Perspectives on Computational Research

Project: Methods and Initial Results

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Proposed research question

My research topic is the effect of college major on geographical mobility. The specific proposed research questions are: (1) Does college major influence individual's geographical mobility; (2) How (or to what extent) does college major influence individual's geographical mobility?

Hypotheses

Based on the proposed hypothesis, I put forward two hypotheses.

Hypothesis 1: Locational Dependence Hypothesis

H_{1a}: Occupational location is influenced by place of origin

H_{1b}: Occupational is not significantly influenced by place of origin

Then I would examine the effect of college major on the relationship between original location and occupational location.

Hypothesis 2: College Major Inference Hypothesis

H_{2a}: College major has impact on whether geographical mobility happens

H_{2b}: College major has impact on distance of geographical mobility

Data

1. Data Source

To conduct analysis on the above hypotheses, this study needs data with information of college degree, occupation, and demographics. The data I would use is from the National Survey of College Graduates. It is a longitudinal biennial survey, particularly focusing on the science and engineering workforce. The respondents are individuals under the age of 76 by February 1 2015, with at least a bachelor's degree by January 1 2014, and living in the U.S. during the survey reference period. The survey has been conducted since the 1993, replacing the previous Survey of Natural and Social Scientists and Engineers (SSE) which began in 1972. This study would use the most recent collection, the 2015 NSCG.

The initial data was collected with a self-administered web survey. For the occurrence of nonrespondents, a self-administered mail survey would be held. And nonrespondents to the mail survey would receive computer-assisted telephone interviewing (CATI). With these efforts, the 2015 NSCG has a weighted response rate of 70%. According to data documentation on its official site, this dataset contains 135,000 sample cases. However, due to the nonresponses, its public version only contains 91,000 observations.

2. Descriptive Statistics

This study mainly uses 11 variables. 3 of them are used in original setting, 5 of them are adjusted, and the other three of them are constructed based on several other variables in the dataset.

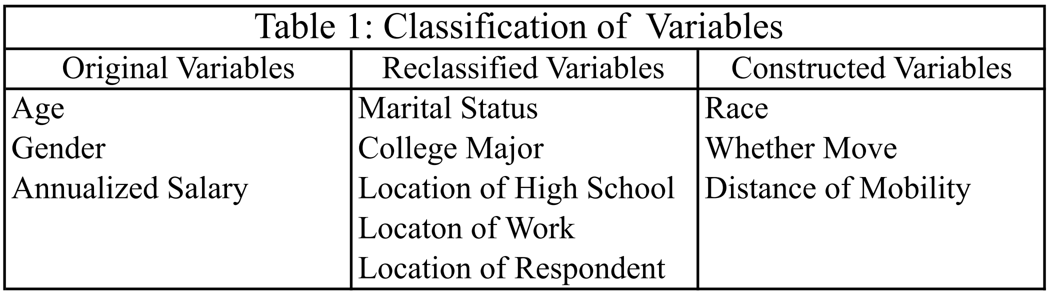


Table 1: Classification of Variables

Original Variables	Reclassified Variables	Constructed Variables
Age Gender Annualized Salary	Marital Status College Major Location of High School Locaton of Work Location of Respondent	Race Whether Move Distance of Mobility

Note that the annualized salary uses imputation to deal with missing values. According to data documentation, the general range of nonresponse rate for key items is from 0.0% to 0.6%, but salary has a nonresponse rate around 11%. Since this assignment is to provide initial results and insights, I use unconditional mean imputation to simply adjust this problem. The non-missing values and mean of the annualized salaries are not revised.

The original variable of marital status includes married, living in a marriage-like relationship, widowed, separated, divorced, and never married. To simplify the situation, I classify the married observations and living in a marriage-like relationship observations into one category with stable relationship. And I classified the others into another category without stable relationship.

Variables of college major and locations are also reclassified. The raw data of college major has more than 100 majors indicated. In this assignment, I categorized them into three categories: (1) engineering, computer science, math, and natural sciences; (2) social sciences; (3) others. And the raw data of locations contains many abroad countries. I converge all the abroad countries into one category: abroad.

And I constructed three variables based on several variables in the raw data. The variable of race is constructed with variables indicating Asian, black and Hispanic in the raw data. The variable of whether individuals move is constructed on whether the observations report the same location of high school and work.

