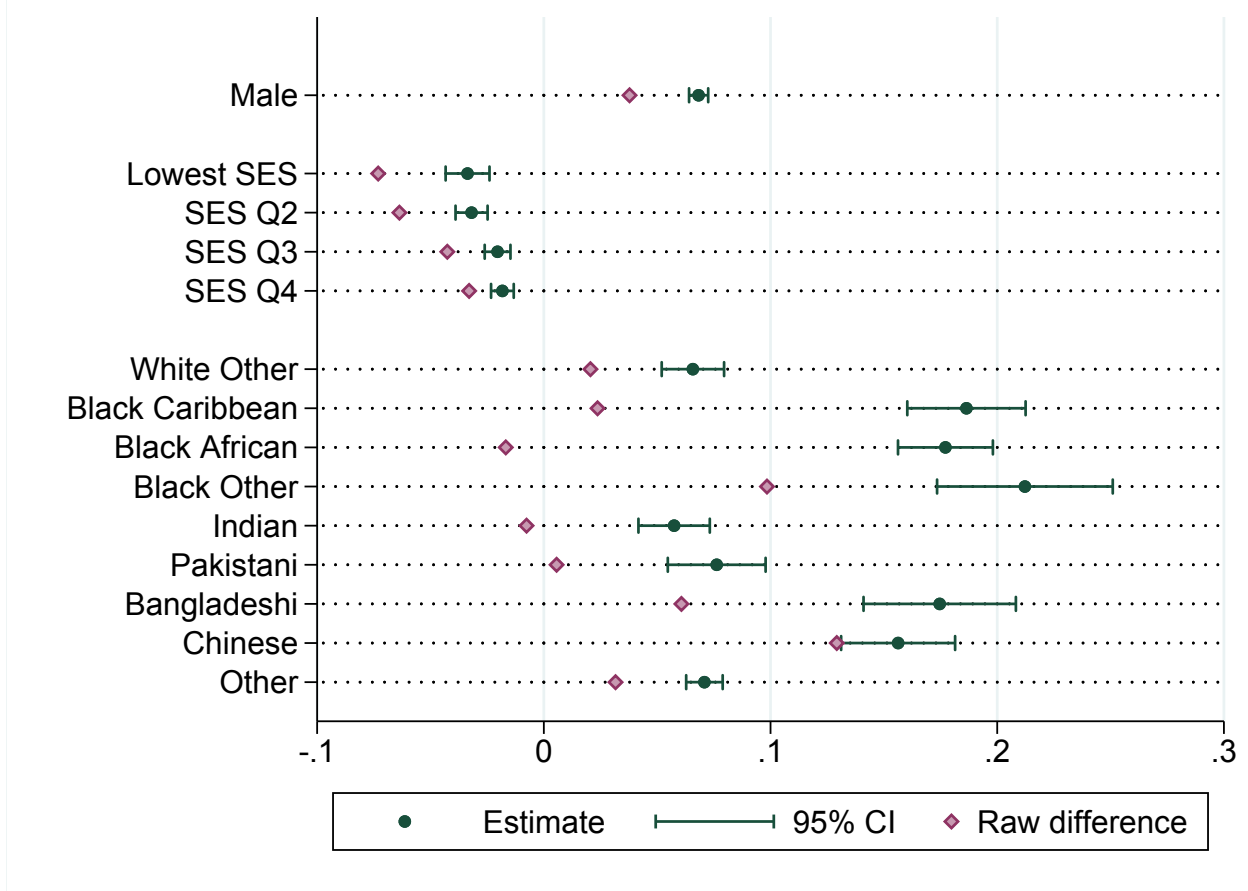
Note: Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

Figure A6: Differences in likelihood of moving to a major city between graduates



Note: Shows coefficients from a linear probability regression model. Only those who have obtained a degree by age 27 are included in the regression. The model regresses an indicator for ‘moving’ – defined as living in a different TTWA at age 27 from at age 16 – on all of the observable characteristics shown in the figure, prior attainment, HE institution, subject choice, TTWA of origin fixed effects and other controls listed in Section 2.2. The reference categories are female, highest SES and White British. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education at age 27 are dropped.

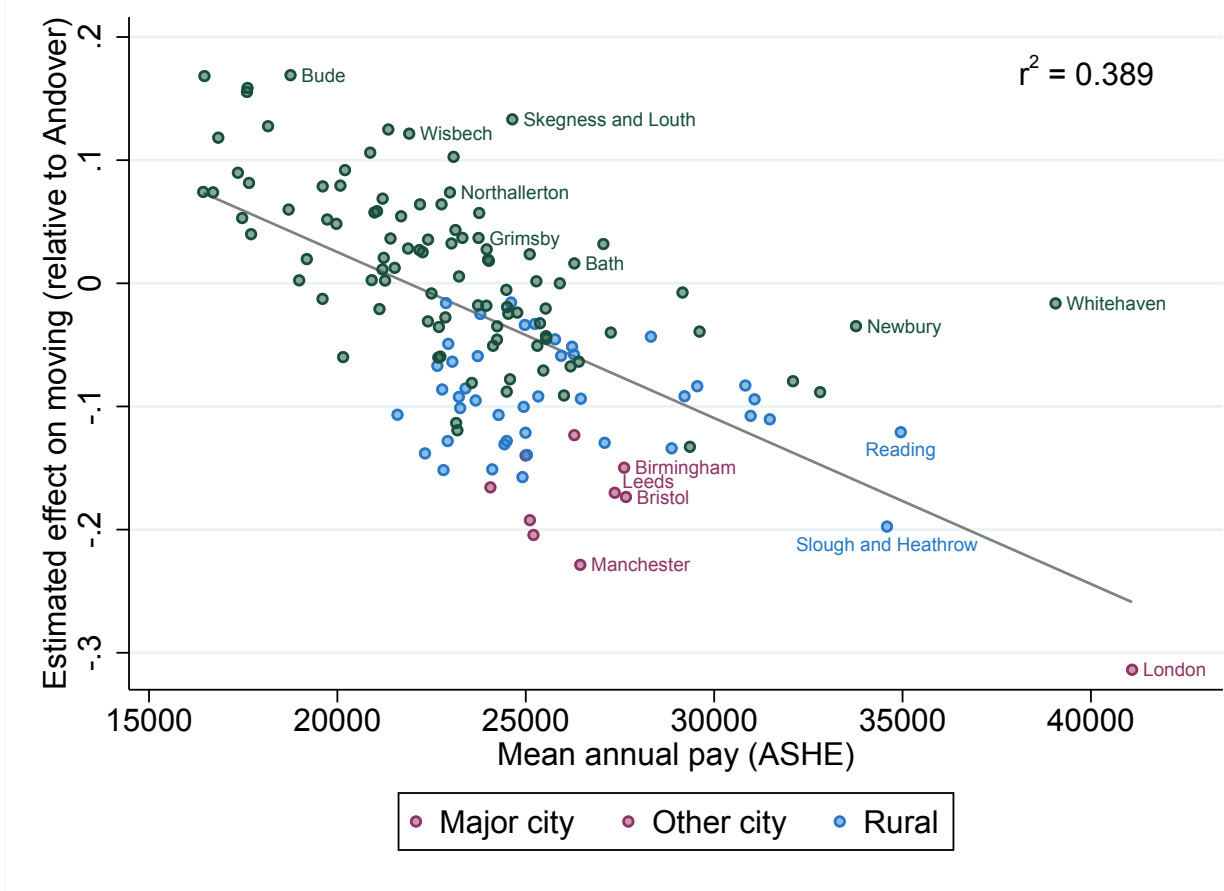
Figure A7: Differences in likelihood of moving to a major city between graduates, movers only



