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Migration and inter-industry mobility of UK graduates

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Abstract

New university graduates are highly geographically mobile, but, as the literature has shown, often struggle in the labour market, working in non-graduate level jobs or in a field different from the one for which they are qualified. In this context, inter-industry moves can act as complements or substitutes for geographical moves, with graduates reacting to job mismatches by either changing location, industry, or both. Self-selection is also likely; industry movers may differ from non-movers in ways that also affect their career outcomes. We analyse the relationship between migration and inter-industry moves using longitudinal microdata for 7060 recent UK graduates.

Keywords: Inter-regional migration, human capital, graduates, self-selection

JEL classifications: R23, I23, J24, J28

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1. Introduction

University graduates are a special category of job seeker, in that they are highly educated and, as the literature on graduation migration shows, also highly mobile (Haapanen and Tervo 2006; Whisler et al., 2008; Faggian and McCann, 2009; Venhorst et al., 2011). In a study based on longitudinal data for graduates from the late 1970s to the early 1990s, Kodrzycki (2001) finds that college graduates are more than twice as likely to move from the US state where they attended college than young people of the same generation with fewer years of schooling. These characteristics mean that the migration determinants of graduates are of particular importance for the analysis of regional economic disparities, since the benefits of encouraging recent graduates to remain in the region of study can be substantial. In this context, colleges and universities can help to raise human capital levels in their region by increasing both the supply and demand for skilled labour (Abel and Deitz, 2009). This occurs as the presence of universities tilts the structure of local labour markets towards occupations that are more human capital intensive (Beeson and Montgomery, 1993; Faggian and McCann, 2006; Abel and Deitz, 2009).

There is also a great deal of policy interest in the career paths of graduates, particularly in the light of recent government policy initiatives aimed at higher

education in the UK. Following the significant expansion in higher education in the 1990s, the then Department for Education and Skills (DfES) commissioned a survey on the career paths of graduates, entitled the 'Class of '99' (Purcell et al., 2005). The authors found that, immediately after graduation, almost 50% of the 1998–1999 cohort were working in non-graduate occupations, that is, occupations that do not require a graduate degree, although this proportion fell to 15% 4 years after graduation.¹ There is also a mismatch between the subject studied and the field of work (McGuinness and Sloane, 2009); a recent study by the Chartered Institute of Personnel and Development (CIPD) shows that 46% of the graduates are currently working in a field different from the one for which they are qualified (CIPD, 2010). Graduates may also take jobs for which they are overeducated as a second best strategy in order to gain valuable experience, obtain on-the-job training and search for a better job match (Rubb, 2003). However, this mismatch due to overeducation can be persistent; Battu et al. (1999) find that over 40% of UK graduates from the 1985 cohort were in jobs that did not match their degree 11 years after graduation.

In addition, the difficulties encountered by graduates in the labour market have been found to be highly subject-specific. Recent research shows that only 51% of creative arts graduates work in the creative industries, or in a creative job outside the creative industries (Comunian et al., 2010). Earnings are also lower for creative arts graduates than those of other graduates in both the creative and non-creative sectors, a situation that persists into the medium term (Abreu et al., 2012). The DfES analysis of the 'Class of '99' also finds that career success is subject-specific; the percentage of graduates employed in graduate-level occupations is significantly higher for subjects such as medicine, education and engineering, and lower for the arts and humanities, particularly in the first 3 years after graduation (Purcell et al., 2005, 62–63).

These findings raise interesting issues regarding the sources of variation in the career paths of graduates, such as whether migration and/or a change in the industry of employment affect graduate earnings and career prospects, and whether personal characteristics such as age, gender, ethnicity and degree characteristics affect the decision to change location and/or industry. To date, there has been little research on graduate migration in conjunction with industry change, other than the relatively descriptive analyses discussed above. This is also true of the literature on migration more generally; few studies have extended the migration framework to incorporate both geographical and industry moves, Gallaway (1969), Nakosteen and Zimmer (1982), Shaw (1991) and Krieg (1997) being notable exceptions.

The key issue is whether industry moves can act as complements or substitutes for geographical moves, with individuals reacting to job mismatches by either changing location, industry or both location and industry.² Related to this is the likely presence

1 These are defined on the basis of the 2000 version of the Standard Occupational Classification (SOC2000). They include occupations for which employers have traditionally required a degree (solicitors, doctors, scientists, secondary school teachers), modern graduate occupations (IT professionals, senior managers in large organizations), jobs for which graduates are being increasingly recruited in large numbers (occupational therapists, surveyors, management consultants) and 'niche' graduate occupations (planning and quality control managers, hotel managers and nurses). The jobs include generally cover managers, senior officials, professionals, associate professionals and technical workers. See Elias and Purcell (2004) for a detailed description.

2 In this study, we do not consider the related issue of occupational change. While also very relevant in explaining the relationship between migration and graduate career paths, there are significant data

of selection bias; industry movers may differ from non-movers in ways that also affect their choice of location and career outcomes. This bias has long been recognized in the literature. In a seminal study, Gallaway (1969) argued that the lower wages observed for migrants across US states (relative to non-migrants) were in part due to the lower wages of industry movers, who made up a large proportion of migrants. This bias is likely to be particularly significant for recent graduates, who are still settling into their careers, and who are therefore more likely to consider an industry change as a means to resolve a mismatch to their current job.

This article extends the existing literature on graduate migration in three ways. First, we study the impact of migration and industry change on the career outcomes of recent graduates, and analyse how personal characteristics affect both the migration strategy and the outcomes. Second, we move beyond a focus on monetary rewards to also consider the effects of migration and industry change on career satisfaction, which has been shown to be an important consideration for highly skilled workers (Mathios, 1989). Third, we control for selection bias in both migration and industry change by estimating a multinomial treatment effects model (Deb and Trivedi, 2006). Our aim is allow for the possibility that migrants who also change industry differ from migrants who do not change industry in ways that also affect their subsequent earnings and career satisfaction. The only similar approach to ours is Nakosteen and Zimmer (1982), who also allow for double selection according to migration and industry change, but assume that the industry change precedes (and is a determinant of) migration, rather than treating the choice as simultaneous. In addition, we use a latent factor approach to allow for selection in both observable and unobservable characteristics (see also Nakosteen et al., 2008, although their latent factor model is used in a different context).

The remainder of the article is organized as follows: Section 2 discusses the previous literature and presents our conceptual framework, Section 3 details our methods and data, Sections 4 and 5 present our descriptive and regressions results and Section 6 concludes.

2. Previous literature and conceptual issues

The literature on migration has largely abstracted from the issue of inter-industry mobility, despite significant evidence to suggest that many migratory moves also involve a change in industry of employment (Greenwood, 1975). The consequences of ignoring this issue are highlighted by Gallaway (1969), in a comment on an earlier article by Lansing and Morgan (1967), who had found that migrants have lower incomes than non-migrants, in contradiction of the human capital model of migration (Sjaastad, 1962). The key contribution of Gallaway (1969) was to show that the wages

restrictions that limit the scope of our analysis. For just over 10% of individuals in our sample, the occupation information provided 3½ years after graduation (as part of the LDLHE survey, see Section 3.1 for details) is only available at the major group SOC level, that is, we do not know their detailed occupation. At this broad level of aggregation, the analysis would not be very informative. One option would be to remove individuals whose detailed occupation data is missing, and run the analysis on the remainder of the sample. However, this would introduce a bias, since individuals whose detailed SOC code is missing all fall into the first two occupation groups ('managers and senior officials' and 'professional occupations'), and their salary is significantly higher than that of the rest of the sample (the difference in mean salaries is significant at the 1% level). Since our analysis is concerned with career outcomes, this might seriously affect our results. We therefore focus on industry change only.

of migrants are actually higher than those of non-migrants if one distinguishes between industry movers and stayers. In particular, he shows that the lower earnings for the migrants observed by Lansing and Morgan (1967) are driven by the lower wages of industry-movers, who make up a large proportion of migrants. Specifically, he finds that workers who only changed location have the highest earnings (\$5560 on average in 1960), followed by those who stayed in the same location and industry (\$5396). Workers who changed industry but not location, and those who changed both industry and location have the lowest earnings (\$3735 and \$3550 average annual earnings, respectively).³ Gallaway (1969) argues that this is a reflection of the lower productivity and greater incidence of involuntary turnover experienced by industry-movers. This finding is supported by other studies on occupational mobility, which show that industry changes lead to lower earnings unless they occur within certain high-tech sectors such as the semiconductor industry (Ong and Mar, 1992). This could be due to a loss in the value of sector-specific skills and knowledge as a result of industry moves, or a loss of advantages such as incentive pay schemes following a change of employer (Kletzer, 1996).

A small number of studies have attempted to further disentangle these findings and analyse the combined effects of industry change and migration on earnings, using multivariate techniques. Industry change can be conceptualized, in keeping with Sjaastad (1962), as an investment in human capital, whereby industry-movers expect to obtain higher lifetime returns (after allowing for switching costs) from changing industry relative to remaining in the same industry. Most of the studies in this subset of the literature start from this premise, but differ in the extent to which they take into account changes in residential location, employer and/or occupation, and in how they deal with the potential sample selection bias caused by non-random selection into migration and industry change (the issue highlighted by Gallaway, 1969). Closest to our study is Shaw (1991), who considers investment in industry-, occupation- and employer-specific skills, and their relevance in predicting migratory behaviour. She argues that individuals who make significant investments in industry-specific skills may find it more advantageous to change regions (but not industries) in order to broaden their range of search and seek out higher wages. These movers tend to be well-educated individuals who are searching for a good job match.