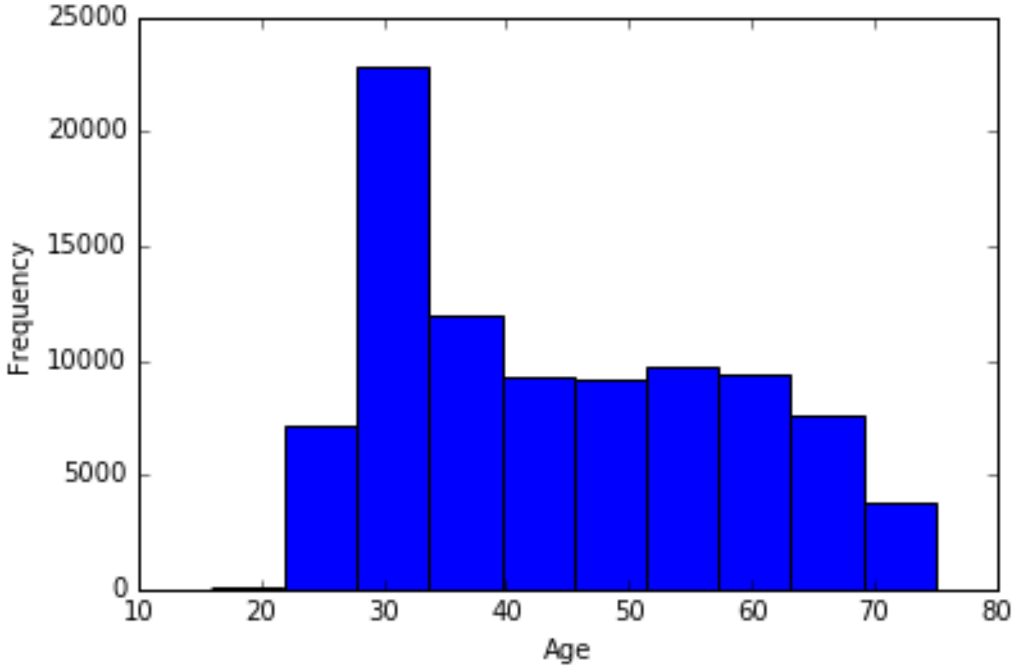
The variable of mobility distance is constructed on the basis of difference between the location of high school and the location of occupation. The distance is recorded as 1 when individuals move to their neighboring regions, and recorded as 2 when they move to regions next their neighboring regions. The rest is defined as the same rule, with the biggest internal mobility distance recorded as 5. If individuals move abroad, the distance is recorded as 8. Although the values of this variable are discrete, they represent the distance in order. So in data analysis, I would treat this variable as continuous variables.

Table 2: Descriptive Statistics					
Continuous Variables					
Variable	Mean	Standard Deviation	Min	Max	Observations
Age	44.26	14.16	16	75	91,000
Annual Salary	83727.09	83349.38	0	1223166	91,000
Mobility Distance	1.85	2.54	0	8	91,000
Categorical Variables					
Variable	Categories			Percent	Observations
Gender					91,000
	Male			53.18	48,396
	Female			46.82	42,604
Marital Status					91,000
	Married or in a married-like relationship			72.58	66,052
	Others			27.42	24,948
Race					91,000
	None of the below			64.87	59,028
	Asian			16.62	15,122
	Black			8.35	7,594
	Hispanic			10.17	9,256
College Major					91,000
	Engineering, CS, Math, and Natural			48.42	44,063

	Sciences		
	Social Sciences	21.07	19,171
	Others	30.51	27,766
If Moved			91,000
	No	56.32	51,251
	Yes	43.68	39,749
Location of High School			91,000
	New England	4.96	4,516
	Middle Atlantic	14.91	13,571
	East North Central	15.74	14,324
	West North Central	7.39	6,722
	South Atlantic	11.76	10,706
	East South Central	3.41	3,106
	West South Central	6.72	6,116
	Mountain	4.48	4,075
	Pacific & US Territories	13.84	12,596
	Abroad	16.78	15,268
Location of Employer			76,814
	New England	6.1	4,684
	Middle Atlantic	0.09	71
	East North Central	14.51	11,144
	West North Central	14.99	11,518
	South Atlantic	7.27	5,588
	East South Central	18.24	14,014
	West South Central	3.54	2,717
	Mountain	8.95	6,873
	Pacific & US Territories	6.38	4,899
	Abroad	19.93	15,306
Location of Respondent			91,000
	New England	5.98	5,446
	Middle Atlantic	14.45	13,146
	East North Central	14.89	13,550
	West North Central	7.18	6,530
	South Atlantic	18.26	16,614
	East South Central	3.61	3,287
	West South Central	8.92	8,121
	Mountain	6.54	5,955
	Pacific & US Territories	20.08	18,275
	Abroad	0.08	76

Table 2 shows descriptive statistics of the variables. And the plots below show the distribution of some key variables and some visualized relationships.

