PAA EXTENDED ABSTRACT

SWITCHING FIELD OF STUDY: DIFFERENT EDUCATIONAL PATHWAYS OF HIGHLY EDUCATED NATIVES AND IMMIGRANTS

Siqi Han*

Department of Sociology

The Ohio State University

* Address correspondence to Siqi Han, Department of Sociology, 238 Townshend Hall, 1885 Neil Avenue Mall, The Ohio State University, Columbus, OH 43210, or by email, han.607@osu.edu.

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Abstract

This paper advances understanding of immigrants' post-immigration educational attainment by considering one aspect of horizontal stratification in their educational pathways: switching field of study between college and graduate school. Foreign educated immigrants with a STEM degree may be more likely to retain in STEM fields than to switch to non-STEM fields when entering a U.S. graduate school than their native counterparts. This is due to immigrants' belief in science universalism and their weaker context-specific knowledge. To test these ideas, I compare foreign college-educated immigrants and U.S. college-educated immigrants to U.S. college-educated natives. Data from National Survey of College Graduates show that immigrants are more likely to retain in STEM or to switch to STEM from non-STEM fields; natives are more likely to switch from STEM to law, medicine and business. These results suggest that lower economic returns among highly educated immigrants can be explained, in part, by field of study.

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Are the fields of Science, Technology, Engineering and Math (hereafter STEM fields) in the U.S becoming "immigrant" fields of study? Does the immigration process alter the educational pathways of high skilled immigrants? If so, are they more likely than native students to end up with STEM degrees? Furthermore, among students who enter advanced training beyond a college degree, do the educational pathways of foreign college-educated immigrants and U.S. college-educated immigrants differ in important ways? The traditional "science pipeline" model (Berryman 1983, England et al. 2007) studies how females leak out of the STEM fields as they proceed to higher level of education compared to males, but a parallel is yet to be drawn between natives and immigrants. Some scholars have asked whether the leaking of natives out of the science pipeline signals the "decline" of the sciences in the U.S. (Lowell and Salzman 2007, Xie and Killeward 2012).[1] On the other hand, the concentration of highly-skilled immigrants in STEM fields may also signal barriers to their social mobility, if this concentration is due to their lack of access to other high-status fields such as law, medicine and business. By comparing the educational pathways of highly educated immigrants and native students, I expect that the U.S. educational system and labor market favor immigrants who pursue advanced degrees in STEM, but that immigrants face barriers to high status non-STEM fields relative to native students. These processes are related to the growing segregation of immigrants and natives in STEM and non-STEM fields of advanced study we have seen in recent decades.

Past research on immigrants' educational attainment focuses on the lower returns to foreign education compared to U.S. education at the same level, due, in part, to place of college education (Zeng and Xie 2004, Arbeit and Warren 2012). Lower recognition of foreign degrees among American employers, non-transferability of certain types of knowledge across societies and presumably lower quality of foreign education are regarded as three explanations for the lower returns. For those who obtain higher education after college, we need to know their educational pathways from college to the final level of education in detail. Tong (2010) discovered that immigrants who obtained both their undergraduate and graduate degrees in the U.S. have higher economic returns than students who had a foreign undergraduate degree and a U.S. graduate degree. This is because the U.S. college education provides a chance to acculturate to the English language and develop context specific skills. While Tong accounts for the pathways consisting of different places of education for immigrants, we do not know whether their field of study would change with place of education. To avoid lower returns to foreign education, do immigrants switch to another field in graduate school where the transferability of skills is higher while less context-specific knowledge is needed?