Note: Shows coefficients from a linear probability regression model. Only individuals who have obtained a degree by age 27 and are also living in a different TTWA at age 27 from at age 16 are included in the regression. The model regresses an indicator for 'living in a major city' on all of the observable characteristics shown in the figure, prior attainment, HE institution, subject choice, TTWA of origin fixed effects and other controls listed in Section 2.2. The reference categories are female, highest SES and White British. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education at age 27 are dropped.

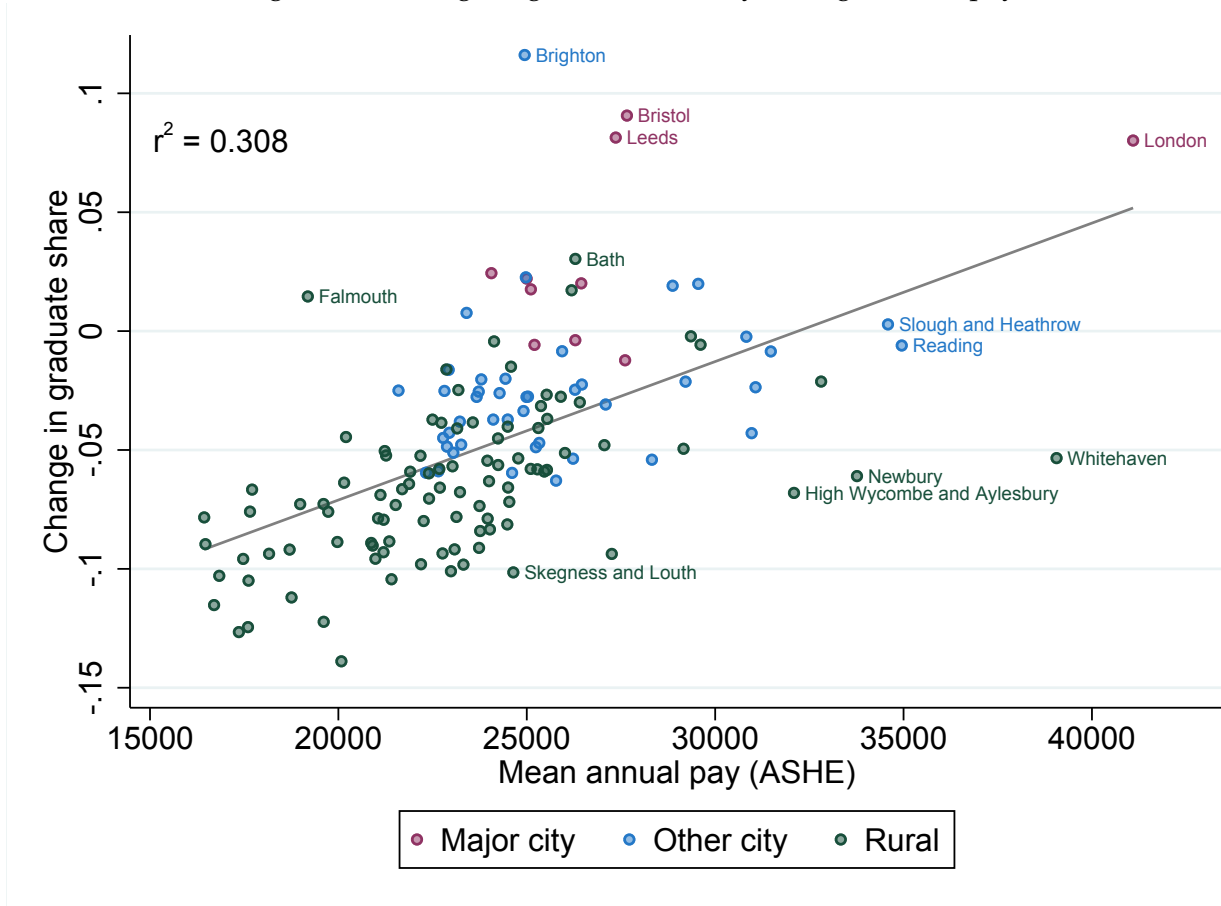


Figure A8: Movement rates by average annual pay of home TTWA, controlling for observables