Figure 1: Distributon of Age



According to Figure 1, the distribution of age in the sample is not normal. This is because the 2015 NSCG has an oversample of young graduates. The group around the age of 30 has higher observations than the other groups. Simply adjust the age distribution may cause more serious problems. By now, I have not found a suitable way to adjust this problem. So I would not apply variable transformation on age in data analysis.

Figure 2: Distributon of Annualized Salary

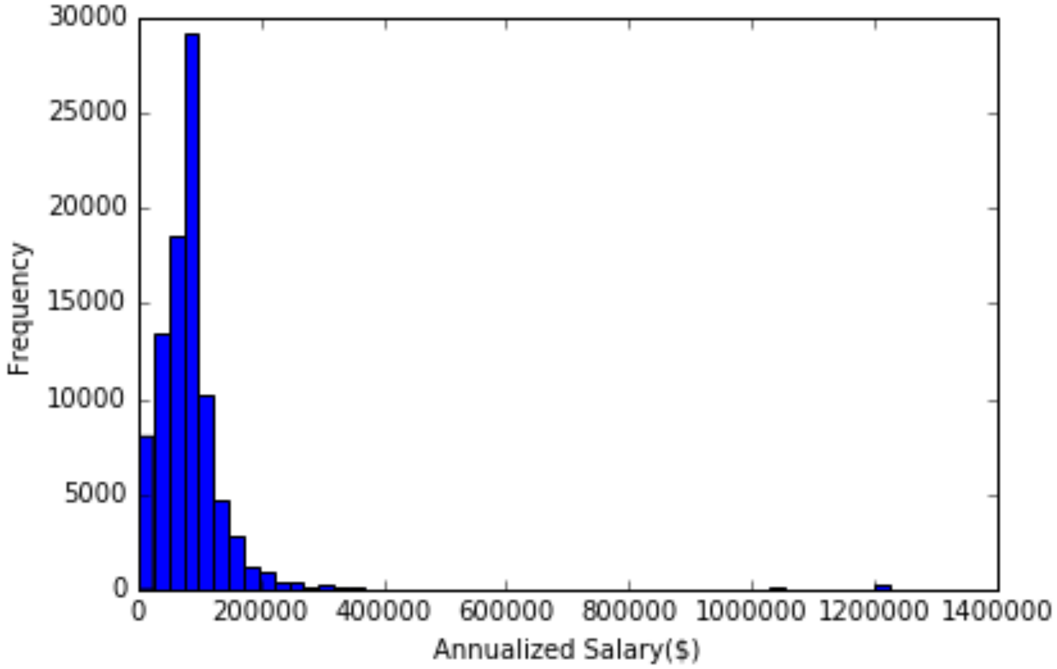


Figure 3: Distributon of Logged Annualized Salary

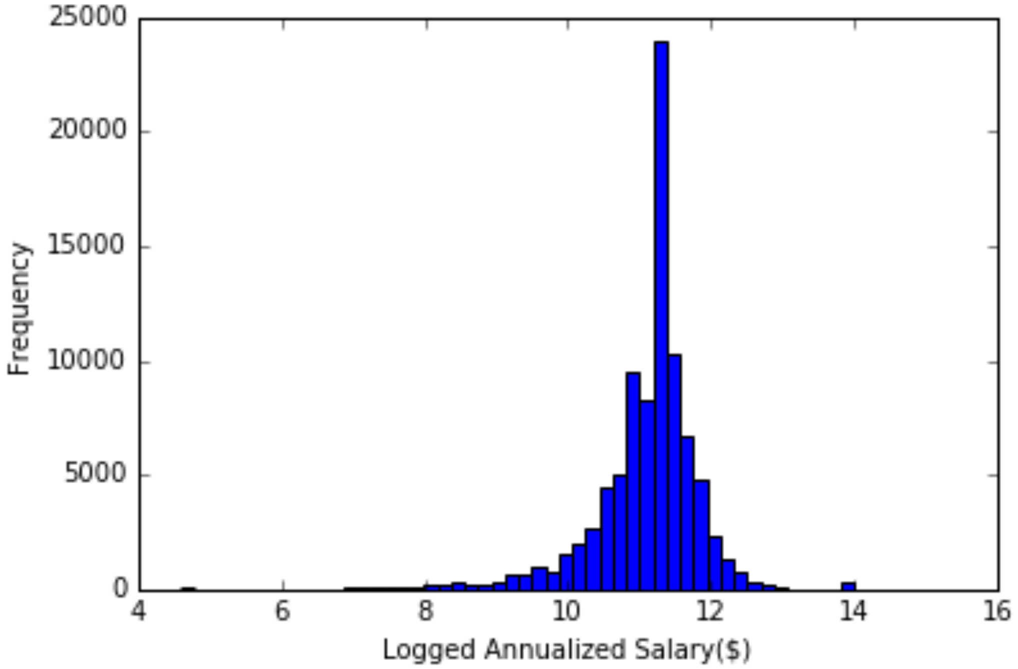


Figure 2 shows that annualized salary does not have a normal distribution. I take the logarithm of annualized salary to