# **International Postgraduate Students’ Labour Mobility in the UK: A Cross-classified Multilevel Analysis**

This article models the migration flows of international students who have graduated from masters and doctoral programmes in UK universities. Previously, access to sufficient data from the DLHE dataset on the destinations of HE international students has been difficult, despite the fact that international student numbers have grown substantially. Two one-year extracts from the Destination of Leavers from Higher Education (DLHE) dataset were analysed (2013/14, 2014/15) using cross-classified multilevel modelling in order to estimate influences on “stay-rate”: the likelihood of highly-skilled graduates remaining in the UK for work after graduation. The home domicile and the UK HEI attended for study were modelled as random effects that allowed the variance in stay-rate to be partitioned between the student, higher levels of domicile and HEI attended. Variance at the domicile level was estimated to be 1.67 times greater than variance at HEI level indicating that home country is a better predictor of stay-rates than the HEI attended. The cross-classified model was a better fit to data than simpler, two-level hierarchical models (students nested in domicile or students nested in HEI attended). A number of student, domicile and HEI level factors were added to the models. At HEI level, attending a Russell Group university and university location outside London were factors that led to significantly lower likelihood of graduates staying in the UK for work. At the domicile level, none of four factors (GDP, unemployment rates, English language and Commonwealth affiliation) were significant in predicting stay rates.

**Key words:** international student migration; postgraduate students; labour mobility; stay-rate; the United Kingdom; cross-classified multilevel logistic modelling

## Introduction

The number of international migrants worldwide has reached 272 million by the year 2019, which has grown 57% compared to the number in 2000 (DESA, 2019). At the meantime, the number of international postgraduate students (i.e. students who came from outside EEA countries) who studied in the UK has nearly tripled in the past two decades, which surged from 56,900 in 2000 to 160,145 in 2018 (HESA, 2002; 2019). In the global competition for high-skill workers and talents, the massive inflow of international students into the UK HE system has drawn much attention from researchers (Cebolla-Boado *et al.*, 2018), and there is also an increasing recognition for the need of having more investigation in their post-study labour movements (Wu & Wilkes, 2017).

Having better understanding of the post-study movements of international graduates have major implications for policy makers, Higher Education Institutions (HEIs), and international graduates. More specifically, governments may be able to design and deliver more effective plans in managing international student migration (ISM) (Szewczyk, 2014; Teichler, 2012; Wiers-Jenssen, 2013). HEIs may can better prepare their international graduates for employment in a global economy (de Wit *et al.*, 2015; Huang & Turner, 2018; Teichler, 2009). As prior international study experience and employment mobility have been argued to have considerable importance in shaping international graduates’ onward migration choices in post-study lives (Collins *et al.*, 2017; Czaika & Toma, 2017; Tan & Hugo, 2017), a better understanding of ISM may assist students to make more knowledgeable choices in deciding where to live and work after graduation.

So far, the application of several theoretical frameworks have been found in the broader literature on migration as well as in research on ISM, which include human capital theory (Roh, 2015), migration network theory (Perkins & Neumayer, 2014), and transnational theory (Gu & Schweisfurth, 2015). However, Raghuram (2013) argues that because of the specificity of student migrants when compared to other categories of migrants, there is a compelling need to improve the theorisation of ISM. In their theoretical research on the study-to-work transitions of international students, Li and Lowe (2016) suggest that the mapping and controlling of the student migration flows are necessary for the theorisation of the flows. More specifically, mapping the flows means to have adequate data on student cross-border movements, while controlling the flows refers to using statistical models to investigate what factors could influence the migration patterns of international graduates. Due to the lack of relevant large-scale quantitative data, no previous study has examined the labour movement flows of international graduates in the UK, nor the factors that could predict their decisions to remain in the UK for work. Based on the recently available DLHE data received from HESA, this study aims to: 1. identify what factors may shape post-study movements of international graduates in the UK context; 2. test the utility of cross-classified multilevel modelling in analysing graduate movements.

The paper first review the theoretical and empirical literature on the post-study migration of international graduates in the global context. Section 3 introduces the research data, methods, and modelling strategy. Descriptive statistics, regression results of the cross-classified multilevel modelling, and corresponding discussion are presented in section 4. It then concludes with a brief summary and implications for future studies.

## Previous studies on international student migration

In the UK, international postgraduate students from non-EEA countries form a unique sub-group of migrants. In addition to their roles as international students, this group of migrants also have family social, cultural, citizen, and present/prospective worker roles and identities. In order to better understand the labour migration patterns of this sub-group of migrants, King and Raghuram (2013) argue that it is necessary to conduct more sophisticated analysis of available quantitative data on student mobility. In the context of the USA, Kim *et al.* (2011) and Roh (2015) investigated the factors influencing foreign doctoral graduates’ decisions to stay in the USA. The results indicated that individual-level variables (e.g. age, gender, field of study, marital status, presence of children etc.), HEI-level variables (i.e. location of HEI), and country-level variables (i.e. R&D expenditure and unemployment rate) all have statistically significant association with post-study migration decisions of international doctoral graduates. More recently, Finn and Pennington (2018) examined the estimates for long-term stay rates of foreign doctorate recipients in the USA after graduation, and substantial differences were found in stay rates by subject area and country of origin. More specifically, the 10-year stay rate of foreign doctoral graduates who received degrees in social and related sciences fields was approximately 30 per cent lower than those who received degrees in STEM fields (i.e. science, technology, engineering, and mathematics). In addition, Chinese and Indian domiciled graduates were found much more likely to stay than graduates from other countries in the long term. In the context of Australia, Hawthorne (2014) and Hawthorne and To (2014) found that the employment outcomes of international students in Australia could be significantly affected by their language backgrounds, subject area, and level of qualification.