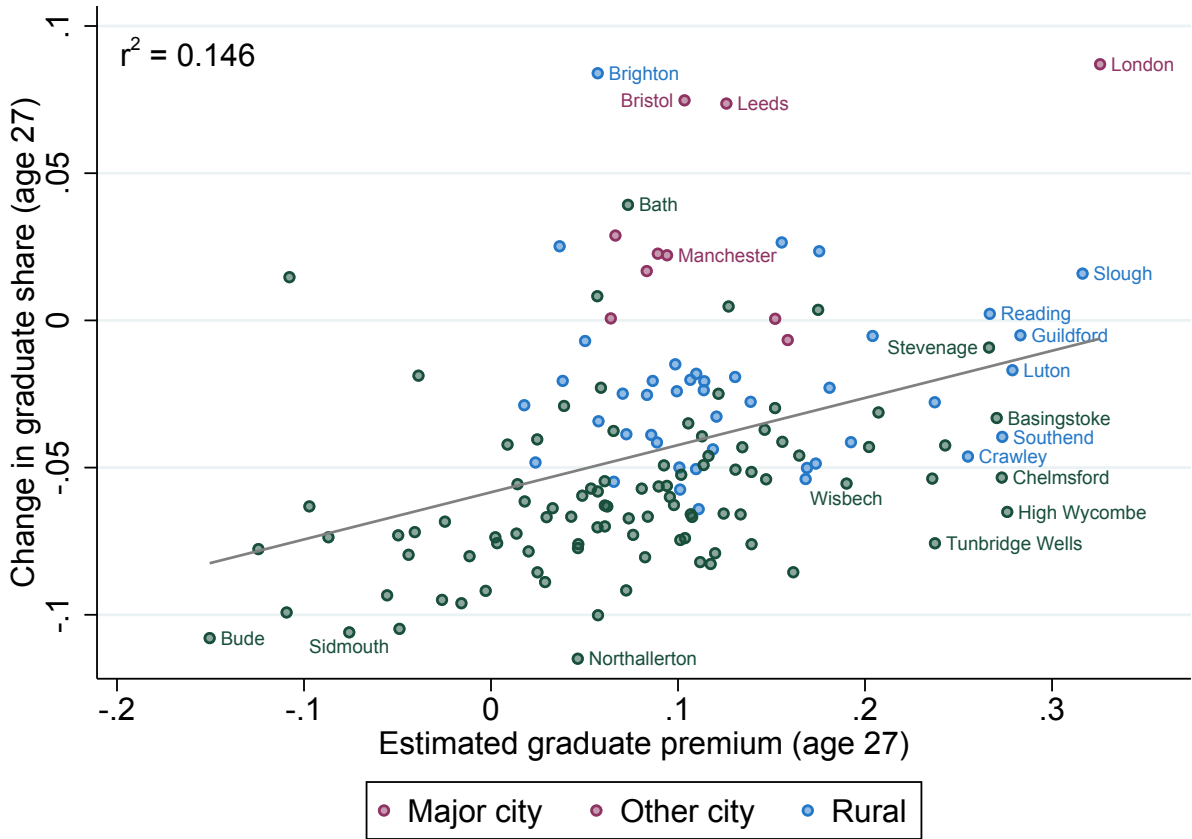
Note: Estimated effects on moving on the vertical axis are the estimated TTWA of origin fixed effects from a linear probability regression model which regresses an indicator for 'moving' – defined as living in a different TTWA at age 27 from at age 16 – on a graduate dummy and the background characteristics listed in Section 2.2. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Mean annual pay for each TTWA is the simple average of reported mean earnings from the 2014 to 2017 vintages of the Annual Survey of Hours and Earnings (ASHE).  $r^2$  is the proportion of the variance in the estimated effects on moving that is predictable by mean annual pay in a TTWA and an intercept (this is the square of the Pearson correlation coefficient).

Figure A9: Change in graduate share by average annual pay



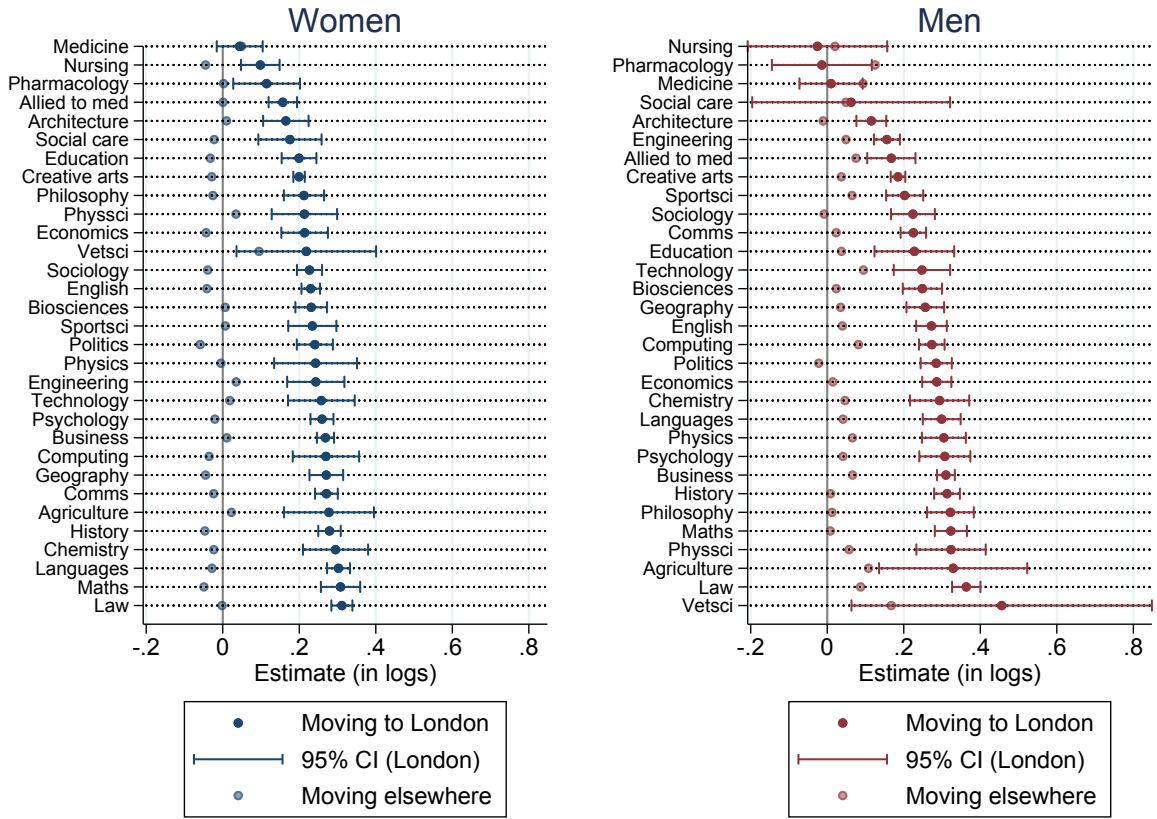
Note: Change in the share of graduates is the percentage point difference between the share of 16-year-olds from the area who *went on to be* graduates and the share of 27-year-olds who live in the area who *are* graduates. The latter share has been adjusted holding the non-graduate population constant at the age 16 level, in order to isolate the effect of graduate moves. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Mean annual pay for each TTWA is the simple average of reported mean earnings from the 2014 to 2017 vintages of the Annual Survey of Hours and Earnings (ASHE).  $r^2$  is the proportion of the variance in the change in the graduate share that is predictable by mean annual pay in a TTWA and an intercept (this is the square of the Pearson correlation coefficient).