adjust this problem. And Figure 3 shows an approximately normal distribution of logged annualized salary. So I would use the logged annualized salary in data analysis.

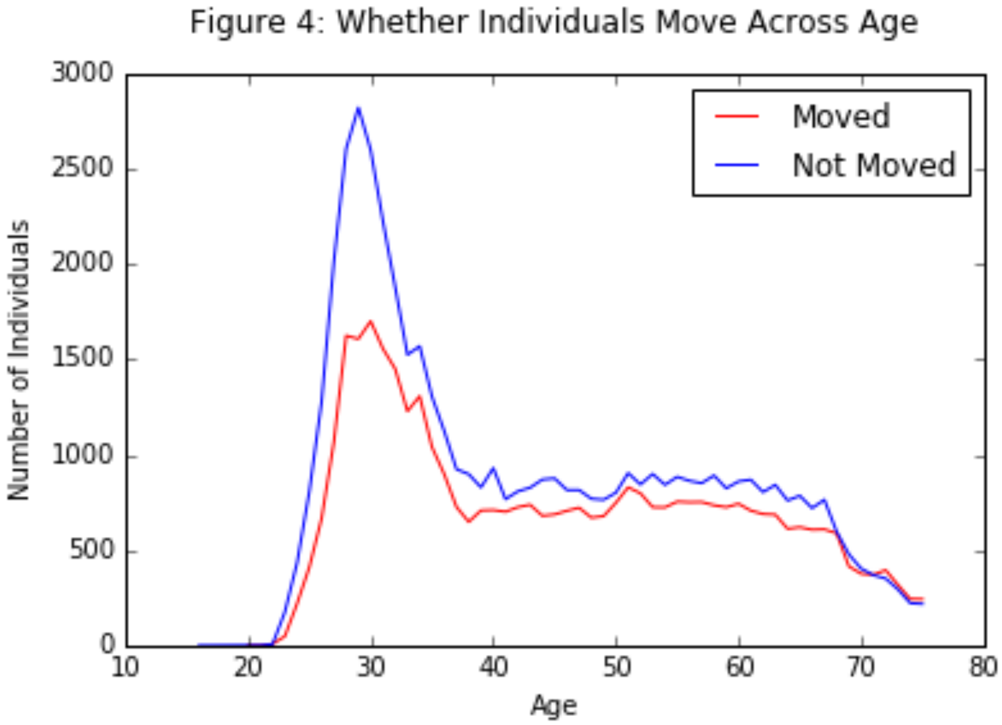


Figure 4 visualized the relationship between age and whether individuals move. Age distributions are generally similar for individual moved and not moved. Individuals with age around 30 have much higher frequency of mobility, which may due to the oversampling of the young graduates. Approximately after the age of 67, the frequencies of both moved observations and the not-moved observations drop, which may due to the age distribution of the sample. And almost across all ages, the not-moved observations are more than the moved observations.