Existing literature shows that various factors could influence international students’ decisions to stay in host countries for employment, which include individual-level factors, HEI-level factors, and country-level factors. In terms of individual-level factors, many studies reveal that gender identity has an important but underestimated role in analysing migration decision of international students (Alberts & Hazen, 2005; Geddie, 2013), which suggests that it might be mistaken to regard highly skilled migration as male dominated. In fact, empirical data in the USA indicates that female doctoral students are generally more likely to remain to work in the host country than their male counterparts (Roh, 2015).

Subject area and level of qualification have also been shown by previous research to influence and shape labour movement of international students. For instance, in the context of Australia, international graduates who received masters or doctoral degrees in high demand fields (e.g. engineering, law, and medicine & dentistry) were found to have higher full-time employment rates than those with qualifications in oversubscribed fields, such as IT and business related subjects (Hawthorne & To, 2014). In the USA, many scholars (Finn & Pennington, 2018; Hoffer *et al.*, 2007) found that international doctoral students within the STEM areas had much higher stay rates than those who received doctoral degrees in social sciences and related areas. Kim *et al.* (2011) claims that international doctoral graduates in STEM subjects are more likely to remain in the USA for work because of the high demand of skilled workers in these disciplines. Although scientific and technological knowledge could spread across nations and regions much easier than before, Peri *et al.* (2015) argue that skilled STEM workers are less mobile, as innovation- and knowledge-intensive industries require tacit knowledge and face-to-face interactions of skilled STEM workers to accelerate the transformation of new ideas into local productivity. In the UK, the Green Paper (BEIS, 2017, p.16) illustrates that this country has experienced ‘particular skills shortages in sectors that depend on STEM subjects’. Nearly half of employers in the UK reported having a shortage of skilled workers with relevant STEM skills, and some employers in specific sectors had to recruit skilled STEM workers from overseas to fill vacancies (CBI, 2016). Therefore, it is necessary to investigate the influence of subject area on international students’ post-study migration in the UK.

In terms of level of qualification, previous literature on the highly skilled migrations indicates that migrants with higher level of education generally have easier and smoother integration into labour market in host countries. For example, according to the US advanced degree exemption scheme, on top of the regular visa cap in each fiscal year, migrant workers with US postgraduate degrees are allocated with additional 20,000 H1-B visas. Hawthorne and To (2014) illustrate that international graduates with a masters/doctoral degree were three times more likely than graduates with bachelor degrees to be in full-time employment in Australia. In April 2012, the British coalition government closed the Tier 1 Post-Study-Work visa, which allowed international graduates from UK universities to remain and work in the UK for two years. In the following year, it introduced ‘the Doctorate Extension Scheme’ to facilitate talented international doctoral graduates to remain to work, though only for an additional 12 months in order to seek skilled work, or set up as entrepreneur (Home Office, 2018, p.41). International graduates with masters degrees were confronting more immigration restrictions compared to their doctoral counterparts.

Existing literature has also emphasised the importance of HEI-level factors in shaping international graduates’ post-study migration patterns. The results of Roh’s (2015) research suggest that international students who received a degree from prestigious doctoral programmes were less likely to stay in the USA compared to those graduated from non-prestigious programmes. Previous research has also found the geographic location of university could shape the study-to-work migration patterns of international graduates. In their study, Kim *et al.* (2011) found that international doctorate recipients who graduated from HEIs located in the North, South, and Rocky Mountain regions had significantly higher rates of staying in the USA compared to those who received degrees from universities located in the Far West areas during the period 1991 to 2005.

Careers and employability service provided by universities/colleges was found to have positive effects in assisting international graduates’ employment in host country. In their empirical research, Tidwell and Hanassab (2007) found that along with the need of acquiring academic skills, majority of international students also reported that they had great needs in obtaining knowledge and information about immigration regulations/visa restrictions and career development. As international graduates’ visa status might restrict or reduce their employment opportunities in the host country, this migration subgroup might experience difficulties in matching their career goals and aspirations with the suitable job vacancies in host labour markets. The employment information and careers supports provided by HEIs, however, can help those international postgraduate students to evaluate the feasibility of their career plans against immigration policies and visa regulations (Crockett & Hays, 2011).

A wide variety of country-level factors has been found to influence the labour mobility of international postgraduate students. International students who are native English speakers were found to have higher full-time employment rates in Australia than students from other language backgrounds (Hawthorne & To, 2014). Beine *et al.* (2014) argue that colonial ties might facilitate the migration of students from former colonies to their ex-colonisers for higher education. Nevertheless, it remains unclear whether colonial ties could also shape the labour movements of postgraduate degree holders. The inequality in wealth and resources between countries are believed have been impelling a great number of people to migrate for better career opportunities, quality of life, and different lifestyles elsewhere (de Haas, 2010). Dumont *et al.* (2007) argue that the workers with tertiary education in low-income countries have a higher general emigration rate when compared to their counterparts in more affluent countries. However, Roh (2015) claims that GDP per capita does not predict the labour mobility of international doctorate recipients after controlling for other country-level fixed-effects. This might be because the inequality in wealth and resources does not only exist between countries, but also could be found within countries, especially in developing economies such as China and India. That is to say, in sourcing countries with high level of heterogeneity, the gap of socioeconomic development between rich and deprived regions would be neglected if national level GDP per capita data were used as the proxy of economic and career opportunities for international students. Therefore, this study will test whether it is still useful to keep GDP per capita as a predictor of international students’ migration flows.