Other studies focus on the impact of personal characteristics such as gender, age and ethnic group. Nakosteen and Zimmer (1982) find that personal characteristics affect both selection into migration/industry change, and the career outcomes of different groups to varying degrees. For instance, non-white workers are more likely to change industry than white workers, while older and female workers are less likely to change industry or location. Along similar lines, Schlottmann and Herzog (1984) study the relationship between career mobility (defined in terms of a change in industry and/or occupation) and inter-state migration for different groups of workers in the USA. They find that career mobility is higher for migrants than non-migrants within each age cohort, and show that migration and career mobility tend to occur simultaneously, although the incidence of either type of move decreases with age. Osberg et al. (1994) also study the joint determination of inter-industry and inter-region labour mobility for workers in Canada,

3 It is interesting to note that our ranking of the average wages of migrants and/or industry movers is very similar to that of Gallaway (1969), despite the differences in study design, country, time period and context.

and find that female migrants benefit only slightly from inter-regional moves, but gain more than their male counterparts from inter-industry moves, perhaps due to the higher incidence of tied migratory moves among women in their sample.⁴

In terms of empirical approach, the literature on migration and career mobility (defined broadly to cover a change in industry, occupation or employer) can be classified into two groups. A first set of studies are based on treatment effects models, whereby dummy variables are included in the analysis to capture the effects of migration and/or career mobility on wages, while accounting for non-random selection into the migration and career mobility categories. A classic example is Krieg (1997), who estimates an earnings equation with a migration dummy variable, and allows for self-selection in the decision to migrate. The effects of a change in occupation and/or employer are then assessed using interaction terms between these variables and the selection-corrected migration dummy. He finds that simultaneous changes in location, occupation and employer have a significantly negative effect on earnings in the medium term.

A second approach is to use an endogenous switching model, with a first stage that involves the estimation of a migration choice model (e.g., deciding whether to migrate and/or change industry), and a second stage that involves estimating an earnings equation for each of the groups in the migration choice model. Self-selection is incorporated into the model by allowing the error terms of the first stage to be correlated with the error terms of the second stage. Nakosteen and Zimmer (1982) use such a model, with a first stage composed of two equations, one for migration and one for industry change. They assume that the decision to change industry precedes the decision to migrate, and influences it, which is consistent with the findings of earlier studies on migration and career change (Schlottmann and Herzog, 1982). The second stage of the model is a set of earnings equations for the four 'migration' categories (non-migrants, industry migrants, region migrants and industry/region migrants). Their results strongly support the hypothesis that there is self-selection into both migration and industry change. A similar approach, although one that is based on the Heckman two-step sample selection model, is used by Shaw (1991).

Since our focus is on understanding the effects of migration and industry change on career outcomes, the treatment effects approach is more suited to our study. Moreover, the endogenous switching approach is computationally demanding when the first stage involves a polychotomous choice (Maddala, 1983, 275–278). We therefore use the treatment effects approach but extend it to allow the first stage of the model to be of a multinomial nature, with individuals choosing between four migration strategies (change in location, change in industry, change in both industry and location, and no change).

4 The literature on migration and industry change is relatively small, and there is therefore little evidence on whether the relationship between these two types of mobility varies significantly across countries. On inter-regional migration, a number of studies have found greater geographical mobility in the USA than in European Union, although there is significant variation across individual EU countries (Huber, 2006). Possible explanations include differences in home ownership and housing market characteristics (Cameron and Muellbauer, 1998; Oswald, 1999), welfare programmes (Fredriksson, 1999) and cultural attitudes to risk (Bentivogli and Pagano, 1999). There are no comparable cross-country studies on inter-industry mobility, but a European Commission study on occupational mobility has recently found that occupational mobility rates also vary substantially across EU countries (Recchi et al., 2006). For the purposes of this study, the key question is whether the relationship between inter-industry mobility and geographical mobility varies systematically across countries, and there is as of yet not enough evidence on to suggest that it does. This remains an important area for future research.

3. Data and methods

3.1. Data

The analysis is based on data collected by the Higher Education Statistical Agency (HESA) on students who graduated from UK higher education institutions (HEIs) during the academic year 2002–2003. The analysis is based on three data streams, the Students in Higher Education Institutions, the Destinations of Leavers from Higher Education (DLHE) and the Longitudinal Destinations of Leavers from Higher Education (LDHLE).

The 2002–2003 Students in Higher Education Institutions is an administrative data set which contains records on all students enrolled in UK HEIs (169 institutions) during the 2002–2003 academic year, including details of the 412,580 students who graduated that year. For each student, the records provide information on personal characteristics (such as age, gender and ethnicity), course characteristics and the location of parental domicile (at the unit postcode level).

In addition, HESA undertakes a yearly survey to gather information on the employment circumstances of graduates 6 months after graduation; the DLHE survey is sent to all UK-domiciled graduates of the previous academic year. It contains information on employment circumstances (whether employed full-time, part-time or self-employed, in higher education, undertaking voluntary work, etc.), annual salary, the sector of employment (SIC code), the occupation (SOC code) and the location of employment (postcode district). In the 2002–2003 survey, 307,650 valid responses were returned by UK-domiciled graduates, giving a response rate of 74.6%.

In 2006, HESA commissioned a follow-up survey sending more detailed questionnaires to a sample of the graduates who had responded to the 2002–2003 DLHE survey, approximately 3 years after the original survey, or 3½ years after graduation.⁵ The sample included a higher proportion of graduates of black, mixed and other ethnic backgrounds, as well as a higher proportion of graduates with foundation degrees, graduates who had received research council funding, graduates domiciled in Northern Ireland, Scotland and Wales, and those who followed teacher training or health-care courses. The LDLHE survey was sent to a 20% sample of the respondents to the original survey, and resulted in 24,823 valid responses, following a 40.3% response rate (equivalent to 8.1% of the original cohort of respondents of the DLHE survey).⁶

The analysis in this article is based on graduates who were employed full- or part-time, self-employed or engaged in voluntary work, for whom salary information, industry of employment and location were all available in January 2004 (via the DLHE survey) and November 2006 (via the LDLHE survey). After excluding observations for which the industry of employment or the location is missing in either survey, the total number of available observations is 13,521. A key variable used in the analysis, annual

5 The decision to send out the longitudinal survey 3½ years after graduation was taken by HESA in consultation with a panel of academics, university administrators and government officials. The panel agreed that 3½ years was a sufficiently long period to observe changes in individual circumstances, but also sufficiently short to ensure high response rates.

6 All the descriptive statistics and regressions presented in the article are weighted to adjust for the over-sampling of these subgroups, using sampling weights provided by HESA.

gross salary, is missing in a significant number of cases; this further reduces the sample to 7060 observations.⁷

The data used in the analysis exclude graduates who are out of the labour force or unemployed, and also under-represents those who are working a reduced number of hours or employed on an ad-hoc basis. The first issue is not expected to be a significant source of bias, given that graduate unemployment figures were low during the period under consideration, and this study is concerned with changes in sector and location of employment, rather than changes in employment circumstances. The second issue may imply that our results are generalizable only to graduates engaged in formal employment (rather than those working on a ‘freelance’ basis); we take this issue into consideration in our discussion of the results in Section 5.

The sub-sample of the LDLHE survey used in this study somewhat over-represents postgraduates (36% vs. 28% in the LDLHE sample), female graduates (67% vs. 64% in the LDLHE sample) and white graduates (77% vs. 70% in the LDLHE sample).⁸ As discussed above, this is mainly due to missing information on salaries, particularly for graduates working part-time or on a freelance basis. While we are able to control for sampling bias in the LDLHE survey (relative to the entire population of graduates) through the use of sampling weights, we are unable to adjust for any additional sampling bias caused by item non-response, since we do not have access to the original sampling information for the LDLHE survey (other than the sampling weights); in particular, we do not have information on the strata used in the sampling process. Any resulting bias is, however, likely to be small, as the difference in the demographic makeup of the two samples is relatively small.

The graduate labour market for the time period of our study, 2002–2006, was fairly stable, and graduate employment prospects were good. This period coincided with a time of economic growth and prosperity, and unemployment rates for recent graduates did not increase significantly between the mid-1990s and the second quarter of 2008, the first full quarter of the most recent recession (ONS, 2012). Although unemployment rates for recent graduates over the period of our study were higher than those of graduates of earlier cohorts, the rates remained fairly stable and relatively low over the period of study (see Figure A1 in the Appendix for details).

3.2. Defining migration and industry change

We define migration using a distance-based measure, so that individuals who change their workplace location by a distance greater than a given threshold are classified as migrants. Conceptually, the migrants in our study are those who have, between 6 months and 3½ years after graduation, moved out of their local labour market, and

7 Salary data are missing either because the information is unavailable (the respondent was unable or unwilling to answer the question) or because the respondent provided their monthly, weekly, hourly or occasional income rather than their annual income in the LDLHE survey (this affected 21% of responses). Since the survey did not record how much of their time was spent working, there is no robust way of determining annual salaries based on the figures reported. We therefore exclude annual income data estimated using monthly, weekly, hourly or ad-hoc income data.