In this paper I advance the understanding of immigrants' post-immigration human capital attainment by incorporating the dimension of horizontal stratification into the study of the educational pathways of highly educated immigrants and natives. I compare immigrants and natives from the 2003 National Survey of College Graduates (NSCG 2003). The immigrant sample is divided into the foreign educated group and the U.S. educated group for further comparison. By focusing on horizontal stratification, or the stratification caused by different fields of study and different places of education, my approach overcomes the deficiency of treating people with "college education" or "graduate education" as a homogeneous group. In particular, I focus on one educational transition: switching field of study

[1] Lowell and Salzman's report estimated that 20 percent of S&E bachelors are in school but not in S&E studies, while Xie and Killeward believed that it is an overestimation due to the inclusion of social sciences.

between college and graduate school. Switching field of study is a type of adjustment individuals make to adapt to the changing characteristics of fields, educational systems and the labor market. The individual decision making process of entering a field reflects the structural requirements in different fields of study that one can meet with. The field people end up with will have a significant impact on their future social mobility. The innovation of this paper is to depict the pattern of field switching in the transition from college to graduate school, which is at the nexus of the educational pathway perspective, the horizontal stratification model and the human capital transferability argument.

The relative advantages among different fields of study vary over time. Evidence from Xie and Killeward (2012), as well as many other sources, indicates that people in STEM fields and occupations have lower incomes as well as lower income growth over time when compared with people in medicine, law and some fields of business. Moreover, STEM fields are typically more competitive and entail higher risks than those other high status fields, because they have long training period and only a small proportion of would-be scientists enjoy the optimal rewards of making original discoveries/breakthroughs and gaining recognition for their contributions to science (Xie and Killeward 2012:42). The majority of scientists endure long periods of training for post-docs and difficulties in finding federal funding and suitable employment. I expect that the obstacles one has to overcome to make a difference in science are recognized by both native and immigrant STEM undergraduates during their college years, but that the ability to change their educational pathways differs. I predict that natives more often switch out of science, while the immigrants retain in science, or even switch into science from another field. To understand the pattern, I first compare foreign-college educated immigrants with U.S. college-educated natives, and then compare U.S. college-educated immigrants with U.S. college-educated natives.

The case of foreign-college educated immigrants illustrates the disadvantages attached both to a foreign college degree and to an immigrant status. They may reduce the likelihood that immigrants switch from science to non-science advanced degrees, or even increase the likelihood that immigrants with a non-science degree pursue advanced training in science. First, the push and pull dynamic between the U.S. labor market and a particular immigrant sending country will draw more immigrants to pursue the STEM degree, because there is room in the demand side left by a lack of native scientists. Second, in addition to the structural demand, the immigrants' subjective perceptions of the STEM fields are related to immigrants' concentration in these fields. The "Science universalism belief" (Xie and Killeward 2012, Tang 2000) is one of the perceptions more often held by disadvantaged social groups. This belief includes the notion that scientific work is judged in terms of merit alone, and the notion that science recruits its members on the basis of talent and not on the basis of functionally irrelevant factors such as race, gender, nationality, religion and social origin. Because citizenship status and place of education can be disadvantaged social characteristics, immigrants may worry that they will be judged negatively in the less "universal" non-STEM fields. Such beliefs may prevent immigrants from switching to non-STEM fields, even when these fields may be easier to pursue or more profitable.

> *Hypothesis 1: Foreign college-educated immigrants with a STEM degree have a higher probability to retain in STEM fields when entering a U.S. graduate school than their native U.S. college-educated counterparts.*

As noted by prior research (Zeng and Xie 2004, Arbeit and Warren 2012, Tong 2010), two other powerful theoretical arguments that will help us understand the formation of the "immigrant" fields are

the degree of skill transferability and the command of contextual knowledge. Natives who studied STEM in college should have better command of English and greater contextual knowledge of the U.S. society than foreign-educated STEM students, who entered graduate school upon arrival. Therefore, natives have a wider set of options and may enter non-STEM fields from all fields including STEM; as a result, they have a higher probability of switching at graduate level from STEM to a non-STEM field that provides comparable or higher prestige. Among all non-STEM fields, law, medicine and business are among the most profitable, and are probably the most common destinations for the native switchers from STEM fields. At the same time, these three fields are highly contextual (Chiswick, Lee and Miller 2005), in other words, foreign college-educated immigrants holding degrees in these fields should suffer the biggest skill discount when transferring. They may not even be admitted by a U.S. graduate school in the first place, if their previous training is not compatible with the U.S. law, medicine or business training tradition. I thus expect foreign college-educated immigrants in the context-specific fields may be motivated to switch to a field that is not as contextual and is in bigger demand: a STEM field.