Figure A10: Regional graduate premium and change in graduate share



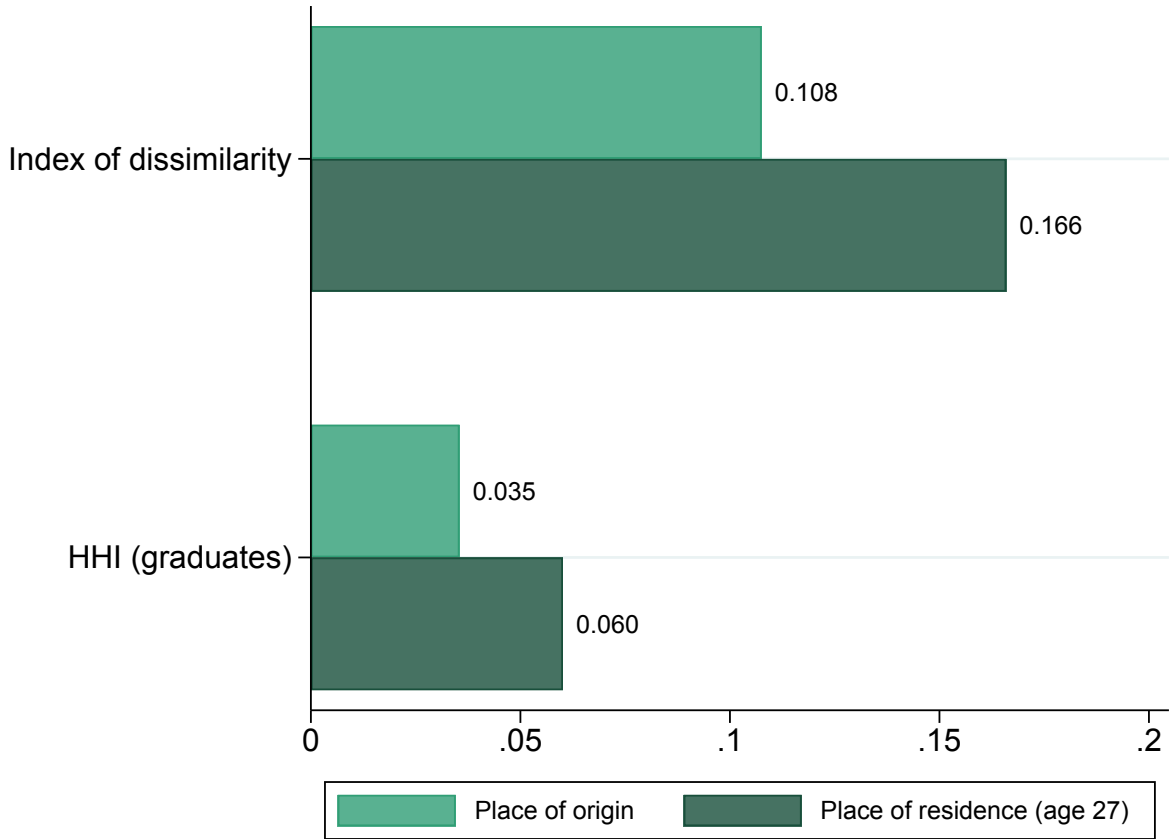
Note: The change in the share of graduates is the percentage point difference between the share of 16-year-olds from the area who *went on to be* graduates and the share of 27-year-olds who live in the area who *are* graduates. ‘Graduate premiums’ are estimated using a regression of earnings on a graduate dummy, interacted with TTWA at age 27, plus controls for background characteristics and school attainment as listed in Section 2.2, fully interacted with a gender dummy. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years.  $r^2$  is the proportion of the variance in the change in the graduate share that is predictable by the estimated graduate premium and an intercept (this is the square of the Pearson correlation coefficient).

Figure A11: Estimated 'moving premium' by subject for London and other moves



Note: 'Moving to London' refers to the estimated 'moving premiums' for students of different subjects from moving to London. 'Moving elsewhere' refers to the 'moving premium' from moving anywhere else. In estimating the 'moving premiums', we control for prior attainment, SES, ethnicity, TTWA at age 16 and other background characteristics listed in Section 2.2, as well as HE institution and subject. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Graduates are only counted as such if they have obtained their degrees before age 27. Individuals observed to be in full-time education at age 27 are dropped.

Figure A12: Spatial concentration of graduates by place of origin and place of residence



Note: The figure plots two commonly used measures of concentration for graduates, both by place of origin and place of residence at age 27, calculated at the TTWA level. The index of dissimilarity can be interpreted as the share of graduates who would need to move to even out the share of graduates across TTWAs. The Herfindahl-Hirschman Index (HHI) directly measures the concentration of graduates across TTWAs (in absolute terms rather than relative to non-graduates). Includes data from the 2002-05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time.

Table A1: Mobility of graduates by whether went to university in home TTWA (age 27)

	Left TTWA to study				Stayed in TTWA to study		
	share	of which			share	of which	
		returned	stayed	other		stayed	left
<i>Gender</i>							
Women	0.77	0.63	0.10	0.27	0.23	0.88	0.12
Men	0.79	0.65	0.10	0.25	0.21	0.90	0.10
<i>Socio-economic background</i>							
Bottom quintile	0.55	0.75	0.09	0.17	0.45	0.92	0.08
2nd quintile	0.70	0.69	0.10	0.21	0.30	0.90	0.10
3rd quintile	0.78	0.66	0.10	0.24	0.22	0.88	0.12
4th quintile	0.83	0.63	0.10	0.27	0.17	0.87	0.13
Top quintile	0.88	0.59	0.10	0.30	0.12	0.84	0.16
<i>Ethnicity</i>							
White British	0.83	0.62	0.11	0.28	0.17	0.87	0.13
White Other	0.70	0.65	0.11	0.23	0.30	0.91	0.09
Black Caribbean	0.56	0.79	0.08	0.13	0.44	0.93	0.07
Black African	0.63	0.77	0.09	0.14	0.37	0.93	0.07
Black Other	0.60	0.75	0.10	0.15	0.40	0.93	0.07
Indian	0.67	0.82	0.05	0.13	0.33	0.92	0.08
Pakistani	0.52	0.85	0.05	0.10	0.48	0.92	0.08
Bangladeshi	0.34	0.80	0.07	0.13	0.66	0.93	0.07
Chinese	0.71	0.67	0.12	0.20	0.29	0.92	0.08
Other	0.72	0.67	0.10	0.23	0.28	0.89	0.11