8 The corresponding figures for the overall population of UK graduates for 2002–2003 are 23% postgraduates, 58% female graduates and 82% white graduates. The LDLHE survey oversampled ethnic minority groups and other demographic subgroups. We control for the sampling design of the LDLHE survey using sampling weights.

secured employment in a different labour market. This move may or may not be accompanied by a residential move, and unfortunately the survey data used in this study does not allow us to distinguish between the two. We therefore require an appropriate distance threshold to ensure that moves of a sufficient magnitude are classified as a move beyond the boundaries of the local labour market.

The question of the appropriate value for the distance threshold then becomes, essentially, an empirical matter. As the literature on multistream migration has shown, in cases where the data include several groups of migrants with different motives, varying distance thresholds can be used to estimate a model that disaggregates disparate migration flows into relatively homogenous ‘streams’ (Gordon, 1991; Boyle, 1993; Gordon and Molho, 1998). In a series of studies, Ian Gordon shows that most local moves (involving a distance of less than 25 miles or approx. 40 km) can be attributed to housing motives, while most national moves (involving a distance greater than 100 miles or approx. 160 km) are likely to be due to employment considerations (Gordon, 1975, 1982, 1988, 1995). Regional moves, occurring at intermediate distances, are likely to be due to a search for a better residential environment (Gordon and Vickerman, 1982; Gordon, 1988).

Since our study is only concerned with changes in employment location, among cohorts of young adults who have recently graduated, there is less heterogeneity in our sample than in those typically considered by the literature. We therefore use one single distance threshold of 15 km, which, as shown by Faggian et al. (2006), is appropriate to capture most local labour markets areas in the UK. An alternative option would have been to use the boundaries of Travel to Work Areas (TTWAs) to define migratory moves, but Faggian et al. (2013) show that the average radius of TTWAs in the UK is 15.68 km, and that the migration patterns predicted by a distance threshold of 15 km are very similar those predicted by TTWA boundaries. Our use of a 15-km threshold also has the advantage of ensuring that our work is comparable with previous studies on graduate migration in the UK (Faggian and McCann, 2006; Faggian et al., 2006; Faggian and McCann, 2009). In order to test the robustness of our results, we estimate our models using 35 km, 50 km and 100 km distance thresholds, and the results remain essentially unchanged (see Tables A1 and A2 in the Appendix for details). We discuss these robustness tests in more detail in Section 5.

As previously mentioned, we have detailed information on the domicile of students before they attend higher education in the form of the unit postcode of the place of domicile, provided by the Students in Higher Education Institutions data set. However, the data collected by the DLHE and LDLHE surveys are less precise. Of respondents to the DLHE who provided information on the location on their employment, only 29% provided the unit postcode, with the remainder providing the postcode district (a less precise measure). In the case of the LDLHE survey, only the postcode district is available. In order to maintain consistency across the various stages of the analysis, we therefore define migration as a move of more than 15 km from the centroid of the postcode district of the location of employment at the time of the DLHE survey (6 months after graduation), to the centroid of the postcode district of the location of employment at the time of the LDLHE survey (3½ years after graduation).

Our analysis also includes two additional variables used as instruments, ‘migrated to attend university’ and ‘migrated after graduation’ (see Section 3.3 for a discussion). These are defined, respectively, as a move from the parental Local Authority District/Unitary Authority (LAD/UA) to attend a HEI located in a different LAD/UA, and a

move from the LAD/UA of the HEI to a different LAD/UA for employment 6 months after graduation. These moves are defined in terms of administrative boundaries because the location of many HEIs in non-residential areas or out-of-town campuses makes the use of a distance measure uninformative, since practically all students would be defined as migrants on the basis of a 15-km distance cut-off.

In terms of sector mobility, we use the Standard Industrial Classification (SIC) 2003, used by Companies House in the UK to classify firms according to a four-digit code. Since we are interested in understanding the drivers of career moves across industries, we base our analysis on a medium level of industry disaggregation, and use two-digit codes to classify our graduates according to industry of employment. For robustness, however, we also report our findings at the one-, three- and four-digit codes (see Section 5 for a discussion).

3.3. Model specification

Our empirical strategy allows for the possibility that unobservable characteristics that lead an individual to choose migration and/or industry change will also affect their subsequent (post-migration) salary and career satisfaction. We therefore estimate a model composed of two stages; the first stage follows the literature in treating migration and industry change as investments in human capital, while the second stage is based on a Mincer-type model of earnings.

In the first stage, the individual chooses a migration strategy out of four mutually exclusive choices, which are as follows: to stay at the current location and in the current industry ('No change'), to move to a new location but remain in the same industry ('Location only'), to change industry but remain at the same location ('Industry only') or to change both location and industry ('Both'). Let V_{ij}^* denote the indirect utility associated with the j -th treatment, $j=0, 1, \dots, J$ for individual i , and:

$$V_{ij}^* = \mathbf{z}_i' \alpha_j + \sum_{k=1}^J \delta_{jk} l_{ik} + \eta_{ij}, \quad (1)$$

where $\mathbf{z}_i$ is a set of exogenous covariates with associated parameters α_j , and η_{ij} are i.i.d. error terms. The indirect utility V_{ij}^* is also a function of unobserved characteristics that are common to the individual's migration strategy and outcome (salary and career satisfaction), such as entrepreneurial spirit, captured by the latent factors l_{ik} , which are assumed to be independent of η_{ij} . Without loss of generality, let $j=0$ denote the control group and $V_{i0}^* = 0$.

While V_{ij}^* is not observed, we do observe the choice of migration strategy in the form of a set of binary variables d_j . These are collected by a vector $\mathbf{d}_i = [d_{i1}, d_{i2}, \dots, d_{iJ}]$. We follow Deb and Trivedi (2006) in assuming that the probability of selecting a given migration strategy, conditional on the latent factors, has a mixed multinomial logit structure:

$$\Pr(\mathbf{d}_i | \mathbf{z}_i, \mathbf{l}_i) = \frac{\exp(\mathbf{z}_i' \alpha_j + l_{ij})}{1 + \sum_{k=1}^J \exp(\mathbf{z}_i' \alpha_k + l_{ik})}, \quad (2)$$

where $j=0, 1, 2, \dots, J$.

The outcome equation explains the career outcome of an individual 3½ years after graduation, and we use two outcome variables: the natural logarithm of the annual

salary in 2006 (deflated to 2004 prices using the Average Earnings Index) and a binary variable to indicate whether the graduate is ‘very satisfied’ with their career at the time of the second survey.⁹ The expected value of each outcome variable is given by:

$$E(y_i | \mathbf{d}_i, \mathbf{x}_i, \mathbf{l}_i) = \mathbf{x}_i' \boldsymbol{\beta} + \sum_{j=1}^J \gamma_j d_{ij} + \sum_{j=1}^J \lambda_j l_{ij}, \quad (3)$$

where y_i is the career outcome for individual i , $\mathbf{x}_i$ is a set of exogenous covariates with associated parameter vector $\boldsymbol{\beta}$, and γ_j is a vector of treatment effects relative to the control choice (‘None’). Because $E(y_i)$ is a function of the latent factors l_{ij} , the outcome is affected by the unobserved characteristics that also affect selection into the treatment. We assume that the outcome variables follow a normal distribution, and in the case of the binary variable we estimate the second stage using a probit model.

As noted in Deb and Trivedi (2006), and discussed in Walker et al. (2004) and Maddala (1983), identification of the model requires that the scale of each choice equation be normalized, if restrictions are not to be placed on the parameters or intercepts. In addition, the covariance between the errors of the choice equations needs to be fixed. This is achieved by imposing a set of normalization restrictions $\delta_{jk} = 0$ for all $j \neq k$, that is, each choice is affected by a unique latent factor. In addition, we restrict the coefficients so that $\delta_{jj} = 1$ for all j in order to normalize the scale of each choice equation. The resulting model can be estimated using a Maximum Simulated Likelihood (MSL) approach.¹⁰ While it is not strictly necessary that the vector of covariates $\mathbf{z}_i$ includes additional variables relative to $\mathbf{x}_i$ for the model to be identified, we include three exclusion restrictions, discussed in the next section.

3.4. Variables included in the analysis

Our analysis ultimately seeks to explain earnings and career satisfaction for recent graduates, 3½ years after graduation, as a function of personal characteristics, type of university, course attended and subject studied while controlling for the effects of a change in location or industry, given potential sample selection into this choice. We estimate Mincer-type model (Mincer, 1974; Heckman et al., 2006; Lemieux, 2006) and include the following variables as covariates in $\mathbf{x}_i$ (see Equation (3)):

Female: A dummy variable to indicate whether the respondent is female, in order to control for differences in salary and career satisfaction between male and female graduates. While we cannot directly measure sex discrimination, the coefficient in the salary model gives an indication of whether female graduates tend to earn lower salaries. The coefficient for career satisfaction may be different from that of the salary model; previous research has found that female graduates are more altruistic

9 The variable used for career satisfaction implies that all other responses, including ‘fairly satisfied’, ‘not very satisfied’ and ‘not at all satisfied’ are grouped together. The reason is that we find that the distinction between ‘very satisfied’ and ‘fairly satisfied’ has the greatest explanatory power, with very few respondents choosing ‘not very satisfied’ and ‘not at all satisfied’. We also want to capture good career outcomes, so ‘very satisfied’ is an obvious choice.