Hypothesis 2.1: Foreign college-educated immigrants with a STEM degree have a lower probability to switch to a non-STEM field when entering a U.S. graduate school than their native U.S. college-educated counterparts.

Hypothesis 2.2: Foreign college-educated immigrants with a STEM degree have a lower probability to switch to law, medicine or business when entering a U.S. graduate school than their native U.S. college-educated counterparts.

Hypothesis 3: Foreign college-educated immigrants with a non-STEM degree have a higher probability to switch to STEM fields when entering a U.S. graduate school than their native U.S. college-educated counterparts.

I then use the U.S. educated immigrant group to illustrate the educational pathways immigrants may have entered, if they did not have the issue of limited skill transferability or a lack of contextual knowledge. I expect that during the process of acculturation, immigrants may gradually gain contextual knowledge and resemble the educational pathways of natives. In this paper, I draw from previous research (e.g. Portes and Zhou 1993, Redstone and Massey 2004, Alba 2004) and use four dimensions of acculturation: a U.S. college degree, English proficiency, age at immigration and the length of stay in the U.S. The importance of a U.S. college degree is addressed by separating the U.S. educated immigrants from the foreign educated ones. For the other three dimensions, the corresponding hypothesis is:

Hypothesis 4: For U.S. college-educated immigrants, longer years of stay, younger age at immigration and better English ability increase their probability of switching to a non-STEM field.

The NSCG 2003 dataset[2] is trimmed into a sample which only contains college graduates who entered graduate school and attained their highest degree in the U.S. It offers the respondent's level of higher education, place of education and field of study from the highest degree to the 3rd highest degree, with a specific set of information for the first bachelor's degree. There are 143 majors under 28 fields in the dataset, but for the efficiency of analysis, the paper aggregates some of the fields. The operational

[2] The newest cycle, NSCG 2010 is out for public use. I intend to incorporate it into the next set of analyses in the full paper.

fields of study in this paper are engineering, life/biological sciences, math and computer sciences, physics, social sciences, law, medicine, business, and all others[3]. The highlight of this categorization is the three professional fields: law, medicine, and business, which are seldom classified or specified in this way in previous studies. Switching field of study is defined as having a field of highest degree that differs from field of first bachelor's degree.

Preliminary results

Table 1 drawn from the data suggests a strong pattern for foreign college-educated immigrants to retain in the STEM fields in graduate school. From the beginning, there has already been a large difference in the percentage of students majoring STEM in college between the foreign college-educated immigrants and the U.S. college-educated natives. 66.5% of the former group has a STEM college degree, while only 31.8% of the latter has it. The retention rate for foreign college-educated immigrants in STEM is 86.47% (57.5% / 66.5%), while it is only 57.23% (18.2% / 31.8%) for U.S. college-educated natives. Both results support hypotheses 1 and 2.1. On the other hand, natives are able to switch to law, medicine and business from both STEM and non-STEM fields than foreign college-educated immigrants. There are 9.8% native STEM students switched to law, medicine and business, and 18.1% native non-STEM students switched to the three fields. Respectively, for foreign college-educated immigrants, there are only 6% and 8.1%. These numbers support hypothesis 2.2 and hypothesis 3.