## DATA AND METHOD

### 3.1 Destination of Leavers from Higher Education (DLHE) data

The Higher Education Statistics Agency (2018a) in the UK started collecting the DLHE data from international (non-EU domiciled) students since 2011, and previously data collection was limited to UK and EU domiciled graduates only. This is the very first dataset that provides a national level overview of post-study employment activities of non-EU graduates in the UK HE system. The DLHE survey data has also been linked with ‘Students in Higher Education’ data (HESA, 2018b), which provides information about student characteristics such as age, gender, level of qualification obtained, subject of study etc. The DLHE survey is centrally designed and defined by HESA, while the data collection is locally managed by each HEI. The data used by this study came from the DLHE 2013/14 and 2014/15 surveys. DLHE 2011/12 and 2012/13 were not included in modelling, because HESA suggested that the quality of data from those two surveys was not good enough for analysis (i.e. comparatively lower response rates). For those who completed their study between 1st August 2013 and 31st December 2013, the survey was carried out in April 2014. For those who completed between 1st January 2014 and 31st July 2014, the survey was scheduled in January 2015. Similar data collection arrangements were made for DLHE 2014/15 survey. The target sample of this study was international postgraduate students of working age (younger than 60) who obtained masters or doctoral degree from a UK HEI. In total, there were 38812 students responded their location of employment, which indicates a response rate of 29.1%.

DLHE data used in this study has a non-hierarchical two-way cross-classified structure. In this type of dataset, lower level units simultaneously belong to two non-nested higher-lever clusters (Rasbash *et al.*, 2014). In this study, 38812 international postgraduate students were nested within 159 domiciles and were separately nested within 150 HE institutions at the same time. An average of 244.10 graduates per domicile replied their location of employment (minimum = 1; maximum = 9490), and an average of 258.75 graduates per HEI reported their location of employment (minimum = 1; maximum = 3079). A total of 12 (3.88%) of these higher-level units were singletons (i.e. a higher-level unit which only contains one graduate). More specifically, 10 (6.28%) of the 159 domiciles contained only one graduate, and 2 (1.33%) of the 150 HEIs have only one valid respondent. In this two-way cross-classification of domiciles by HEIs, each student belongs to a combination of one domicile and one HEI.

### 3.2 Variables

The dependent variable (Location of Employment) in this study was a dichotomous variable which indicated whether an international (non-EEA) postgraduate degree recipient still remained in the UK to work after finishing his/her studies (Work in UK=1, Work in other countries=0). As the DLHE survey data was collected from participants approximately six months after the completion of their studies, the definition of stayers in the study is defined as international postgraduate students whose destination of employment was located within the UK at the time point when the DLHE survey was conducted.

#### Individual-level variables

The independent variables consisted of individual-level, HEI-level, and domicile-level variables. The individual-level variables included demographic features (i.e. gender and age, age was measured at 31st July of the year in which graduates gained their qualifications), and educational background (subject area, level of qualification, and mode of study). Level of qualification in this study only includes doctoral research qualification, taught doctorate, masters research qualification, and taught masters. Other postgraduate diplomas, certificates and professional qualifications were not included in this study.

#### HEI-level variables

The HEI-level variables in this study were prestige level of HEIs and their locations. In the UK, the Russell Group members are 24 highly research-intensive universities. The research excellence of those universities has been widely recognised both domestically and internationally, and the Russell Group has been used by many previous studies as the criteria in defining the most prestigious universities in the UK HE system (Hemsley-Brown, 2015). Therefore, the prestige level of HEI was measured by whether an institution is one of the 24 Russell Group universities. The variable, location of HEI, was used to measure whether an institution’s main-site is based within the Greater London boundary.

#### Domicile-level variables

Domicile-level variables that had been tested in this study included three binary independent variables (i.e. two variables related to language, and one related to previous colonial affiliation) and three continuous independent variables (i.e. Purchasing Power Parity based GDP per capita, unemployment rate, and youth unemployment rate). Purchasing Power Parity (PPP) is an economic theory that measures prices at different locations, and PPP based GDP is widely used as an indicator in comparing differences in living standards between countries. Variables related to language were majority native English speaking country marker, and English as official language country marker. Previous colonial affiliation was measured by whether a country is one of the commonwealth members. In terms of continuous domicile-level variables, this study extracted corresponding data from the World Bank online databases. As the DLHE data used in this study covered international postgraduate students who graduated between academic years 2013/14 to 2014/15, this study therefore extracted data of 2014 and 2015 from the World Bank databases. The values in each continuous domicile-level variable were the average numbers of the corresponding values from 2014’s and 2015’s data.

### 3.3 Modelling strategy

The cross-classified data structure, dichotomous feature of dependent variable, large higher-level unit sizes, and small proportion of singleton groups suggest that this dataset is suitable for analysis by fitting a cross-classified multilevel logistic model (Clarke & Wheaton, 2007; Stegmueller, 2013). There are also some application of the cross-classified multilevel modelling on population movement research which are based on datasets with cross-classified structures (Shuttleworth & Gould, 2010; Thomas *et al.*, 2015; Vitali & Arpino, 2015). Through analysing the DLHE data, this study intended to explore how individual-level factors, HEI-level factors, and domicile-level factors could affect international students’ migration flows in the UK context. The research aim of this study also suggests that a model with cross-classified specification is preferred to single-level fixed-effects model or two-level hierarchical model. Firstly, that is because international students in this sample are not completely independent cases. Students from the same country might share similar cultural symbols and may be affected by the same domicile-level contextual factors. In addition, international students graduated from the same university were possibly advised and served by the same careers service. That is to say, the assumption of independence of observation is violated, and ignoring HEI-level or domicile-level might result in overestimating the importance of the other level in shaping international postgraduate students’ migration pattern.