10 The model was estimated using the `mtreatreg` command in Stata, an extension of the `treatreg` command to a multinomial setting, created by Partha Deb, Hunter College, CUNY. The MSL procedure was run with 2000 replications.

and tend to value their job environment more than their male counterparts (Chevalier, 2007).

Age and Age (sq): In traditional Mincer equations, it is generally assumed that (log) earnings are a non-linear function of experience, which is typically captured using age – years of schooling – 5 (the school starting age). In our case, however, we do not have information on the total years of schooling, since we only know the degree awarded to each graduate and the year in which they started the course. We do not know how long each graduate studied before enrolling in the course they graduated from in 2002–2003. In order to avoid introducing additional measurement error, we therefore use age and age squared as proxies for experience.

Ethnicity: We control for the ethnicity of each graduate by using dummy variables to indicate whether he/she is white, black, Asian or of other ethnicity.¹¹ Although (as with gender) we cannot explicitly test for racial discrimination, the coefficient does give an indication of the differences in salary and career satisfaction for non-white graduates relative to white graduates.

Type of university: We control for differences in human capital by using a series of dummy variables to capture the quality and type of the degree course. In particular, we control for the type of university attended, by classifying HEIs into four categories: Russell Group and 1994 Group (research-intensive universities), other old universities, post-1992 institutions (former polytechnics and new universities) and specialized colleges. We merge the Russell and 1994 groups because several institutions that were part of the 1994 Group in 2002–2003 subsequently joined the Russell Group, so that it is difficult to distinguish between the two groups. This set of dummy variables is intended to act a proxy for quality of the degree obtained (Hussain et al., 2009).

Type of degree: The analysis includes all students who were enrolled in undergraduate or postgraduate degrees (but excluding further education and other vocational courses below higher education level), who graduated in the 2002–2003 academic year. We include both undergraduate and postgraduate students in our analysis in order to test whether, in addition to the subject studied, having studied a course at a higher level has an effect on career outcomes.¹² We distinguish between first degrees (bachelor degrees), postgraduate degrees (master degrees, PhDs and postgraduate diplomas) and other undergraduate degrees (undergraduate diplomas, foundation degrees and equivalent professional qualifications).¹³ This set of dummy variables intends to capture the Mincerian schooling effect (Psacharopoulos, 1994), and we would expect the completion of a more advanced degree to lead to higher wages and greater career satisfaction.

11 The 'white' category includes individuals of white British, white Irish or other white background; the 'black' category includes black African, Caribbean and other black backgrounds; 'Asian' includes Indian, Pakistani, Bangladeshi, Chinese and other Asian backgrounds; 'other ethnicity' includes mixed-ethnicity and other ethnic minority backgrounds. Although previous research has shown that there can be significant differences in the educational outcomes of ethnic subgroups, for instance, ethnic Chinese or Indian students (Connor et al., 2004), our sample is too small to allow us to draw meaningful comparisons between subgroups. We therefore include only broad ethnic categories.

12 Because we include both first degree and postgraduate students we are unable to use degree classification as an explanatory variable, since it is not available for all degree types.

13 The distribution of the individuals in our data according to this variable is as follows: 61% of individuals completed a first degree in 2002–2003, 28% completed a postgraduate degree and 11% completed an undergraduate degree other than a first degree.

Subject: We include the subject of study in the form of nine dummy variables capturing broad subject groups (health sciences, biological sciences, physical sciences, social sciences, business, humanities, creative arts, education and combined courses).¹⁴ The motivation is that different subjects can lead to different levels of salary and job satisfaction after graduation, after controlling for the type of university, degree and personal characteristics (Machin and Puhani, 2003).

Change in location or industry: The remaining variables are the treatment effect dummies, capturing whether a change in location ('Location only'), a change in industry ('Industry only') or a change in both location and industry ('Both'), relative to the base category ('No change'), results in higher salary and career satisfaction levels, after accounting for selection into the choice of migration strategy.

While these covariates are taken from the Mincer earnings model literature, they are also appropriate to model career satisfaction, our second outcome variable. This alternative measure is chosen on the basis of the literature on the career paths of artists and arts graduates, who are frequently motivated by non-monetary incentives (Abbing, 2002; Comunian et al., 2010; Abreu et al., 2012). The models using the natural logarithm of salary and career satisfaction are therefore estimated using the same set of covariates x_i .

Now turning to the first stage of the estimation process, our model includes most of the variables of the second stage (with the exception of the treatment effects), and three additional exclusion restrictions to aid identification. However, the motivation for including the variables, and hence the interpretation of the coefficients, is different from that in the outcome regressions. The following variables are included in z_i (see Equation (1)):

Female: We control for gender by including a dummy variable for female graduates. The migration literature has mainly considered the issue of gender in connection with tied moves of couples or households. However, a few studies have recently analysed the issue more explicitly. Faggian et al. (2007) find that women are in general less migratory, but if female graduates do migrate, they are more likely to migrate repeatedly, a finding supported by Schneider and Kubis (2009). Détang-Dessendre and Molho (2000), using 1993 data for France on individuals aged 21–22 years or 26–27 years, find higher migration levels among women relative to men, over both short (less than 25 km) and long distances (above 60 km). Men are more mobile only over medium-range distances (between 25 and 60 km). Boyle and Halfacree (1995), focusing on the migration of the service class in England and Wales in 1981, reach the conclusion that 'service class women appear to be more mobile than service class men, although service class men are still more mobile than the non-service class population' (p. 49). However, in the context of career change, the literature has found that women are less likely to change job or industry (Nakosteen and Zimmer, 1982; Linneman and Graves, 1983).

14 The subject group dummies are based on the Joint Academic Coding System (JACS). 'Health sciences' includes subject groups A and B; 'biological sciences' includes C and D; 'physical sciences' includes F, G, H and J; 'social sciences' includes K, L and M; 'business' includes N; 'humanities' includes Q, R, T and V; 'creative arts' includes P, W and a few individual codes from G, J, and K covering creative arts courses in computer science, architecture and design, see Comunian et al. (2010, 396) for a detailed list; 'education' includes X, and 'combined courses' includes courses that span two or more JACS subject groups.

We use this variable to investigate the effect of gender on both location and industry change.¹⁵

Age and Age (sq): The cost of migration is generally believed to be greater for older workers, who are more settled in their current location and therefore have higher psychic costs of migration. In addition, the benefits of migration for older workers are likely to be lower, since the length of their working lives, over which the benefits are accrued, is shorter. The empirical literature has found that age is a strong negative determinant of migration. Schwartz (1976), using data from the 1960 US Population Census, showed not only that the migration rate declines with age, but that it declines at a rate which increases with education. Similarly, Inoki and Suruga (1981), using data on inter-prefectural migration from Japan's 1970 Population Census, find that the migration rate peaks at 8.10% for the 20–24 age group and then declines with age to a minimum of 0.8% for people aged 65 years or over. A similar pattern was identified by Bates and Bracken (1987) for England and Wales, using Census data for 1971 and 1981. We control for the effect of age on migration by including age (in years) and age squared, to allow for non-linearities.

Ethnicity: The literature has generally found that ethnic minorities tend to have lower migration propensities, due to lower access to information (which increases search costs), more limited resources to move, or because they may face discrimination at the destination (Lee and Roseman, 1997; Faggian et al., 2006; White and Wolaver, 2006). In terms of industry change, Nakosteen and Zimmer (1982) find that non-white workers are more likely to change industry than their white counterparts, but there is no significant effect on migration (although the coefficient is negative). We test the effect of ethnicity on the propensity to migrate by including ethnicity dummies (black, Asian and other ethnicity).

Type of university: The human capital model of migration predicts that individuals with higher human capital are more mobile, since the benefits from migration are greater (Sjaastad, 1962). The search costs for educated workers are also lower than for less educated individuals; this applies in particular to those who attend elite institutions, and as a result have greater access to influential networks. In the absence of a robust measure of years of schooling, we use three variables to account for human capital in the analysis: the type of university attended (Russell or 1994 Group, other old university, post-1992 university or specialized college), the type of degree achieved (undergraduate, postgraduate or other first degree) and the subject studied.

Type of degree: We use the type of degree achieved to control for human capital (see previous paragraph). A postgraduate degree typically involves a greater degree of specialization in the chosen field, and therefore a greater investment in a specific career path. We would therefore expect graduates who have followed a postgraduate course to be less likely to change industry of employment, other things being equal. This hypothesis is also in line with the literature on job mismatch and overeducation, which

15 The marital status of individuals, and the presence of children and/or elderly dependants, has been shown by the literature to also affect migration decisions (Mincer, 1978; Graves and Linneman, 1979; van Dijk et al., 1989). Unfortunately, in the context of our data, this information is only routinely collected for students in Northern Ireland, and is therefore not available for most individuals in our sample.

has found that graduates with a postgraduate qualification are less likely to be in a job mismatch situation than those without a postgraduate qualification (Dolton and Vignoles, 2000).