Note: The second, third and fourth columns are shares among those who leave their home TTWA to study and thus add up to 1. 'Returned' refers to those whose age 27 address is in the same TTWA as their address at age 16. 'Stayed' refers to those whose age 27 address is in the same TTWA as their university. 'Other' refers to those whose age 27 address is neither in the same TTWA as their address at age 16 nor in the same TTWA as their university. The last two columns are shares among those who stay in their home TTWA to study and thus also add up to 1. 'Stayed' refers to those whose age 27 address is in the same TTWA as their address at age 16 (which is also the TTWA of their university). 'Left' refers to those whose age 27 address is not in the same TTWA as their address at age 16 (and thus also not in the same TTWA as their university). The two columns headed 'share' also add up to 1. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education at age 27 are dropped.

## A2 Misrecording

In order to quantify the scale of misrecording based on our two measures of the share of people living with their parents at each age – from our DWP data (LEO) and from the FRS – we set up a simple model of misrecording and estimate it using the generalised method of moments (GMM).

Suppose  $\sigma_t$  is the share of students actually living with their parents in period  $t$ .  $\sigma_t^*$  is the share of people recorded in the DWP as living in the same LSOA at age 16, which we assume to be the same as the share of people recording their parents' address.  $t = 0$  is the period at age 16 when all students live with their parents, so  $\sigma_0 = \sigma_0^* = 1$ .  $t = 1, \dots, T$  are in each case the tax year  $t$  years after graduation.

Assume further that people never move back in with their parents after living away in any period  $t \geq 1$ . All students who live with their parents in any period  $t$  correctly record their address with HMRC. Students who do not live with their parents either record their correct address or their parents' address. In the first period after moving, a share  $\alpha$  record their correct address. In each subsequent period, a share  $\rho$  of the remainder update their address to the correct address. Under these assumptions,  $\sigma_t^*$  is given by

$$\sigma_t^* = \sigma_t + (1 - \alpha) \sum_{s=1}^t (\sigma_{s-1} - \sigma_s) (1 - \rho)^{t-s}. \quad (1)$$

Note that it is possible from this to work out  $\{\sigma_t\}_{t=1}^T$  from  $\{\sigma_t^*\}_{t=1}^T$  (and vice versa) if  $\alpha$  and  $\rho$  are known.

We can then estimate the parameter vector  $\theta = (\sigma_1, \dots, \sigma_T, \alpha, \rho)$  using GMM. We use the sample moment conditions

$$\sigma_t - \hat{\sigma}_t = 0 \text{ for } t = 1, \dots, T \quad (2)$$

where  $\hat{\sigma}_t$  is the share living with parents recorded in the FRS and

$$\hat{\sigma}_t^* - \sigma_t - (1 - \alpha) \sum_{s=1}^t (\sigma_{s-1} - \sigma_s) (1 - \rho)^{t-s} = 0 \text{ for } t = 1, \dots, T \quad (3)$$

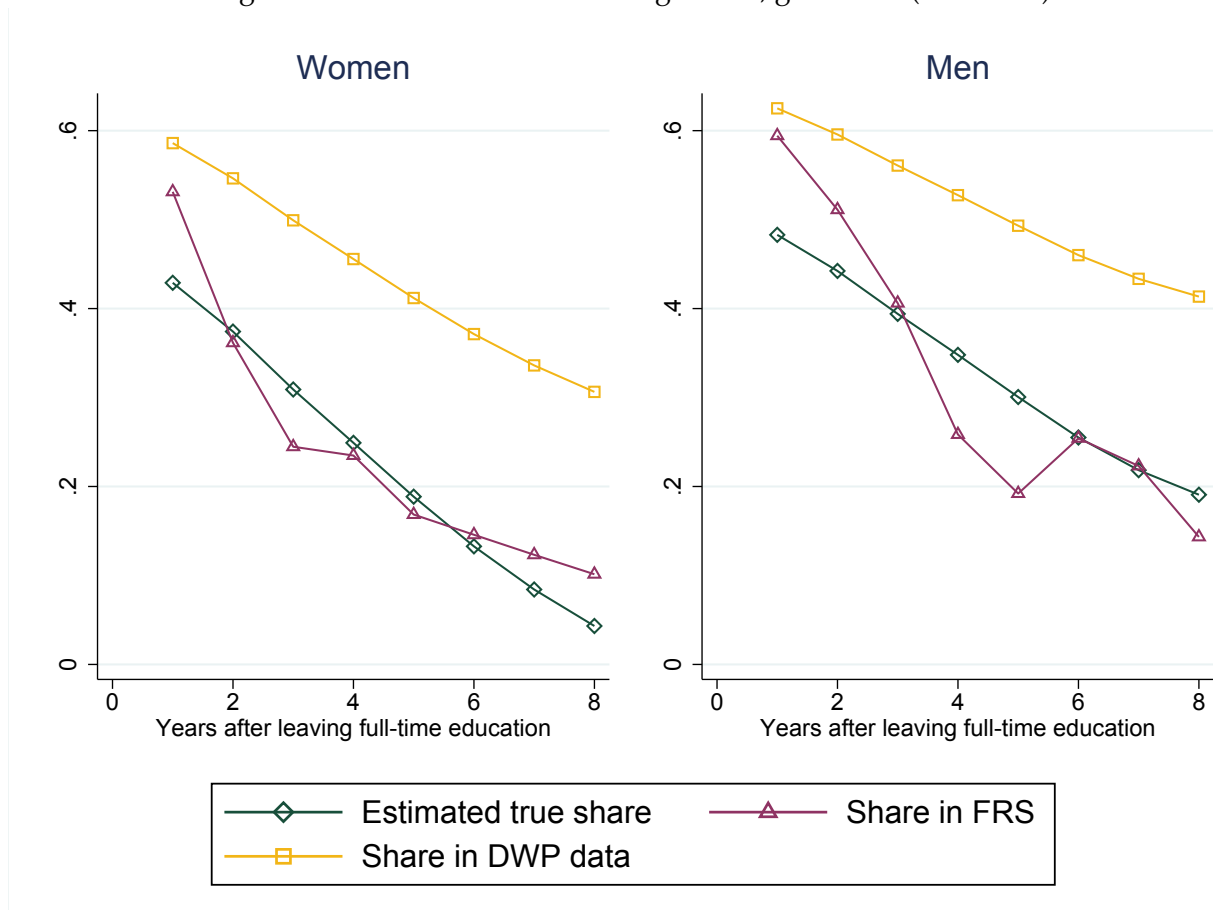
where  $\hat{\sigma}_t^*$  is the share living in the same LSOA in LEO. Moment conditions are weighted using the diagonal weight matrix  $W = \text{diag}(\text{Var}(\hat{\sigma}_1)^{-1}, \dots, \text{Var}(\hat{\sigma}_T)^{-1}, \text{Var}(\hat{\sigma}_1^*)^{-1}, \dots, \text{Var}(\hat{\sigma}_T^*)^{-1})$ .