Secondly, multilevel modelling enables researcher to estimate group effects and effects of group-level predictors at the same time (Goldstein, 2011). In single-level fixed effects model that includes dummy variables for groups (e.g. domiciles and HEIs), the effects of group-level variables are confounded with the effects of group dummies, as any group-level predictor could be expressed as a function of group dummies. The simultaneous inclusion of group-level predictors and group dummies might lead to multicollinearity problem, so it is not possible to estimate both in fixed effects model. In addition, in the context of this study, it would be also technically unrealistic to include 158 domicile dummies or 149 HEI dummies into the fixed effects model.

Variance partition coefficient (VPC) measures the proportion of total variation explained by higher levels. Browne *et al.* (2005, p.603) suggest that there are three methods that can be used to estimate VPCs in multilevel binomial logistic models, which are ‘Model Linearization’, ‘Simulation’, and ‘Latent Variable Approach’. This study adopted the ‘Latent Variable Approach’, and in this method level-1 residual is assumed to follow a logistic distribution, with a fixed variance () of (equals to 3.29). Hence, the domicile VPC was calculated as , the HEI VPC as , and individual VPC as . The multilevel logistic models were fitted by Markov chain Monte Carlo (MCMC) methods using MLwiN (Browne, 2009; Rasbash *et al.*, 2014). The Bayesian Deviance Information Criterion (DIC) was used to measure models’ goodness of fit with model complexity, with a lower DIC value represents a better model fit.

## ANALYSIS

### 4.1 Descriptive summary of ISM patterns

Approximately 21.6% of international postgraduate students who responded their location of employment remained in the UK for employment. Table 1 presents the descriptive statistics by graduates’ demographic and educational backgrounds. Compared to their female counterparts (20.4%), male graduates (22.9%) were more likely to work in the UK at 1% significance level. While only 18% of graduates who received masters degrees remained to work in the UK, nearly half of doctoral degree recipients reported working in the UK. It is particularly noteworthy that a small number of graduates who were part-time students had significantly higher stay rates (29.9%) compared to full-time degree recipients (21.1%), which might can be explained by visa restrictions. Before 2018, the UK Home Office only issued Tier 4 student visa to international students in full-time studies. This suggests that those part-time degree recipients were holding visas other than Tier 4 student visa (e.g. dependant visa and Tier 2 visa etc.). In other words, those part-time degree recipients might have less visa restrictions in finding jobs in the UK than full-time degree recipients, which in turn resulted in a higher stay rate.

The term job-finding method refers to the method to secure employment as oppose to merely job-searching methods. The most obvious difference between those who remained to work in the UK and those employed in other countries is the usage of personal contacts. Almost one third (30.8%) of graduates who worked in other countries reported personal contacts as their job-finding method, which was in contrast to a smaller proportion of students (18.2%) who used personal contacts to find employment in the UK. It is reasonable to assume that the majority of international students has more useful contacts/networks in their home countries than in the UK. These personal contacts could reduce the costs and risks of international graduates in finding jobs and rise the probability of migrating back to their countries of origin (Guerassimoff, 2003; Massey *et al.*, 1990). The result of this study seems to provide additional support the importance of personal contacts in obtaining jobs which has been emphasised by previous research (Goel & Lang, 2019).

Students worked in the UK seem to be more successful in obtaining a job through HEI sources (e.g. Careers Service, lecturer, university website etc.). Around one fifth (19.8%) of students who remained in the UK secured a job through their universities/colleges, and doctoral graduates (25.3%) seem to have higher probability in obtaining a job via these sources than masters graduates (18.1%). This result stresses the importance of HEIs in assisting international students to find employment in the UK. Nevertheless, the university/college careers and employability services are commonly underutilised by international postgraduate students because of linguistic and cultural barriers (Raunic & Xenos, 2008). The descriptive statistics show that only 9% of the employment of international graduates was found on the basis of job information provided by HEIs. What is more, HEIs in the UK are less helpful in facilitating international students to find employment outside the UK, as they generally have not paid enough attention to the employability needs of international students (Huang & Turner, 2018).

**Please insert Table 1 here**

Figure 1 shows the distribution of international postgraduate students who remained to work in the UK by age (22-47). The number of graduates aged from 19 to 21 (i.e. less than 0.2%) and aged from 48 to 60 (i.e. less than 1.3%) was relatively small. Age was found to have a negative linear association with the probability of staying in the UK among doctorate recipients, which confirmed the results in a previous study in the context of the USA (Roh, 2015). However, for masters graduates, the association between age and the probability of staying was non-linear. This result indicated a differential influence of age on stay rates between doctoral graduates and masters graduates which is worthy of further examinations.

**Please insert Figure 1 here**

The rates of remaining to work in the UK varied greatly across different countries/regions and HEIs. Figure 2 shows that among UK’s top 30 sourcing countries/regions, Iran (68.1%), Bangladesh (42.6%) and Australia (41.6%) had the highest proportions of graduates remained to work in the UK, while Oman (5%), Thailand (6.1%) and Iraq (7.8%) had the lowest proportions. Figure 3 shows the stay rates of international postgraduate students who graduated from the top 30 HEIs that received the highest number of international postgraduate students in the UK. With the exception of Bournemouth University, the universities that have stay rates above the average were either Oxbridge universities or those located within London. Students who graduated from Russell Group universities (19.4%) were found less likely to remain in the UK compared to their counterparts who graduated from other universities (24.4%) at 1% significance level. Students who graduated from universities located within London (27.0%) were found to have higher possibility of remaining to work in the UK than those who graduated from universities outside London (19.0%) at 1% significance level.