Subject: We use dummy variables for the subject studied to account for human capital, but also to control for the unique career paths of certain subjects such as education and the health sciences, for which graduates spend a period of additional training in a local school or hospital, which may constrain migration and industry change in the period immediately following graduation. For instance, in order to qualify as teachers, graduates are generally required to complete a postgraduate certificate in education (PGCE), or alternatively to follow a degree course that includes a teacher training component. Similarly, nurses are required to complete a pre-registration nursing degree, of which 50% of the time is generally spent working in local hospitals or as a trainee community nurse. Although the skills acquired while studying these subjects are applicable across a range of sectors and occupations, the vocational aspects of education and health, requiring a period of specialization, imply that graduates of these subjects tend to seek employment in a relatively narrow range of industries.

Our data show support for this hypothesis. A good indication of the breadth of career options typically considered by graduates within each subject is the percentage of graduates employed in the top five occupations for their subject, using four-digit Standard Occupational Classification (SOC) codes. In our sample of 2002–2003 graduates, 80% of individuals with an education degree were employed in one of the top five occupations for that subject (all professional occupations in the field of education) 6 months after graduation, as were 66% of health graduates (all in professional health occupations). In contrast, only 29% of graduates of the physical sciences were employed in the top five occupations for that subject group, as were only 25% of business graduates. These statistics indicate that while many occupations are open to all graduates regardless of the subject studied, career paths tend to be better defined for some subjects than they are for others, thereby discouraging industry change. We therefore include subject dummies in order to test the effect of the subject studied on the decision to migrate and/or change industry.

In addition to these variables, we include three exclusion restrictions to help with identification. These are variables that act as instruments for the migration strategy choice variable in the outcome regressions. We use the following variables:

Migrated to attend university: Whether the individual migrated to attend university, or not. We define migration in this context as a move beyond the boundaries of the Local Authority District or Unitary Authority (LAD/UA) of their place of domicile. The literature on migration has shown that previous migratory moves are highly correlated with subsequent moves. After controlling for the type of university attended and the degree awarded, we would therefore not expect to see a direct effect on salary or career satisfaction 3½ years after graduation, only an indirect effect via the subsequent choice of migration strategy.

Migrated after graduation: Whether the individual migrated from the area of study within 6 months of graduation, where migration is defined as a move from the LAD/UA of the institution to a different LAD/UA for employment. This variable is also highly correlated with subsequent migration, and once we control for personal characteristics, human capital and the nature of the first job after graduation

(see below), we would not expect to see a direct effect on salary or career satisfaction 3½ years after graduation, only an indirect effect via the propensity to change location or industry.

First job required degree: We include this variable to capture whether the degree qualification obtained by the individual was a requirement for the first job obtained after graduation (because it was a formal requirement, because it was expected or because it provided an advantage). This is intended to capture whether the first job after graduation is a graduate-level job, with in turn affects the probability of a corrective change in location or industry later on. Again, we expect this variable to have no direct impact on salary or career satisfaction, except via its effect on migration strategy.

3.5. Validity of the instruments

An important consideration when estimating treatment effects models is the quality of the exclusion restrictions, or in other words, the validity of the instruments. This generally requires that the instruments satisfy two conditions. First they must be ‘relevant’, that is, they must be strongly correlated with the variables that they are instrumenting. This is to avoid the problem of ‘weak instruments’ (Nelson and Startz, 1990; Staiger and Stock, 1997). Second, the instruments must be ‘exogenous’ to the model, specifically, they must be uncorrelated with the error term in the second stage of the model.

In order to test the ‘relevance’ assumption, a standard procedure involves estimating a first-stage regression with the variable to be instrumented as dependent variable, and the instruments included in the regression as explanatory variables. The instruments must be jointly significant in this regression. Table A3 (in the Appendix) shows the results of a multinomial logit model of migration choice (equivalent to the first stage of our multinomial treatment effects model), with the instruments added as explanatory variables. The three instruments perform well in this regression. With ‘None’ as the base category, the variables are jointly significant in all three equations of the model (corresponding to ‘Both’, ‘Industry only’ and ‘Location only’). This holds for all levels of industry disaggregation, as shown by the chi-squared tests of joint significance of the instruments (Table A4).

In order to test for ‘exogeneity’, a common approach is to use an ‘overidentifying restrictions test’, which, assuming that at least one instrument is valid, tests the validity of all the other instruments. This requires that the model is overidentified, that is, that it has more instruments than endogenous variables. Although no equivalent of this test has been developed for the multinomial treatment effects model used in this article, as an approximation we use a simple instrumental variables (IV) model. The model is composed of a Mincer-type equation of salary as a function of the explanatory variables discussed in Section 5.2 plus two endogenous variables: (i) a dummy variable capturing whether an individual has changed industry between 6 months and 3½ years after graduation, and (ii) a dummy variable capturing whether an individual has changed location over the same period. These two dummy variables replace the multinomial migration strategy variable used in our main estimation framework. In order to allow for heteroscedasticity in the model (which is a common problem when estimating Mincer equations), we use a general method of moments (GMM) approach, and obtain Hansen’s J statistic in order to conduct the overidentifying restrictions test

Table 1. Percentage of 2002–2003 graduates who changed location and/or industry between 6 months and 3½ years after graduation

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Both	16.30	17.26	21.95	25.21
Industry only	21.94	23.08	34.73	42.47
Location only	17.32	16.21	11.52	8.27
None	44.45	43.45	31.79	24.06
Total	100.00	100.00	100.00	100.00

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

(Hansen, 1982). The null hypothesis is that the instruments are valid. As shown in Table A5, Hansen’s J test statistic is not significant for either of the two outcome variables, at any level of industry disaggregation. Taken together with our conceptual arguments for using these variables as instruments (discussed in Section 3.4), the tests indicate that the instruments are robust.

4. Descriptive statistics

In order to provide an overview of the relationships analysed using the multivariate model, we first present some descriptive statistics for the percentage of graduates in our sample who change location and/or industry between 6 months and 3½ years after graduation, and their career outcomes.¹⁶ We are primarily interested in the results where industry is defined at the two-digit SIC code level (in keeping with the previous literature), but will also present and discuss results for other levels of sectoral disaggregation, for comparison purposes.

The percentage of graduates in each migration category is given in Table 1. We focus on the second column of Table 1, which shows the proportions in each category at the two-digit SIC code level. The base category is no location or industry change (‘None’), and 43% of graduates fall into this category. A further 23% also remain at the same location, but change industry. Of those graduates who do migrate, 52% also change industry, a figure that is very close to the 56% found by Gallaway (1969), and significantly higher than the 35% of non-migrants who change industry. As we vary the sectoral definition and the level of sectoral aggregation becomes more narrow (as we move from left to right in Table 1), a larger proportion of graduates in each migration category is shown to have changed industry. This holds for both migrants and non-migrants, and simply shows that more graduates change narrow industrial sector than broad industrial sector.

As discussed in Section 1, the literature on graduate career paths has shown that the propensity to change industry is highly subject-specific, and this can also be seen in Table 2. Graduates from the physical sciences, business and the creative arts are the

16 The DLHE and LDLHE survey dates were 15 January 2004 and 27 November 2006, respectively, for the cohort of students who graduated in 2002–2003. All descriptive are weighted using survey sampling weights.

Table 2. Percentage of 2002–2003 graduates who changed industry between 6 months and 3½ years after graduation, by subject

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Health sciences	12.75	12.94	21.92	56.27
Biological sciences	48.62	50.78	67.63	73.70
Physical sciences	54.17	60.38	71.69	75.31
Social sciences	46.58	49.63	61.96	66.09
Business	53.18	56.73	68.11	73.98
Humanities	51.21	52.57	70.44	75.54
Creative arts	53.82	56.92	71.20	75.81
Education	22.72	25.88	62.19	65.96
Combined course	38.16	42.56	60.16	65.12
All subjects	43.01	45.91	60.53	69.85

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

most likely to change industry (based on a two-digit SIC code definition), while those in the health sciences and education are the least likely to change. This is most probably linked to the specialized nature of the training received in these subjects, which is closely linked to employment in particular sectors of the economy. As we move to a more narrow definition at the four-digit SIC code, these large gaps largely disappear.

Tables 3–5 show basic descriptive statistics for the dependent variables used in the multivariate models. Tables 3 and 4 show the mean and median annual salary for graduates in each migration category at 6 months and 3½ years after graduation, respectively, where salaries in 2006 have been deflated to ensure they are comparable salaries in 2004 (see Section 3.3). The most successful category of graduates at 6 months are those who will subsequently change location, while the least successful are those who will subsequently change industry, or both industry and location. This result remains unchanged after 3½ years, with those who change location receiving the highest average salaries, and those who change industry, or both industry and location receiving the lowest. These findings provide an early indication that there is a degree of self-selection in the migration decision. Table 5, showing the results for career satisfaction, confirms this. Graduates who change location (but remain in the same industry) and those who do not change either industry or location are more likely to be ‘very satisfied’ with their careers than those who change industry or change both industry and location.¹⁷

5. Regression results

The estimation results are shown in Tables 6–9. For each of the two dependent variables, $\ln(\text{salary})$ and career satisfaction, we show the results corresponding to the

17 The variable on career satisfaction is only available in the LDLHE survey at 3½ years after graduation, and not in the DLHE survey, so comparisons over time are not possible.