When we took this model to the data, we found that the point estimate for the updating parameter  $\rho$  was near zero or even negative (depending on the group for which it was estimated), and imposing  $\rho = 0$  did not substantially affect the fit of the model. We have therefore set  $\rho = 0$  in our preferred specification. In that case, (3) simplifies to

$$\hat{\sigma}_t^* - (1 - \alpha + \alpha\sigma_t) = 0 \text{ for } t = 1, \dots, T. \quad (4)$$

We also found no substantial differences between men and women; as a result, while we use separate moments for each gender, we restrict  $\alpha$  to be the same across genders in our preferred specification.

Figure A13: Preferred misrecording model, graduates ( $\alpha = 0.725$ )



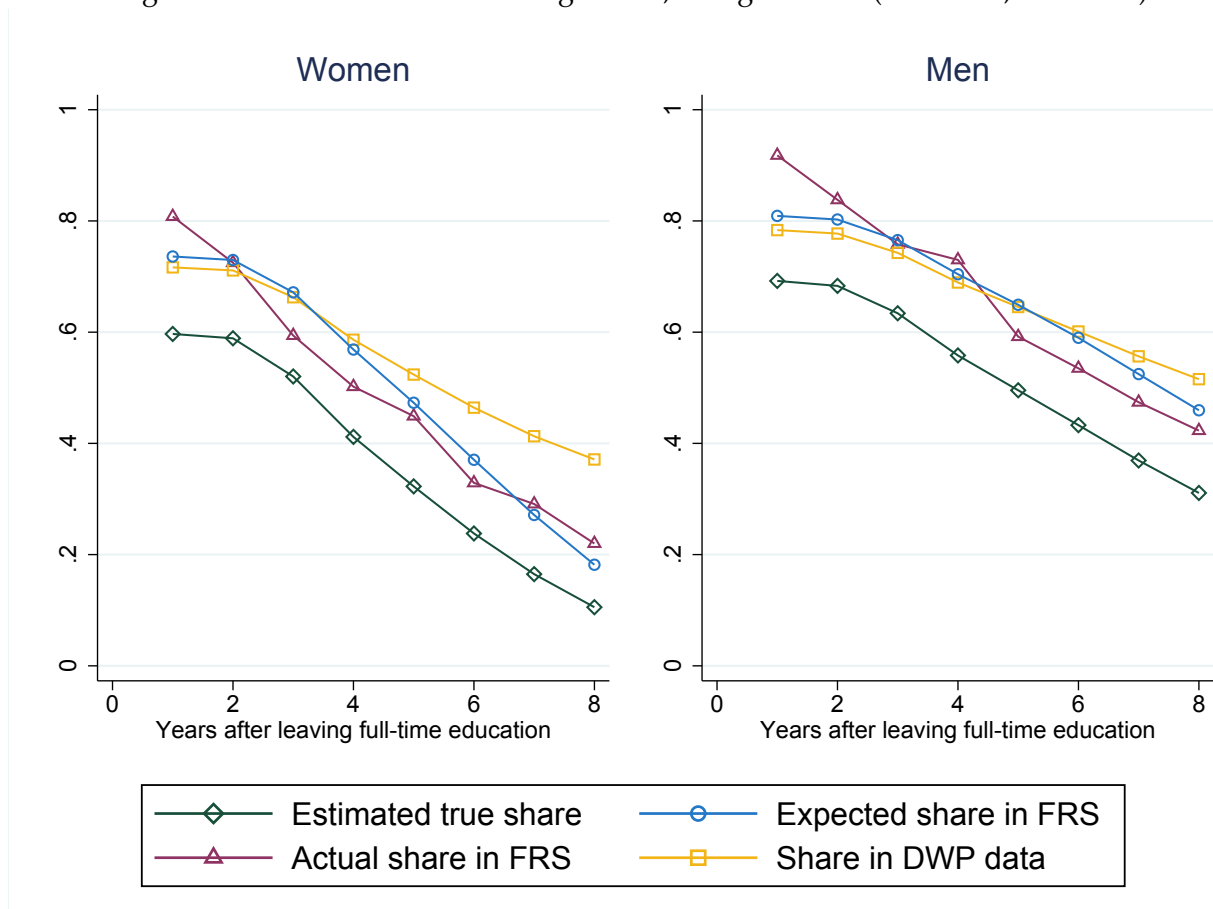
Note: 'Estimated true share' refers to  $\sigma_t$ , 'Share in FRS' refers to  $\hat{\sigma}_t$  and 'Share in DWP data' refers to  $\hat{\sigma}_t^*$ . Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years.



As shown in Figure A13, this model fits fairly well for graduates. We obtain a value for the share of people updating their address of  $\alpha = 0.725$ . This implies that the true number of people moving may be around 40% higher than the administrative records would suggest.

Our model fits less well for non-graduates, who are substantially younger on average when they leave full-time education. Our conjecture is that this is explained by disproportional rates of non-response to the FRS among young people who do not live with their families. It is well known that young people are less likely to respond to surveys in general, but as the FRS is a household survey, young people living at home will be counted as long as their parents respond.

Figure A14: Preferred misrecording model, non-graduates ( $\alpha = 0.703, \delta = 0.531$ )



Note: 'Estimated true share' refers to  $\sigma_t$ , 'Expected share in FRS' refers to  $\tilde{\sigma}_t$ , 'Actual share in FRS' refers to  $\hat{\sigma}_t$  and 'Share in DWP data' refers to  $\hat{\sigma}_t^*$ . Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years.