**Please insert Figure 2 here**

**Please insert Figure 3 here**

### 4.2 Cross-classified multilevel logistic model analysis

Table 2 shows the results of the null single-level, hierarchical and cross-classified models. The results of two-level hierarchical models (Model B and C) show that domicile-level VPC and HEI-level VPC were 21.1% and 17.2% respectively. Nevertheless, the cross-classified model (Model D) shows that 18% of total variation in the model was between domicile groups, while 10.8% of variation was between HEI groups simultaneously. Compared to cross-classified null model, both students-within-domicile null model and students-within-HEI null model overstate level-2 variation, which might increase the risk of making type-1 errors (Goldstein, 2011). In addition, the comparison between the DIC of Model D and DICs of other three models shows a considerable improvement in the case of cross-classified specification. Model D has the DIC (36355.228) lower by much more than ten points, which indicates that cross-classified multilevel logistic models should receive substantially more statistical support than single-level models and two-level models (Spiegelhalter *et al.*, 2002).

**Please insert Table 2 here**

Table 3 (Model 1-3) presents the results of selected multilevel logistic models. These models were built by adding individual-level and higher-level variables in groups into the baseline model (Model D, in Table 2). For each model, Wald tests were performed to examine whether the coefficients of newly added variables were significant at least at the 5% level. Variables that had non-significant coefficients and those which did not improve the model fit were excluded from latter models. Model 1 included individual-level variables only. Two sets of interaction terms between educational backgrounds and gender were added in Model 2. Lastly, HEI-level variables were incorporated in Model 3 to examine the impacts of HEIs on employment location of international students.

In Model 1, a series of polynomial functions of age (centred to its grand mean) were tested, and the cubic function was found to have the best model fit compared to other functions of age, which confirmed the non-linear relationship between age and stay-rate that has been identified in Figure 1. Coefficients of educational background variables confirmed the results of descriptive statistics. After controlling for other variables, doctoral degree recipients were 3.8 times more likely to stay (β=1.336, odds ratio==3.8) compared to masters degree recipients. Graduates who attended full-time programmes were 31.1% less likely (β= -0.372) to work in the UK than their counterparts who took part-time programmes. In terms of subject area, after controlling, STEM graduates (β=0.468) and BAS graduates (β=0.298) were 59.7% and 34.7% more likely to work in the UK respectively compared to graduates who studied in other non-STEM subjects.

STEM graduates and doctoral graduates were found to have higher probability of remaining than graduates with other educational backgrounds, and this could be explained by several potential mechanisms. Firstly, STEM graduates could obtain work permits more easily in the UK. Several government reports have mentioned that there is a considerable high-skill labour shortage in STEM fields in the UK (BEIS, 2017; Bosworth *et al.*, 2013; Störmer *et al.*, 2014; UKCES, 2015). According to the UK Home Office (2019), migrants in shortage occupations could be awarded attribute points for the Tier 2 General work visa sponsorship more easily than other migrants. Secondly, different labour market opportunities for doctoral graduates and masters graduates might lead to their different migration processes. Compared to taught masters, PhD holders are generally more likely to work in higher education sector and R&D positions in the private sectors (Garcia-Quevedo *et al.*, 2012). However, the absorbing capabilities for highly qualified human capital in less advanced countries are lower due to the insufficient R&D expenditure in industry, which might result in doctoral graduates who came from those countries are more intended to remain in host countries (e.g. UK) for employments that match their skill-levels (Harvey, 2011; Morano-Foadi, 2005). The UK’s increasing demand for highly skilled labour in those fields might provide STEM international postgraduates, especially at doctoral level, more opportunities to remain in the UK for employment.

In descriptive results mentioned previously, there was a higher proportion of male graduates than females remained to work in the UK. However, logistic regression analysis found more nuanced gender influence on employment locations of international postgraduates. Model 2 included two groups of interactions: the interaction between level of qualification and gender, and interactions between subject area and gender. After controlling, the coefficient of doctoral**×**female was significant at 1% level, which indicated that the gender effect differs between doctoral graduates and masters graduates. The coefficient of gender (β=0.217) indicated that, among masters degree recipients, females were 24.2% more likely to remain in the UK than males after controlling for other factors. However, among doctoral degree recipients, the odds of remaining for females was 2.7% lower than for male graduates (β=coefficient of gender + coefficient of doctoral**×**female=0.217 - 0.244). The interactions between subject area and gender were jointly significant at the 1% level. However, only the coefficient of STEM**×**female was significant (p<0.01), while the coefficient of BAS**×**female was not significantly different from zero. This result suggested that female students (β=0.217) who received degrees in other non-STEM subject areas generally have a higher probability of remaining to work in the UK compared to their male counterparts. This gender advantage would be less obvious among STEM graduates (β=0.217 - 0.176) and among BAS graduates (β=0.217 - 0.076, and not significant at the 5% level).

The findings of this study suggest that female international students are generally more mobile than males, and the influence of gender on employment destination is depending on students’ level of qualification and subject area. The gender difference on employment destinations was negligible among doctorate recipients, but it was much more obvious among masters degree recipients. There are mixed arguments on the influence of overseas education and living experience on female students. Some argue that transnational family ties (Geddie, 2013) and social/cultural-specific gender responsibilities within the family (Lee & Kim, 2010) may constrain the migration decisions of female international students. Some others, however, claim that the experience of different social and cultural norms in the host country of study might empower female migrants to revisit or even to question and challenge constructed cultural and gender norms in their home countries, which might result in higher stay rates of female international postgraduates (Ryan, 2004). This might because some female students, especially those from more masculinity-based societies, were more inclined to work in more egalitarian host countries after graduation due to better career prospects there compared to their countries of origin (Cattaneo *et al.*, 2017; Kim *et al.*, 2011; Musumba *et al.*, 2011). In addition, some female students who want to achieve their career goals or self-realisation may use studying abroad as a step stone for careers in host countries and also as a way of escaping gender norms from home societies (Lin & Kingminghae, 2018). The regression results in this study suggest that, in the context of the UK, overall, the influence of studying abroad on empowering international female students is greater than the constraints of social/cultural-specific gender norms in their home societies.