Table 3. Mean and median salary of 2002–2003 graduates 6 months after graduation, by category (based on two-digit SIC codes)

	Both	Industry only	Location only	No change
Mean	16,108	18,687	21,305	20,233
Median	15,000	17,000	18,000	18,000

Data sources: Students in Higher Education 2002–2003 and DLHE 2002–2003, HESA.

Table 4. Mean and median salary of 2002–2003 graduates 3½ years after graduation, by category (based on two-digit SIC codes)

	Both	Industry only	Location only	No change
Mean	21,604	21,766	25,450	24,769
Median	20,000	20,000	23,000	23,000

Data sources: Students in Higher Education 2002–2003 and LDLHE 2006, HESA.

Table 5. Percentage of 2002–2003 graduates who are ‘very satisfied’ with their career 3½ years after graduation, by category (based on two-digit SIC codes)

	Both	Industry only	Location only	No change
Per cent of all graduates	33.25	32.18	44.44	43.89

Data sources: Students in Higher Education 2002–2003 and LDLHE 2006, HESA.

two-digit SIC code, and then discuss the implications of varying the definition of industry change (by changing the level of sectoral disaggregation).

5.1. Results on graduate earnings

Table 6 gives the results for the model outlined in Section 3.3, with $\ln(\text{salary})$ measured at 3½ years after graduation as the dependent variable. The numbers in the first three columns of the table are relative risk ratios for each choice of migration strategy (‘Both’, ‘Industry only’ or ‘Location only’) relative to the reference category (‘No change’). The numbers in the final column of Table 6 are marginal effects corresponding to the Mincer equation of earnings at 3½ years after graduation.

We first look at the results for the first stage of the model, corresponding to migration strategy. The results for the demographic variables are as predicted by theory. Being female decreases the odds of changing both industry and location by a substantial 40%, but does not affect the odds of changing just the industry or the location of employment (the coefficients are of the right sign, although not statistically

Table 6. Treatment effects model for ln(salary) of 2002–2003 graduates, 3½ years after graduation (based on two-digit SIC codes)

	Both	Industry only	Location only	ln(salary)
Female	0.600*** (0.102)	0.984 (0.157)	0.862 (0.140)	−0.155*** (0.019)
Age	0.791*** (0.064)	0.862** (0.053)	0.999 (0.073)	0.040*** (0.009)
Age (sq)	1.002** (0.001)	1.001 (0.001)	1.000 (0.001)	0.000*** (0.000)
Ethnicity: White [†]				
Ethnicity: Black	0.463*** (0.115)	1.765*** (0.309)	0.538*** (0.112)	0.014 (0.020)
Ethnicity: Asian	1.051 (0.211)	1.366* (0.247)	0.954 (0.187)	0.034 (0.035)
Ethnicity: Other	0.792 (0.183)	1.218 (0.253)	0.891 (0.205)	0.038 (0.023)
Russell and 1994 group	0.683 (0.161)	0.647* (0.156)	0.848 (0.178)	0.080*** (0.029)
Other old university [†]				
Post-1992 university	0.806 (0.188)	0.708 (0.164)	0.767 (0.157)	−0.056* (0.029)
Specialized college	0.666 (0.204)	0.413*** (0.118)	0.608* (0.156)	−0.075** (0.034)
First degree [†]				
Other undergraduate degree	0.829 (0.274)	1.219 (0.335)	0.532** (0.135)	−0.152*** (0.037)
Postgraduate degree	0.653* (0.142)	0.705** (0.123)	1.038 (0.188)	0.174*** (0.020)
Health sciences	0.182*** (0.052)	0.246*** (0.061)	1.179 (0.272)	0.056* (0.029)
Biological sciences	1.063 (0.353)	1.350 (0.414)	0.763 (0.255)	−0.078** (0.032)
Physical sciences	1.314 (0.359)	1.357 (0.357)	0.690 (0.199)	0.022 (0.029)
Social sciences [†]				
Business	1.828** (0.515)	2.090*** (0.550)	0.758 (0.241)	0.102*** (0.038)
Humanities	0.795 (0.263)	1.255 (0.370)	0.728 (0.218)	−0.024 (0.042)
Creative arts	1.053 (0.372)	1.462 (0.480)	0.890 (0.329)	−0.113*** (0.039)
Education	0.266*** (0.096)	0.580* (0.176)	0.739 (0.217)	−0.082** (0.040)
Combined course	0.595 (0.284)	1.425 (0.624)	0.883 (0.398)	0.024 (0.064)
Migrated to university	1.707* (0.511)	0.736 (0.182)	1.775** (0.483)	
Migrated after graduation	1.126 (0.240)	1.166 (0.226)	1.525** (0.323)	

(continued)

Table 6. Continued

	Both	Industry only	Location only	ln(salary)
First job required degree	0.253*** (0.044)	0.347*** (0.056)	0.979 (0.173)	
No change [†]				
Both				−0.089* (0.047)
Industry only				−0.074*** (0.024)
Location only				0.126*** (0.026)
λ (Both)				0.051 (0.049)
λ (Industry only)				0.061*** (0.016)
λ (Location only)				−0.075*** (0.007)
Observations	5033	5033	5033	5033

Note: The table reports the results of a multinomial treatment effects model estimated using MSL (with 2000 replications/draws). Columns 1–3 are the first-stage mixed multinomial logit model for migration choice, and the coefficients report relative risk ratios. Column 4 is the second-stage linear regression model for ln(salary) in 2006 and the coefficients report marginal effects. The observations are weighted using survey sampling weights. Robust standard errors are in parentheses. ***Significant at 1%; **significant at 5%; *significant at 10%. [†]Denotes reference category. *Data sources:* Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table 7. Treatment effects estimates for ln(salary) of 2002–2003 graduates, for different levels of industry disaggregation

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Both	−0.098* (0.050)	−0.089* (0.047)	−0.121** (0.049)	−0.108** (0.046)
Industry only	−0.083*** (0.025)	−0.074*** (0.024)	−0.050** (0.024)	−0.050** (0.023)
Location only	0.117*** (0.024)	0.126*** (0.026)	0.115*** (0.037)	0.129*** (0.040)

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

significant). Similarly, being a year older than average 6 months after graduation decreases the odds of changing industry by 14% and also decreases the odds of changing both industry and location by 21%. Our results therefore indicate that female and older graduates, who have been shown by the literature to be less migratory, are also less likely to change industry of employment, or both industry and location. This may be, as hypothesized by the previous literature, because women and older graduates

Table 8. Treatment effects model for career satisfaction of 2002–2003 graduates, 3½ years after graduation (based on two-digit SIC codes)

	Both	Industry only	Location only	Very satisfied
Female	0.596*** (0.101)	0.975 (0.156)	0.897 (0.146)	0.012 (0.031)
Age	0.797*** (0.063)	0.868** (0.053)	0.983 (0.074)	−0.002 (0.010)
Age (sq)	1.002** (0.001)	1.001 (0.001)	1.000 (0.001)	0.000 (0.000)
Ethnicity: White [†]				
Ethnicity: Black	0.475*** (0.118)	1.775*** (0.311)	0.521*** (0.108)	−0.057* (0.030)
Ethnicity: Asian	1.071 (0.215)	1.354* (0.245)	0.958 (0.185)	−0.067** (0.029)
Ethnicity: Other	0.802 (0.186)	1.239 (0.259)	0.878 (0.197)	−0.045 (0.035)
Russell and 1994 group	0.676* (0.157)	0.647* (0.155)	0.837 (0.176)	−0.056 (0.037)
Other old university [†]				
Post-1992 university	0.799 (0.183)	0.717 (0.165)	0.779 (0.158)	−0.046 (0.037)
Specialized college	0.706 (0.213)	0.443*** (0.125)	0.633* (0.160)	−0.052 (0.043)
First degree [†]				
Other undergraduate degree	0.844 (0.275)	1.212 (0.328)	0.547** (0.140)	0.079* (0.041)
Postgraduate degree	0.660* (0.142)	0.712* (0.124)	1.010 (0.186)	0.045 (0.030)
Health sciences	0.185*** (0.053)	0.250*** (0.062)	1.137 (0.263)	−0.060 (0.038)
Biological sciences	1.103 (0.365)	1.413 (0.433)	0.766 (0.254)	0.052 (0.058)
Physical sciences	1.313 (0.356)	1.384 (0.363)	0.703 (0.203)	0.006 (0.045)
Social sciences [†]				
Business	1.848** (0.521)	2.096*** (0.558)	0.770 (0.244)	0.027 (0.055)
Humanities	0.817 (0.268)	1.267 (0.373)	0.685 (0.200)	0.057 (0.053)
Creative arts	1.064 (0.372)	1.433 (0.463)	0.890 (0.317)	−0.100* (0.052)
Education	0.264*** (0.094)	0.579* (0.177)	0.732 (0.217)	0.089* (0.046)
Combined course	0.600 (0.283)	1.436 (0.630)	0.838 (0.371)	−0.087 (0.075)
Migrated to university	1.795** (0.528)	0.774 (0.191)	1.597* (0.417)	
Migrated after graduation	1.090 (0.233)	1.151 (0.218)	1.621** (0.340)	