[Table 1 about here]

Table 2.1 and 2.2 decompose the switch from one particular STEM field to other fields (other STEM fields, law, medicine or business, or non-STEM non-professional fields) for both males and females. The tables show that immigrants with a STEM bachelor's degree, regardless of their place of education, rarely pursue law. Moreover, foreign college-educated immigrants with a STEM bachelor's degree rarely pursue medicine compared to U.S. college-educated immigrants and natives, even if they had a biology degree. In contrast, foreign-educated immigrants have a higher rate of switching *within* the STEM fields than the other two groups. Gender differences mainly appear in the diversity of educational pathways after obtaining a STEM bachelor's degree. This can be seen by comparing the number of empty cells in table 2.1 and table 2.2. Empty cells are cells that have a frequency lower than 10 persons[4], and thus are not regarded as pathways for the group being analyzed. The female table has more empty cells than the male table, which means there are more fields they aren't able to switch to. The same argument can be raised for the native-immigrant comparison, where immigrants have more empty cells than natives. There are several popular routes from STEM to law, medicine and business: engineering to business, biology to medicine, math/computer sciences to business and physics to medicine. However, although the

[3] The "all others" category is based on the 28 fields coded by NSCG, including agriculture business and production, agricultural sciences, architecture/environmental design, communications, conservation and natural resources, criminal justice/protective services, education, languages/linguistics/literature/letters, health and related sciences *except medicine*, home economics, liberal arts/general studies, library science, parks/recreation/leisure/fitness studies, philosophy/religion/theology, psychology, public affairs, social work, visual and performing arts, and "other fields" defined by NSCG.

[4] Not reporting the information of a cell containing less than 10 persons is a strategy used in presenting tables. When analyzing the contingency tables with log-linear models, all cells will be included.

tendency to follow these routes also exists among immigrants, the percentage is much smaller. For example, 19.48% of U.S. college-educated native males switched from math/CS to business, while 14.55% of U.S. college-educated immigrant males and only 6.64% foreign college-educated immigrant males were able to follow this route. The narrower entrance for immigrants to a professional or non-STEM field can serve as a piece of evidence for the hypotheses that natives and immigrants are channeled into different structural positions in the U.S. educational system, and that immigrants are less able to access other high status fields than the STEM ones.

[Table 2.1 about here]

[Table 2.2 about here]

Next steps

Two models will be used to test the hypotheses. First, I use log-linear models to address the patterns in the first 3 hypotheses. Then, I use logistic regression to model Hypothesis 4. Log-linear model identifies the associations between field of study of the first bachelor's degree and that of the highest degree, independent of the marginal distributions of the number of students by origin and destination fields. This table will be further classified by gender, nativity, and place of education (i.e., native U.S. college-educated males, native U.S. college-educated females, U.S. college-educated male immigrants, U.S. college-educated female immigrants, foreign college-educated male immigrants and foreign college-educated female immigrants). The analyses will explore differences in field switching among different gender, places of education and nativities. After depicting the pattern of field switching among different subgroups, the U.S. college-educated immigrants will be modeled by logistic regression to see if the assimilation indicators play a part in their choices of graduate field of study. The choice will be recoded into a binary variable (0 “did not switch to law, medicine or business” and 1 “switched to law, medicine or business”). The expectation is that the higher their assimilation indicators, the higher the probability of switching to law, medicine or business.

Differences in the field switching patterns between two immigrant groups and the native group have significant social implications. Different capabilities of switching to a wider range of fields, especially to law, business and medicine, can be regarded as a stratifying force among the highly educated population, which brings about the growing segregation of immigrants and natives in academia as well in the labor market.

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Table 1 Distribution of field of study at highest level according to first bachelor's degree, foreign college-educated immigrants and natives

		Total number of students at bachelor's level		Number(%) of students in STEM/non-STEM	Highest degree		
						Non-STEM	
					STEM	Law, Medicine and Business	All others except law, medicine and business
First Bachelor's degree	Foreign educated immigrants	3999	STEM	2664 (66.5%)	57.5%	6%	3%
			Non-STEM	1335 (33.5%)	6.6%	8.1%	18.7%
	Natives	33545	STEM	10664 (31.8%)	18.2%	9.8%	3.8%
			Non-STEM	22881 (68.2%)	2.7%	18.1%	47.3%

Note: All respondents have obtained their graduate degree in the U.S. The "all others except law, medicine and business" category includes "all others" category and "social sciences" category among the 8 operational fields of study identified by the paper.