**Please insert Table 3 here**

Model 3 introduced two HEI-level variables: HEI prestige and HEI location. The HEI-level variance () decreased significantly from 0.581 in Model 2 to 0.430 in Model 3, indicating that after controlling for other factors, around 26.0% of the between-HEI variation was explained by these two variables. The coefficients for the variables Russell Group (β= -0.557) and Greater London Area (β=0.571) were both significant at 1% level, highlighting the importance of prestige and location of HEIs in explaining the employment destination of international graduates.

In terms of HEI prestige, graduates from Russell Group universities were 42.7% less likely to remain in the UK compared to those graduated from other institutions, and this may be partly explained by graduates’ socioeconomic status (SES) and the social and economic conditions in some of the major sourcing countries. For example, in China, although the number of mainland Chinese students studying abroad has increased dramatically since the early 2000s, the high cost of overseas education could be afforded by a small number of privileged families. In order to avoid the fierce competition for the limited places at elite domestic universities (e.g. Project 211 and Project 985 universities) as well as improve their competitiveness in Chinese labour market, an increasing number of students chose to study at high-ranking foreign universities, such as Russell Group universities in the UK (Bodycott, 2009; Iannelli & Huang, 2014). According to Xiang and Shen (2009), elite foreign credentials were regarded by many Chinese new rich as internationally recognised cultural capital, which could be further converted into other forms of capital (e.g. economic capital and political capital) during the period of wealth concentration and class formation in China. Therefore, international graduates from high-prestigious universities are more likely to leave the UK might because some graduates, especially those with more privileged backgrounds, believe that their investment in overseas education would be better rewarded in their countries of origin (de Haas, 2010). Unfortunately, as the data related to graduates’ SES was not available in the DLHE survey for postgraduates, this study was not able to test the influence of SES on residential and occupational choices of international graduates in the context of UK.

In terms of HEI location, regression results suggest that graduates who attended HEIs located within the Greater London area were 77.0% more likely to stay in the UK for work, which may be explained by two possible mechanisms. Firstly, the graduate employment opportunities is not evenly distributed in the UK, and the generation of job-matching opportunities is more aggregated on London and its surrounding regions (Faggian & McCann, 2009). Graduates from universities in London may have more time and opportunities to establish networks with potential employers or accumulate work experience during the period of study. Secondly, some graduates may be attracted by the employment opportunities, career prospects and incomes in London which were not available in their home countries, and they deliberately chose London as their study destination and planned to remain in there to work after graduation. Several studies have found that some students from other EU/EEA countries used this study-migration pathway as the stepping-stone for future employment in London (Beaverstock & Hall, 2012; Csedő, 2008; King *et al.*, 2014). It would be worthwhile for future studies to examine whether graduates from non-EEA countries have also adopted this study-migration pathway for employment in London.

A series of domicile-level variables were added into the multilevel regression models in the final set of model building steps. The Wald tests showed that none of these variables (i.e. GDP per capita, unemployment rates, English language background, and colonial affiliation) had coefficients that are significantly different from zero (Table 4), indicating that none of the domicile-level variables tested in this study has significant influence on stay rate of international graduates in the UK. The result of this study is consistent with the finding of Roh (2015) that GDP could not predict the stay rate of international graduates. Due to the possible within-country income inequality in many developing countries, the GDP per capita of the whole country may not be an accurate measurement of the living standard in regions where those return graduates chose to live and work. Future studies could examine whether GDP per capita data at province-level or city-level has influences on shaping the migration patterns of international graduates.

**Please insert Table 4 here**

## Conclusions and implications

Through fitting the recently available DLHE data with cross-classified multilevel logistic models, this paper has sought to extend existent understanding on international student migration by examining the effects of demographic and contextual features on graduates’ employment destinations in the UK context. The paper contributes to current research on ISM in several aspects. First of all, the results show that international graduates’ country of origin and university of study both have prominent roles in predicting their employment destinations after graduation, with 18.0% of total unexplained variation was attribute to the domicile-level and 10.8% to the HEI-level. Previous research (Roh, 2015) has found that the inclusion of graduate-within-domicile (country of origin) hierarchy improves the accuracy of statistical estimation on graduate mobility. This paper argues that international graduate migration data has more complex cross-classified structures, and the nesting of graduates within HEIs should not be neglected in model specification. The simultaneous inclusion of individual-level effects and wider domicile and HEI contextual influences are appropriate and necessary for statistical robustness and completeness in understanding ISM.

Further, at individual-level, results show that the degree level of graduates seems to have the largest impact on probability to work in the UK, and the influence of gender on graduate mobility need to be discussed together with graduates’ educational backgrounds. At HEI-level, this paper finds that university of study explains a significant, although small relative to country of origin, proportion of variation in graduates’ employment destination. After adjusting for other graduate, HEI and domicile characteristics, this paper finds that prestige and location of the HEI attended explain approximately one quarter of the between-HEI variation. At domicile-level, whilst the importance of GDP, unemployment, language backgrounds, and colonial affiliation on cross-border mobility have been stressed by existent migration theories and empirical research (Castles *et al.*, 2014; Massey *et al.*, 1993), the results of this paper show that these country-level contextual factors do not have significant association with the employment mobility of international graduates.

This paper provides empirical support to the plea of King and Raghuram (2013) that current theorisation of ISM needs improvement. Although the results show that country of origin and university of study both have substantive impacts on graduate mobility, it remains mostly unclear that what contextual factors could influence graduates’ residential and occupational choices and how. We suggest that the analyses of student migration need to be extended beyond the spatialities of migration, and focus more on the spatialities of knowledge (Raghuram, 2013), the aspirations for mobility (Tran, 2015), and the interactions between structures and graduate agency (Li & Lowe, 2016). Future research that adopts biographical and qualitative approaches is much needed in improving existent understanding on employment decision-making of international graduates as well as their active engagements with the dynamic contextual forces.