(continued)

Table 8. Continued

	Both	Industry only	Location only	Very satisfied
First job required degree	0.245*** (0.042)	0.327*** (0.052)	0.977 (0.164)	
No change [†]				
Both				−0.245*** (0.075)
Industry only				−0.234*** (0.066)
Location only				0.301*** (0.085)
λ (Both)				0.226*** (0.070)
λ (Industry only)				0.242*** (0.058)
λ (Location only)				−0.372*** (0.084)
Observations	5006	5006	5006	5006

Note: The table reports the results of a multinomial treatment effects model estimated using MSL (with 2000 replications/draws). Columns 1–3 are the first-stage mixed multinomial logit model for migration choice, and the coefficients report relative risk ratios. Column 4 is the second-stage probit model for career satisfaction (‘very satisfied’) in 2006 and the coefficients report marginal effects. The observations are weighted using survey sampling weights. Robust standard errors are in parentheses. ***Significant at 1%; **significant at 5%; *significant at 10%. [†]Denotes reference category. *Data sources:* Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table 9. Treatment effects for career satisfaction of 2002–2003 graduates, for different levels of industry disaggregation

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Both	−0.290*** (0.002)	−0.245*** (0.075)	−0.256*** (0.009)	−0.281*** (0.003)
Industry only	−0.193*** (0.002)	−0.234*** (0.066)	−0.252*** (0.012)	−0.253*** (0.003)
Location only	0.343*** (0.002)	0.301*** (0.085)	0.324*** (0.009)	0.300*** (0.003)

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

are constrained in their migration choices by their family circumstances and a relatively higher costs of moving.

We find that the effects of ethnicity on migratory behaviour varies according to whether a move involves a change in industry and/or location. Being of black ethnicity increases the odds of changing industry by 77%, but decreases the odds of changing location, or changing both industry and location, by 46% and 54%, respectively. A similar result holds for graduates of Asian ethnicity; the odds of changing industry

are 37% higher than for white graduates. These results indicate that graduates belonging to ethnic minorities are more likely to resolve an unsatisfactory job match by changing industry rather than by migrating. This is in keeping with the literature on migration, which has found that ethnic minorities tend to be less geographically mobile, and the findings of Nakosteen and Zimmer (1982), who show that non-white workers are more likely to change industry than white counterparts. The latter also find no statistically significant effect of ethnicity on migration.

The results for type and quality of education indicate that having attended a more prestigious university (proxied by those who are in the Russell or 1994 groups) reduces the odds for changing industry by 35%, as does attending a specialized college or having a postgraduate degree. This would suggest that a higher quality and/or a more specialized education result in better-targeted career paths that reduce the need for industry change. Having a postgraduate degree (or first degree other than an undergraduate degree) also lowers the odds of changing location, most likely for the same reasons. The results for the subject of study are as expected, with highly vocational degrees such as those in the health sciences and education being associated with lower odds of changing industry (by 75% and 42%, respectively) or of changing both industry and location (by 82% and 73%, respectively). Likewise, having a degree in a subject that provides skills that are easily suited to a wide range of industries, such as business, increases the odds of changing both industry and location by 83%, and the odds of changing industry only by a substantial 109%.

The last three figures reported at the end of Columns 1–3 of Table 6 correspond to the exclusion restrictions. The results are also as expected; having migrated to university increases the odds of changing location, or changing both industry and location, by 78% and 71%, respectively; having migrated immediately after graduation increases the odds of subsequent migration by 53%; and having secured a job that requires a degree (a graduate-level job) immediately after graduation reduces the odds of subsequently changing industry, or both industry and location, by 35% and 25%, respectively. This last result also supports our hypothesis that a change in industry is mostly a reaction to a mismatch between the skills and knowledge acquired during a degree course and the subsequent sector of employment.

Now turning to the second stage, we estimate a linear regression model for $\ln(\text{salary})$ 3½ years after graduation, using a Mincer equation approach. The model allows us to control for selection into migration groups, based on both observable and unobservable characteristics. The results for gender and age in the Mincer regressions are as expected. Being female results in earnings that are 16% lower than those of male graduates, while every additional year of age (assumed to be a proxy for labour market experience) adds 4% to earnings. We find no effects of ethnicity on earnings after controlling for sample selection bias due to migration strategy.

With respect to the education variables, having attended a Russell or 1994 Group university results in an 8% increase in earnings (relative to having attended an 'other old university'), while a degree from a post-1992 university results in 6% lower earnings, and one from a specialized college results in 8% lower earnings. Similarly, a more specialized education in the form of a postgraduate degree result in 17% higher earnings. In terms of the subject studied, a degree in the health sciences or business adds to earnings (in the order of 6% and 10%, respectively), and a degree in the biological sciences, creative arts and education leads to lower earnings, with the effect being particularly strong for the creative arts (11% lower earnings). As mentioned in

Section 3.1, our data significantly under-represent graduates who are self-employed or working on a freelance basis, so the estimated effect of a creative arts degree on earnings is likely to be even more negative if those categories of graduate are also included, since self-employed and freelance graduates tend to have significantly lower incomes regardless of the subject studied (Abreu et al., 2012).

The model allows us to estimate the return to different migration strategies, relative to the base category of ‘No change’. In keeping with our descriptive analysis, the results indicate that changing both industry and location (‘Both’) results in a fall in earnings of 9%, while a change in the industry of employment (‘Industry only’) results in a decrease in earnings of 7%. In contrast, changing location (‘Location only’) results in an increase in earnings of 13%. Our results therefore suggest that changing both industry and location requires a greater period of adjustment than changing location only, which results in lower earnings, at least in the short term. Our findings also provide evidence of a positive selection in unobservables for graduates who change both industry and location, and of negative selection for those who change location only.

We next run the same model at different levels of sectoral disaggregation; the results are shown in Table 7. As we move to more narrow categories, there are more graduates who fall into the ‘Both’ and ‘Industry only’ categories, and fewer in the ‘Location only’ and ‘None’ categories. A move from left to right along Table 7 therefore picks up the effects of more subtle sectoral moves. The results indicate that the return to migration increases as categories become narrower, although the effect is not monotonic. For the four-digit SIC code, the ‘Location only’ group now includes those who stay within their narrow sector but migrate, and are therefore more likely to realize high returns to their education and industry-specific capital. The returns are in turn lower for those who change both industry and location. This group is now wider than before, since it includes all migrants who changed narrow job category, and is therefore likely to be picking up more graduates who are not well matched to their jobs.

As discussed in Section 3.2, the choice of an appropriate distance threshold used to define migration is essentially an empirical matter. We therefore test the robustness of our results to variations in the distance threshold. The results relating to our treatment effects (migration strategy variables) are shown in Table A1 of the Appendix, while all other regression results, although not reported, are similar in sign and statistical significance to those shown in Table 6. As shown, the substantive conclusions of our analysis are unchanged if the distance threshold is 35, 50 and 100 km (instead of 15 km). The effect of a change in location between 6 months and 3½ years after graduation on earnings is still positive, while the effect of a change in industry, or a change in both industry and location, is still negative.

5.2. Results on career satisfaction

We next report on the results for the dependent variable measuring career satisfaction. We use a distinction between graduates who are ‘very satisfied’ and all other categories in order to capture positive career outcomes. The results for the first-stage migration equation are virtually identical to those for the earnings model, so we focus our discussion on differences in the results of the outcome regression (Table 8, fourth column).

Unlike in the previous model, neither gender nor age are found to affect career satisfaction, although ethnicity still does. Being of black or Asian ethnicity results in

significantly lower levels of career satisfaction (6% and 7% lower probability of being 'very satisfied', respectively), other things being equal. There are no statistically significant effects for the quality of education variables, but the subject studied does affect career satisfaction, which is lower for the creative arts (10% lower probability), and significantly higher for education (9% higher probability).

The results for the returns to migration variables are, again, very similar to those in the previous model. Changing industry, or both industry and location, leads to lower levels of career satisfaction (23% and 25% lower levels, respectively), while changing location results in higher levels of career satisfaction (30% higher). However, when varying the definition of industrial aggregation used in the model we find a few differences (Table 9). Most notably, the negative returns industry change are greater (i.e., more negative) when the model is run at the three- to four-digit SIC code levels. This implies that as we also consider people who changed narrow sector, we find that changing sector has a more negative effect on career satisfaction than if we consider broad sectors only. It seems that changing narrow sector has a more negative impact on morale than changing broad sector, after controlling for selection effects. The results also indicate positive selection for those who changed both location and industry, and negative selection for those who changed location only.

Finally, as in the previous section, we test the robustness of the results to the use of different distance thresholds to define the migration strategy variable; the results for the treatment effects are shown in Table A2 in the Appendix. As before, none of the substantive results of the analysis change if a different distance threshold is used.