To account for this effect, we introduce another parameter ( $\delta$ ) into the model, which represents the share of non-graduates not living at home who respond to the FRS (relative to the share whose

parents respond). Then (2) becomes

$$\tilde{\sigma}_t - \hat{\sigma}_t = 0 \text{ for } t = 1, \dots, T \quad (5)$$

where

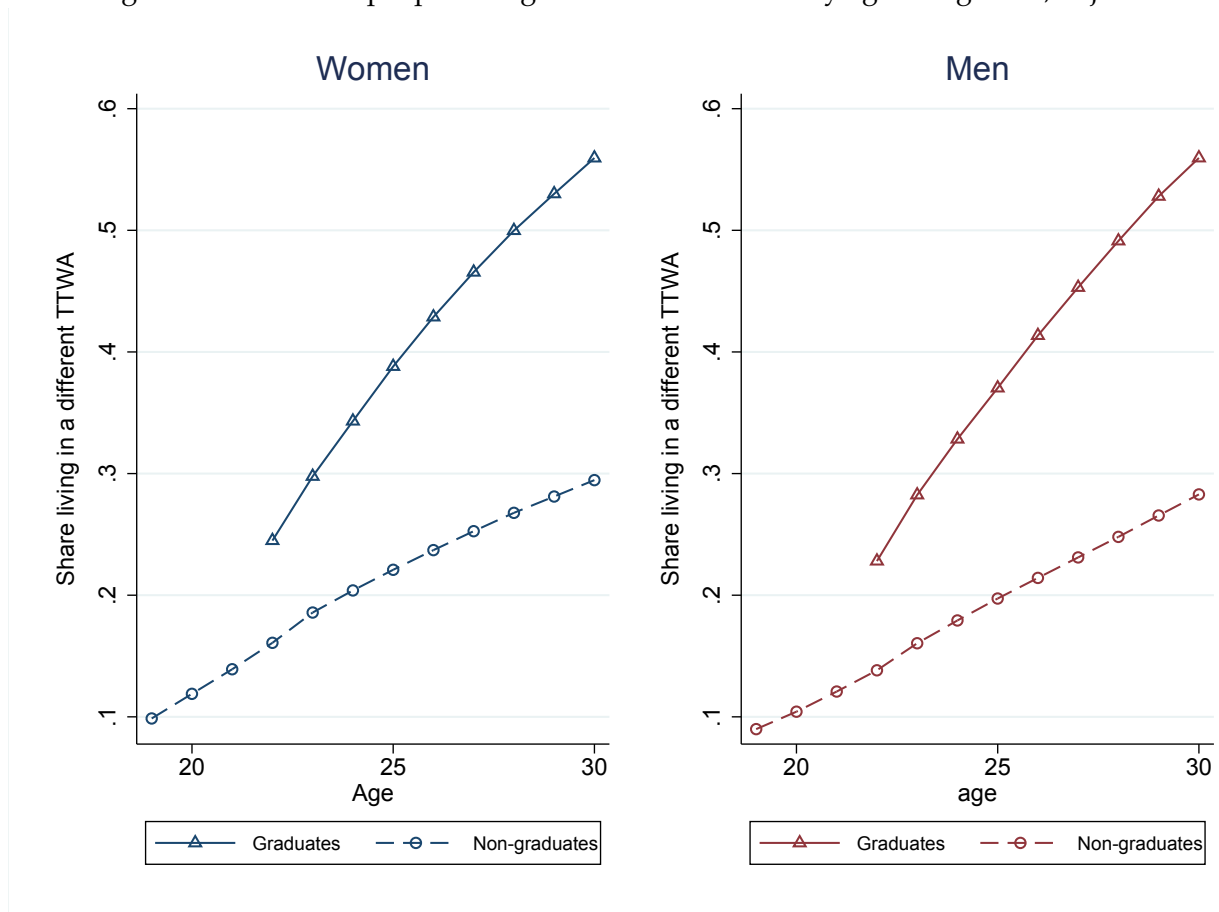
$$\tilde{\sigma}_t = \frac{1}{1 + \delta \left( \frac{1}{\hat{\sigma}_t} - 1 \right)}.$$

(4) remains unchanged.

When we estimated this augmented model on the data for non-graduates, we obtained a value of  $\alpha = 0.703$  for the share of people correctly updating their address, which is very close to the value obtained for graduates. We get  $\delta = 0.531$  for the (relative) share of young people living away from home responding to the FRS, which seems realistic. Figure A14 shows the fit of the model. While the model has some trouble fitting the FRS data in the first year after full-time education (which is likely related to limitations of the administrative school records we hold), the fit is good overall. While these results for non-graduates are likely less reliable than the results for graduates given the potential problems with non-response in the FRS for very young people, it is reassuring that the estimated share of people with correctly updated addresses ( $\alpha$ ) is roughly similar to what we obtain for graduates.

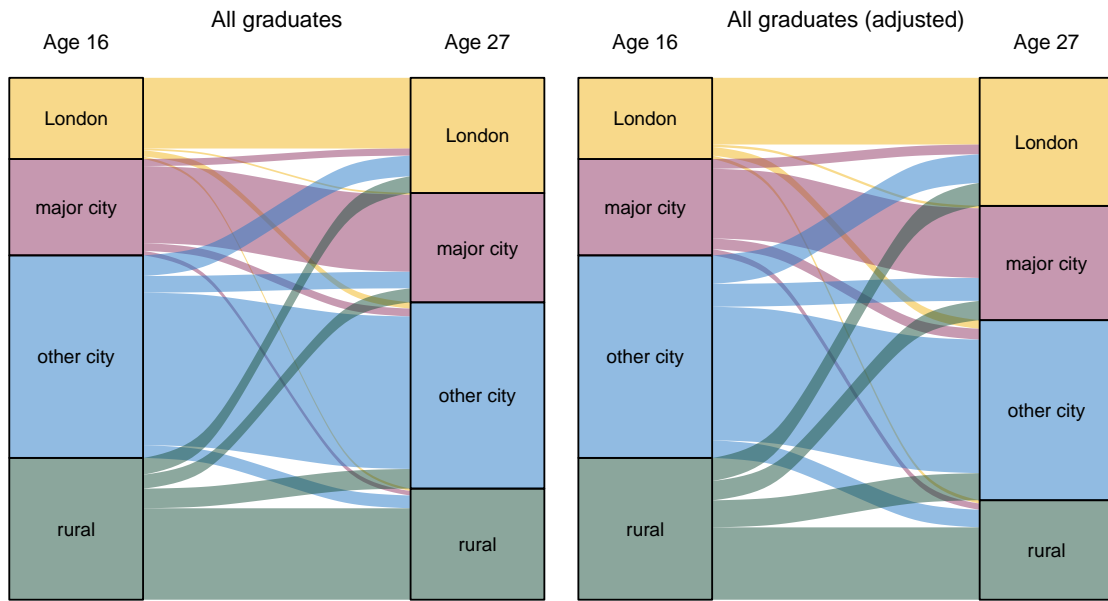
### A3 Figures adjusted for misrecording