Figure 5: Distance of Move Across Age

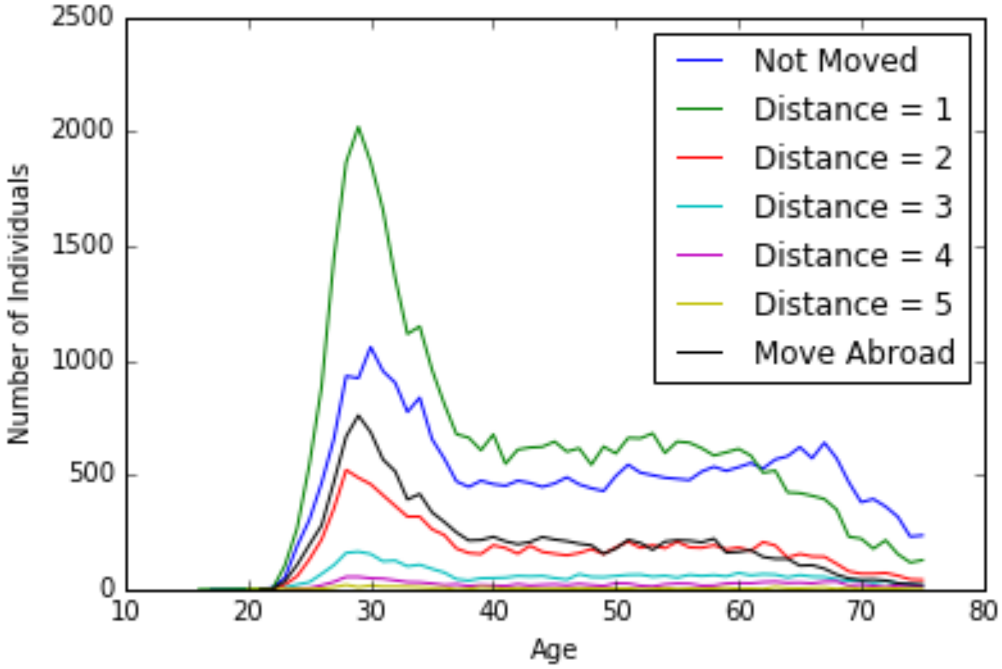


Figure 5 shows the distance of move across age. Similar to the patterns of Figure 4, there are more observations around the age of 30 than any other cohorts. For the mobility distance range from 2 to 5, the more the distance, the less the frequency. Many observations move to their neighboring regions.

Figure 6: Mobility by Major

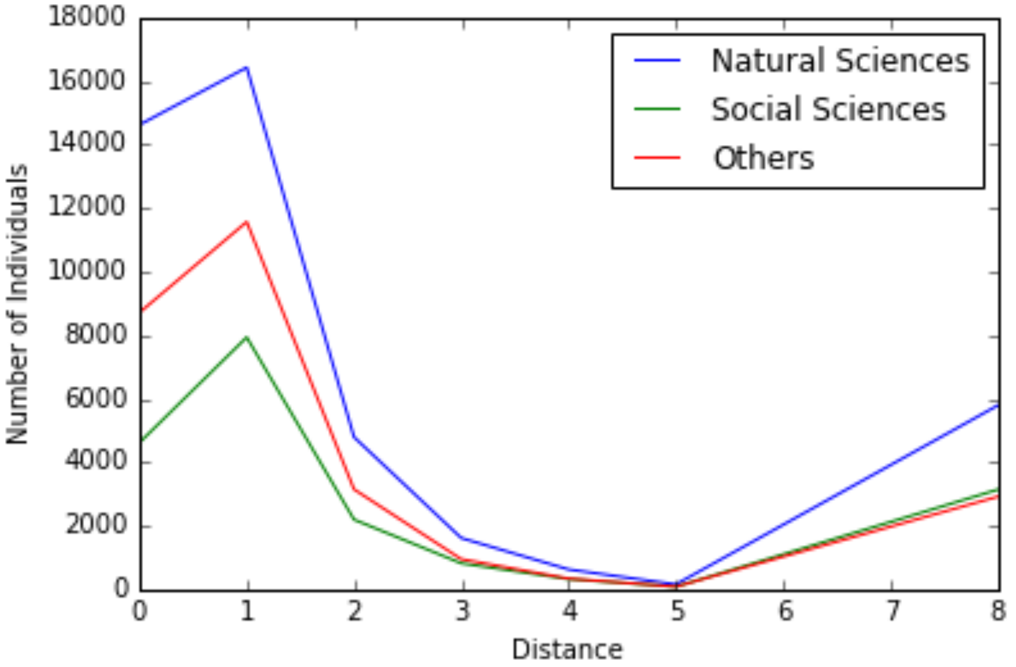


Figure 6 indicates that there is far more individuals majored in natural sciences than in social sciences and other majors. And there are more individuals graduated with other majors than with the social science. However, for internal mobility within US, with the increase of mobility distance, the amounts of people move of each category are getting closer. And they converge when the distance is 5.