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Table 1. Descriptive statistics of employment location of international postgraduate students, in 2013/14-2014/15 (N = 38812)

| **Categorical variable** | **Work in other countries (%)** | **Work in UK (%)** | **Total (%)** | **Chi-Square** | **Cramer’s V** |
| --- | --- | --- | --- | --- | --- |
| **Gender** |  |  |  |  |  |
| Female | 79.6 | 20.4 | 52.8 | 33.672\*\* | 0.029 |
| Male | 77.1 | 22.9 | 47.2 |  |  |
| **Level of Qualification** |  |  |  |  |  |
| Masters (both taught and research) | 81.2 | 18.8 | 89.2 | 1449.926\*\* | 0.193 |
| Doctoral (both taught and research) | 55.6 | 44.4 | 10.8 |  |  |
| **Mode of Qualification** |  |  |  |  |  |
| Part-time | 70.1 | 29.9 | 6.1 | 102.060\*\* | 0.051 |
| Full-time | 78.9 | 21.1 | 93.9 |  |  |
| **Subject Area** |  |  |  |  |  |
| *STEM* | 74.1 | 25.9 | 33.0 | N/A | N/A |
| Medicine & Dentistry | 73.8 | 26.2 | 2.4 |  |  |
| Subjects allied to Medicine | 71.4 | 28.6 | 3.0 |  |  |
| Biological Sciences | 73.5 | 26.5 | 3.5 |  |  |
| Veterinary Science (n = 18) | 66.7 | 33.3 | 0.0 |  |  |
| Agriculture & Related Subjects | 82.0 | 18.0 | 0.6 |  |  |
| Physical Sciences | 77.4 | 22.6 | 3.2 |  |  |
| Mathematical Sciences | 73.9 | 26.1 | 1.6 |  |  |
| Computer Science | 66.0 | 34.0 | 4.6 |  |  |
| Engineering & Technology | 75.2 | 24.8 | 10.6 |  |  |
| Architecture, Building & Planning | 80.2 | 19.8 | 3.3 |  |  |
| *Business & Administrative Studies (BAS)* | 80.1 | 19.9 | 32.1 |  |  |
| *Other non-STEM* | 81.0 | 19.0 | 34.9 |  |  |
| Social Studies | 81.6 | 18.4 | 13.7 |  |  |
| Law | 86.1 | 13.9 | 5.0 |  |  |
| Mass Communications & Documentation | 81.2 | 18.8 | 3.2 |  |  |
| Languages | 83.3 | 16.7 | 3.4 |  |  |
| Historical & Philosophical Studies | 75.2 | 24.8 | 2.7 |  |  |
| Creative Arts & Design | 71.8 | 28.2 | 4.4 |  |  |
| Education | 86.3 | 13.7 | 2.4 |  |  |
| Combined (n = 4) | 75.0 | 25.0 | 0.0 |  |  |
| **Job-finding methods** |  |  |  |  |  |
| Media (e.g. newspaper/magazine ad) | 4.4 | 4.0 | 4.3 | N/A | N/A |
| Employer’s website | 12.8 | 15.5 | 13.4 |  |  |
| Recruitment agency/website | 11.8 | 14.0 | 12.3 |  |  |
| Personal contacts (e.g. family and friends) | 30.8 | 18.2 | 28.1 |  |  |
| Already worked there (e.g. intern/placement) | 16.8 | 12.8 | 15.9 |  |  |
| HEI Careers Service and other HEI sources | 6.1 | 19.8 | 9.0 |  |  |
| Social media/professional networking sites | 6.2 | 5.1 | 6.0 |  |  |
| Speculative application | 1.9 | 1.6 | 1.8 |  |  |
| Other | 9.3 | 8.9 | 9.2 |  |  |
| Total | 100 | 100 | 100 |  |  |
| **English Language Background 1** |  |  |  |  |  |
| Majority English speaking country | 70.5 | 29.5 | 15.1 | 258.317\*\* | 0.082 |
| Other countries | 79.8 | 20.2 | 84.9 |  |  |
| **English Language Background 2** |  |  |  |  |  |
| English as official language country | 73.5 | 26.5 | 46.7 | 477.124\*\* | 0.111 |
| Other countries | 82.7 | 17.3 | 53.3 |  |  |
| **Previous Colonial Affiliation** |  |  |  |  |  |
| Commonwealth country | 72.5 | 27.5 | 32.3 | 376.843\*\* | 0.099 |
| Other countries | 81.2 | 18.8 | 67.7 |  |  |
| \* *p* < 0.05, \*\* *p* < 0.01, N/A refers to Not Applicable | | | | | |

Table 2. Comparison between single-level and multilevel null models, DLHE 2012/13-2013/14 (N=38812)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Model A:  Single-level  Null | Model B:  Domicile only  Multilevel Null | Model C:  HEI only  Multilevel Null | Model D:  Cross-classified Null |
|  | Estimate(SE) | Estimate(SE) | Estimate(SE) | Estimate(SE) |
| Fixed effects |  |  |  |  |
| Intercept | -1.289 (0.012)\*\* | -1.370 (0.093)\*\* | -1.103 (0.087)\*\* | -1.294 (0.105)\*\* |
|  |  |  |  |  |
| Random effects |  |  |  |  |
| Domicile-level variance () |  | 0.878 (0.141) |  | 0.831 (0.139) |
| HEI-level variance () |  |  | 0.681 (0.102) | 0.497 (0.077) |
| Individual-level variance () | 3.29 | 3.29 | 3.29 | 3.29 |
|  |  |  |  |  |
| VPC |  |  |  |  |
| Domicile-level |  | 21.1% |  | 18.0% |
| HEI-level |  |  | 17.1% | 10.8% |
| Individual-level | 100% | 78.9% | 82.9% | 71.2% |
|  |  |  |  |  |
| Goodness of fit (DIC) | 40494.807 | 37715.636 | 38382.063 | 36355.228 |
| \* *p* < 0.05, \*\* *p* < 0.01 | | | | |