Figure A15: Share of people living in a different TTWA by age and gender, adjusted



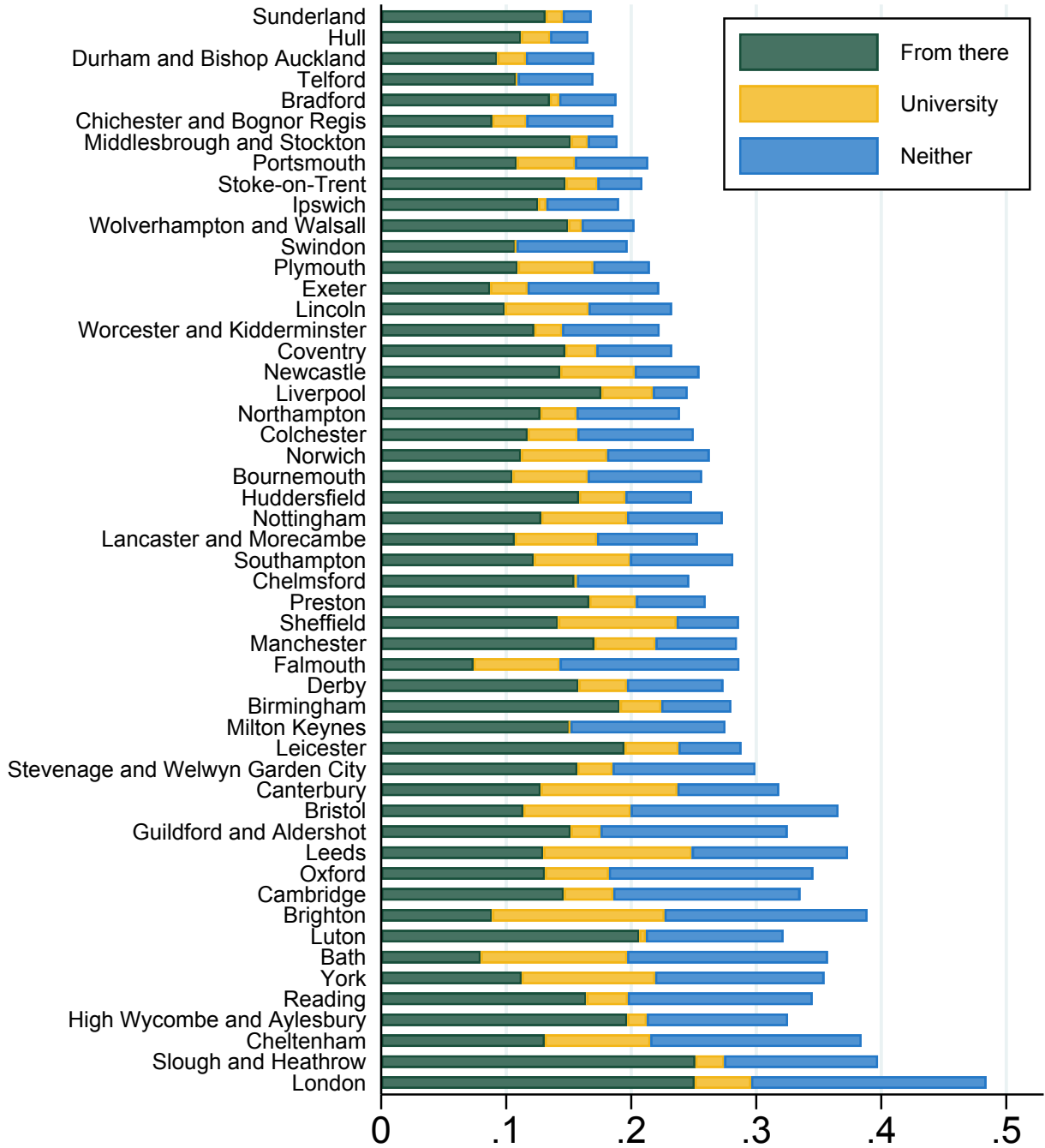
Note: Includes data from the 2002–09 GCSE cohorts, and from the 2012/13 to 2016/17 tax years. Graduates are only counted as such once they have obtained their degrees. Individuals observed to be in full-time education are dropped, and the graduation year is dropped for non-graduates studying part-time. Results have been adjusted to account for misrecording using the estimated parameters from our misrecording model.

Figure A16: Mobility patterns of graduates, age 16 to age 27, adjusted



Note: The left-hand figure shows the area types where graduates lived at age 16, and compares these with where they live at age 27, showing the flows of graduates to and from each area type. The right-hand figure shows the same data adjusted to account for misrecording using the estimated parameters from our misrecording model. Those observed to be in full-time education at age 27 are excluded from the chart. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education at age 27 are dropped.

Figure A17: Composition of graduate share in TTWAs with universities, adjusted



Note: 'From there' refers to the share of 27-year-olds living in each TTWA who have obtained a degree and were living in the same TTWA at age 16. 'University' refers to the share of 27-year-olds living in each TTWA who have obtained a degree from a university in that TTWA and were *not* living in the same TTWA at age 16. 'Neither' refers to the share of 27-year-old graduates living in each TTWA who have not obtained a degree from a university in that TTWA *and* were not living in that TTWA at age 16. Only TTWAs that contain a university are included in the figure (a small number of institutions with campuses spread across multiple TTWAs are disregarded). Results have been adjusted to account for misrecording using the estimated parameters from our misrecording model. To facilitate comparisons with Figure 22, the ordering of TTWAs from that figure has been retained. Includes data from the 2002–05 GCSE cohorts, and from the 2013/14 to 2016/17 tax years. Individuals observed to be in full-time education at age 27 are dropped.



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For any enquiries regarding this publication, contact us at:

[Gabriel.KITE@education.gov.uk](mailto:Gabriel.KITE@education.gov.uk) or [www.education.gov.uk/contactus](http://www.education.gov.uk/contactus)