6. Conclusions

A small but growing literature has studied the determinants and outcomes of graduate migration, but has not considered the significance of a concurrent change in industry of employment. In this article, we address this issue explicitly, by estimating a model of graduate career outcomes that also takes into account individual self-selection into migration or change of industry of employment. We consider two outcome variables, salary and career satisfaction of graduates 3½ years after graduation. Our results indicate that graduates who change location fare better than those who do not change location or industry, but those who change both location and industry do worse in the short term, both in terms of lower earnings and lower career satisfaction. In keeping with the literature on migration, this would seem to indicate that the costs and period of adjustment are greater for migratory moves that also involve a change of industry. It is interesting to note that the results of our analysis are very similar for our two outcome variables, salary and career satisfaction, which contradicts the popular view that career path decisions of graduates in subjects such as the creative arts result from their willingness to sacrifice salary in return for career satisfaction. Our results suggest that graduates are more driven by career satisfaction than is generally believed, or that salary and career satisfaction tend to develop in tandem.

We control for a number of personal and degree-related characteristics that may affect career outcomes and migration decisions. We find that female graduates are less likely to change both industry of employment and location, and also earn lower salaries than their male counterparts, after controlling for their choice of migration strategy. This may reflect a higher proportion of tied moves for female graduates, although we

have no detailed information on marital status or cohabitation, so are unable to test the relevance of family circumstances. This result of a lower mobility of female graduates is in line with the findings of the migration literature more generally. Moreover, we find that ethnicity has a substantial effect on migration strategy. Black graduates are more likely than white graduates to change industry, and less likely to migrate, although there is no significant effect of ethnicity on earnings after controlling for migration strategy. To the extent that these results suggest the presence of constraints to the mobility of female and ethnic minority graduates, there is scope for advisory programmes to both direct students towards courses that are in keeping with their medium-term location preferences, but also to inform them of the typical career paths that result from decisions made immediately following graduation. This type of advice has become more widely available in the UK in recent years (for instance through the Unistats initiative), but the quality and availability of the advice differs greatly across subjects areas, being particularly scarce for smaller, more unusual, courses.

Our results also show that graduating from a more prestigious university, or completing courses at postgraduate level, both result in a lower likelihood of changing industry in the short term. This would suggest that the match between the course studied and the first job after graduation is a better one for more qualified graduates from prestigious universities, other things being equal. Again, this result is in line with migration theory and our predictions, since highly qualified graduates are less constrained by the conditions of the local job market, and are able to direct their job search to a wider area. As mentioned above, a caveat is that we are unable to control for differences in family and other circumstances across individuals, which also affect migration decisions after graduation.

Some of our most interesting results are on the impact of the subject studied on migration strategy and career outcomes. For instance, we find that graduates of the health sciences and education, subjects that provide specialized training for very specific careers, are substantially less likely to change industry (or both industry and location) than graduates of other vocational subjects such as business, which provide skills suitable for a wide range of occupations. This result may indicate that subjects that are highly career-specific, and those that teach a broad range of transferable skills, are most useful in preparing students for the graduate job market and ensuring good career outcomes, measured in terms of salary and career satisfaction. Indeed, it is interesting to note that following the increase in annual tuition fees in England and Wales to £8000–£9000 for most undergraduate courses in 2012–2013, there has been an increase in applications for university places in subjects such as medicine, education, engineering, law and business studies that fit into one of the two categories outlined above, to the detriment of more specialized but less vocational courses in the arts, social sciences and the humanities. This shift in preferences has occurred despite there being no overall shift towards subjects with higher than expected first salaries following graduation (UCAS, 2012).

While it is too early to draw any substantive conclusions on the impact of recent higher education policies on graduate migration strategies, there is evidence to suggest that new entrants to higher education, who are likely to face significantly higher tuition fees than earlier cohorts, will be likely to favour courses (and institutions) that offer either skills and vocational training suited to specific careers, or very flexible skills suitable to a broad range of careers. The latter are particularly valuable during an economic downturn, when entering the labour market is likely to be particularly

challenging for recent graduates. Institutions could help to broaden the appeal of courses in the arts, humanities and social sciences by highlighting the transferable skills gained from following these courses, and providing guidance on the range of career options (both in terms of sector and location) available on graduation, especially in cases where there are no clear career paths associated with a degree course. Greater financial support for part-time and postgraduate study could help recent graduates resolve a job mismatch by allowing them to retrain or specialize in a subject area that is relevant to their sectoral and location choice.

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Appendix

Table A1. Effect of changing the migration distance cut-off on estimates of the treatment effects for ln(salary), based on two-digit SIC codes

	15 km	35 km	50 km	100 km
Both	−0.089* (0.047)	−0.100** (0.050)	−0.087* (0.046)	−0.108*** (0.033)
Industry only	−0.074*** (0.024)	−0.085*** (0.025)	−0.091*** (0.024)	−0.094*** (0.023)
Location only	0.126*** (0.026)	0.126*** (0.033)	0.149*** (0.037)	0.120*** (0.043)

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table A2. Effect of changing the migration distance cut-off on estimates of the treatment effects for career satisfaction, based on two-digit SIC codes

	15 km	35 km	50 km	100 km
Both	−0.245*** (0.075)	−0.342*** (0.004)	−0.295*** (0.058)	−0.359*** (0.002)
Industry only	−0.234*** (0.066)	−0.254*** (0.008)	−0.247*** (0.069)	−0.342*** (0.004)
Location only	0.301*** (0.085)	0.269*** (0.008)	0.224*** (0.056)	0.113*** (0.003)

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table A3. First-stage multinomial logit model of migration choice, used to test instrument relevance (two-digit SIC codes)

	Both	Industry only	Location only
Female	0.644*** (0.097)	0.973 (0.137)	0.869 (0.125)
Age	0.816*** (0.059)	0.874** (0.048)	0.990 (0.065)
Age (sq)	1.002* (0.001)	1.001 (0.001)	1.000 (0.001)
Ethnicity: White [†]			
Ethnicity: Black	0.520*** (0.115)	1.565*** (0.240)	0.573*** (0.108)
Ethnicity: Asian	1.052 (0.186)	1.313* (0.208)	0.958 (0.165)
Ethnicity: Other	0.823 (0.168)	1.162 (0.211)	0.901 (0.185)
Russell and 1994 group	0.708* (0.147)	0.675* (0.144)	0.854 (0.159)
Other old university [†]			
Post-1992 university	0.816 (0.168)	0.736 (0.151)	0.797 (0.145)
Specialized college	0.668 (0.182)	0.455*** (0.116)	0.628** (0.144)
First degree [†]			
Other undergraduate degree	0.862 (0.254)	1.208 (0.290)	0.589** (0.130)
Postgraduate degree	0.683** (0.133)	0.727** (0.111)	1.025 (0.164)
Health sciences	0.213*** (0.056)	0.277*** (0.062)	1.103 (0.223)
Biological sciences	1.049 (0.308)	1.303 (0.350)	0.809 (0.243)
Physical sciences	1.277 (0.308)	1.312 (0.306)	0.741 (0.191)
Social sciences [†]			
Business	1.709** (0.425)	1.927*** (0.446)	0.804 (0.229)
Humanities	0.837 (0.243)	1.205 (0.312)	0.775 (0.208)
Creative arts	1.070 (0.330)	1.384 (0.397)	0.902 (0.296)
Education	0.302*** (0.101)	0.603* (0.164)	0.753 (0.193)
Combined course	0.651 (0.278)	1.339 (0.518)	0.894 (0.357)
Migrated to university	1.611* (0.429)	0.797 (0.176)	1.639* (0.415)
Migrated after graduation	1.119 (0.209)	1.168 (0.200)	1.456** (0.278)

(continued)

Table A3. Continued

	Both	Industry only	Location only
First job required degree	0.304*** (0.046)	0.401*** (0.057)	0.908 (0.143)
Observations	5033	5033	5033

Note: The table reports the results of a multinomial logit model. The coefficients report relative risk ratios. The observations are weighted using survey sampling weights. Standard errors are in parentheses. ***Significant at 1%; **significant at 5%; *significant at 10%. †Denotes reference category. The data sources are as follows: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table A4. Chi-squared tests for joint significance of the instruments, at different levels of industry disaggregation

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Chi squared (Both)	63.88***	64.77***	51.06***	37.66***
<i>p-value</i>	0.000	0.000	0.000	0.000
Chi squared (Industry)	46.94***	42.66***	31.42***	29.89***
<i>p-value</i>	0.000	0.000	0.000	0.000
Chi squared (Location)	16.36***	15.00***	26.00***	20.52***
<i>p-value</i>	0.001	0.002	0.000	0.000

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Table A5. Overidentifying restrictions test based on IV (GMM), at different levels of industry disaggregation

	One-digit SIC code	Two-digit SIC code	Three-digit SIC code	Four-digit SIC code
Hansen's J (salary)	0.351	0.421	0.109	0.007
<i>p-value</i>	0.554	0.516	0.741	0.932
Hansen's J (satisfaction)	2.076	2.367	1.509	0.599
<i>p-value</i>	0.150	0.124	0.219	0.439

Data sources: Students in Higher Education 2002–2003, DLHE 2002–2003 and LDLHE 2006, HESA.

Figure A1. Graduate unemployment rate, by time elapsed since graduation. Seasonally adjusted quarterly data, 1992 Q2 – 2011 Q4. *Data source:* Labour Force Survey, ONS.