Table 3. Estimation results of cross-classified multilevel logistic models, DLHE 2012/13-2013/14 (N=38812)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Model 1: Null+Individual-level variables | Model 2: M1+Individual-level interactions | Model 3: M2+HEI-level variables |
|  | Estimate (SE) | Estimate (SE) | Estimate (SE) |
| Fixed effects |  |  |  |
| Intercept | -1.175 (0.130)\*\* | -1.258 (0.093)\*\* | -1.322 (0.139)\*\* |
| Individual-level |  |  |  |
| Age-gm | 0.038 (0.004)\*\* | 0.038 (0.004)\*\* | 0.038 (0.005)\*\* |
|  | -0.009 (0.001)\*\* | -0.009 (0.001)\*\* | -0.009 (0.001)\*\* |
|  | 2.38×10-4 (2.86×10-5)\*\* | 2.26×10-4 (2.57×10-5)\*\* | 2.27×10-4 (2.68×10-5)\*\* |
|  |  |  |  |
| Female (ref: male) | 0.088 (0.027)\*\* | 0.217 (0.048)\*\* | 0.217 (0.052)\*\* |
| Doctoral (ref: masters) | 1.336 (0.044)\*\* | 1.433 (0.054)\*\* | 1.438 (0.056)\*\* |
|  |  |  |  |
| Subject Area |  |  |  |
| (ref: other non-STEM) |  |  |  |
| STEM | 0.468 (0.040)\*\* | 0.568 (0.048)\*\* | 0.573 (0.054)\*\* |
| BAS | 0.298 (0.041)\*\* | 0.357 (0.050)\*\* | 0.364 (0.058)\*\* |
| Full-time (ref: part-time) | -0.372 (0.064)\*\* | -0.370 (0.057)\*\* | -0.357 (0.059)\*\* |
|  |  |  |  |
| Interactions with gender |  |  |  |
| Doctoral×female |  | -0.244 (0.082)\*\* | -0.242 (0.079)\*\* |
| STEM×female |  | -0.176 (0.066)\*\* | -0.179 (0.069)\*\* |
| BAS×female |  | -0.076 (0.065) | -0.079 (0.071) |
| HEI-level |  |  |  |
| Russell Group University |  |  | -0.557 (0.150)\*\* |
| (ref: other universities) |  |  |  |
| Greater London Area HEI |  |  | 0.571 (0.140)\*\* |
| (ref: HEIs in other areas) |  |  |  |
|  |  |  |  |
| Random effects |  |  |  |
| Domicile-level variance () | 0.787 (0.132) | 0.783 (0.131) | 0.789 (0.132) |
| HEI-level variance () | 0.582 (0.090) | 0.581 (0.089) | 0.430 (0.072) |
| Individual-level variance () | 3.29 | 3.29 | 3.29 |
|  |  |  |  |
| Goodness of Fit (DIC) | 34686.572 | 34666.989 | 34673.734 |
| \* *p* < 0.05, \*\* *p* < 0.01 | | | |

Table . Cross-classified multilevel logistic models describing association between domicile-level predictors and binary location of employment outcome

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | M4:M3+GDP per capita | M5:M3+Unemp-loyment | M6:M3+Youth unemployment | M7:M3+English Marker (native) | M8:M3+English Marker (official) | M9:M3+Colonial affiliation |
|  | Estimate (SE) | Estimate (SE) | Estimate (SE) | Estimate (SE) | Estimate (SE) | Estimate (SE) |
| Domicile-level |  |  |  |  |  |  |
| GDP per capita, PPP | -0.006 (0.004) |  |  |  |  |  |
| Unemployment rate |  | 0.018 (0.014) |  |  |  |  |
| Unemployment rate, Youth  (% of total labour force ages 15-24) |  |  | 0.013 (0.007) |  |  |  |
| Majority native English speaking country |  |  |  | 0.080 (0.296) |  |  |
| English as official language country |  |  |  |  | -0.202 (0.181) |  |
| Commonwealth affiliation |  |  |  |  |  | -0.167 (0.195) |
|  |  |  |  |  |  |  |
| Random effects |  |  |  |  |  |  |
| Domicile-level variance () | 0.722 (0.126) | 0.832 (0.145) | 0.815 (0.142) | 0.793 (0.134) | 0.797 (0.133) | 0.801 (0.134) |
| HEI-level variance () | 0.440 (0.073) | 0.434 (0.073) | 0.434 (0.072) | 0.431 (0.072) | 0.432 (0.072) | 0.430 (0.072) |
| Individual-level variance () | 3.29 | 3.29 | 3.29 | 3.29 | 3.29 | 3.29 |
|  |  |  |  |  |  |  |
| Goodness of Fit (DIC) | 34374.802 | 34517.732 | 34574.713 | 34674.321 | 34672.234 | 34672.641 |
| *\* p* < 0.05, \*\* *p* < 0.01 | | | | | | |

**Figure 1 Distribution of international postgraduate students who remained to work in the UK by age, 2013/14 - 2014/15 (figure only shows proportion aged from 22 to 47)**

图表

描述已自动生成

Figure 2 Stay rate of international students from top 30 sourcing countries/regions in 2013/14-2014/15

图片包含 图表

描述已自动生成

Figure 3 Stay rate of international students who graduated from top 30 HEIs that received the highest number of international postgraduate students in 2013/14-2014/15