Method

For tentative data analysis, I would apply logistic regression to examine the Locational Dependence Hypothesis (Hypothesis 1), and apply OLS regression t examine the College Major Inference Hypothesis (Hypothesis 2). These two techniques are very traditional and have long been used, so I would not discuss the usage of them.

I would use demographic variables (age, gender, and race and marital status) nested models to examine the effect of majors. I would first apply:

$$\mathrm{IS\_MOVED_i} = \beta_0 + \beta_1 {*}\mathrm{AGE_i} + \beta_2 {*}\mathrm{GENDER} + \beta_3 {*}\mathrm{RACE_i} + \beta_4 {*}\mathrm{MARRITAL\_STATUS_i} + \beta_5 {*}\mathrm{SALARY} + \varepsilon_\mathrm{i} \quad \text{(1), and}$$

$$\mathrm{DISTANCE_i} = \beta_0 + \beta_1 {*}\mathrm{AGE_i} + \beta_2 {*}\mathrm{GENDER} + \beta_3 {*}\mathrm{RACE_i} + \beta_4 {*}\mathrm{MARRITAL\_STATUS_i} + \beta_5 {*}\mathrm{SALARY} + \varepsilon_\mathrm{i} \quad \text{(2).}$$

Then add the variable of college majors to examine its effect:

$$\mathrm{IS\_MOVED_i} = \beta_0 + \beta_1 {*}\mathrm{AGE_i} + \beta_2 {*}\mathrm{GENDER} + \beta_3 {*}\mathrm{RACE_i} + \beta_4 {*}\mathrm{MARRITAL\_STATUS_i} + \beta_5 {*}\mathrm{SALARY} + \beta_6 {*}\mathrm{MAJOR_i} + \varepsilon_\mathrm{i} \quad \text{(3), and}$$

$$\mathrm{DISTANCE_i} = \beta_0 + \beta_1 {*}\mathrm{AGE_i} + \beta_2 {*}\mathrm{GENDER} + \beta_3 {*}\mathrm{RACE_i} + \beta_4 {*}\mathrm{MARRITAL\_STATUS_i} + \beta_5 {*}\mathrm{SALARY} + \beta_6 {*}\mathrm{MAJOR_i} + \varepsilon_\mathrm{i} \quad \text{(4).}$$

These approaches would be too simple for a real research. But they are useful for this tentative analysis. Further steps would be taken to explore in detail, if the hypothesized relationships occur in these regression models.

Tentative results

Table 3 shows tentative results of the logistic regression and the OLS. Model (1) and Model (3) are nested models for Hypothesis 1, while Model (2) and Model (4) are nested models for Hypothesis 2.

Table 3: Regression

	(1)	(3)	(2)	(4)
VARIABLES	Whether Moved		Mobility Distance	
Age	0.0120***	0.0129***	−0.0152***	−0.0146***
	(0.000507)	(0.000513)	(0.000610)	(0.000615)
Female	−0.143***	−0.0832***	−0.0763***	−0.0913***
	(0.0142)	(0.0147)	(0.0171)	(0.0177)
Asian	1.234***	1.207***	−0.0920***	−0.0873***
	(0.0198)	(0.0199)	(0.0232)	(0.0233)
Black	0.105***	0.117***	−0.502***	−0.530***
	(0.0258)	(0.0259)	(0.0310)	(0.0310)
Hispanic	0.170***	0.173***	0.782***	0.755***
	(0.0233)	(0.0234)	(0.0283)	(0.0283)
Married	0.280***	0.272***	−0.235***	−0.221***
	(0.0161)	(0.0162)	(0.0192)	(0.0192)
Logged incom	0.119***	0.105***	−0.0367***	-0.0305***
	(0.00907)	(0.00911)	(0.0107)	(0.0107)
Social sciences		−0.273***		0.344***
(vs. natural sciences)		(0.0187)		(0.0224)
Others		−0.213***		-0.0907***
(vs. natural sciences)		(0.0167)		(0.0202)
Constant	-2.485***	-2.256***	3.111***	2.975***
	(0.103)	(0.104)	(0.121)	(0.122)
Observations	90,660	90,660	90,660	90,660
R-squared			0.024	0.028

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of Model (1) and Model (3) supports Hypothesis 2_a. College major has impact on whether geographical mobility happens. And the results of Model (2) and Model (4) supports Hypothesis 2_b.