Table 2.1 Breakdown of male STEM bachelors who switched fields at highest level of education, by place of education and nativity

Male	Number of students at bachelor's level	Total number and percent switched	Number and percent switched to:				
native			other STEM fields	law	medicine	business	other fields*
Engineering	3423	1450 (42.36%)	259 (7.57%)	53 (1.54%)	44 (1.28%)	913 (26.67%)	181 (5.29%)
Biology[5]	1759	1235 (70.21%)	109 (6.20%)	33 (1.87%)	749 (42.58%)	91 (5.17%)	253 (14.38%)
Math/CS	1037	509 (49.08%)	100 (9.64%)	26 (2.51%)	32 (3.09%)	202 (19.48%)	149 (23.63%)
Physics	1729	900 (52.05%)	364 (21.05%)	26 (1.50%)	226 (13.07%)	123 (7.11%)	161 (9.31%)
U.S. educated immigrant			other STEM fields	law	medicine	business	other fields*
Engineering	756	248 (32.80%)	59 (7.80%)	-	13 (1.72%)	143 (18.91%)	27 (3.57%)
Biology	222	161 (72.52%)	-	-	108 (48.64%)	13 (5.85%)	31 (13.95%)
Math/CS	165	65 (39.40%)	23 (13.94%)	-	-	24 (14.55%)	17 (10.30%)
Physics	179	94 (52.51%)	49 （27.73%）	-	21 (11.73%)	10 (5.59%)	13 (7.26%)
foreign educated immigrant			other STEM fields	law	medicine	business	other fields*
Engineering	1323	407 (30.76%)	223 (16.86%)	-	-	151 (11.41%)	32 (2.42%)
Biology	126	44 (34.92%)	19 (15.08%)	-	-	-	18 (14.29%)
Math/CS	241	57 (23.65%)	26 (10.79%)	-	-	16 (6.64%)	15 (6.22%)
Physics	347	140 (40.34%)	115 (33.14%)	-	-	10 (2.88%)	11 (3.17%)

Note: All respondents have obtained their graduate degree in the U.S. "Other fields" are non-STEM, non-professional fields including "all others" category and "social sciences" category. Empty cells are categories with an actual size of population less than 10 persons, which makes it less meaningful to present. The neglected percentages in empty cells may make a difference in fields where the total number of switchers is small, thus the total percentage switched will be larger than the sum of percentages switched in such fields because of the empty cells.

[5] Biology is a traditional "pre-med" major. Proceeding to medical school with a biology degree is usually regarded as a natural transition instead of "switch". But in the original dataset, there is an option of "pre-med majors", which distinguishes the biology students in the track with those who are not. For this reason, I believe "biology" does not overlap "pre-med majors", and thus regard the switch from biology to medicine as a switch.

Table 2.2 Breakdown of female STEM bachelors who switched fields at highest level of education, by place of education and nativity

Female	Number of students at bachelor's level	Total number and percent switched	Number and percent switched to:				
native			other STEM fields	law	medicine	business	other fields*
Engineering	504	208 (41.27%)	38 (7.54%)	-	-	127 (25.20%)	29 (5.75%)
Biology	1156	774 (66.96%)	66 (5.71%)	18 (1.56%)	341 (29.50%)	52 (4.50%)	297 (25.69%)
Math/CS	547	300 (54.84%)	51 (9.32%)	14 (2.56%)	-	109 (19.93%)	119 (21.76%)
Physics	509	298 (58.55%)	120 (23.58%)	15 (2.95%)	51 (10.00%)	29 (5.70%)	83 (16.31%)
U.S. educated immigrant			other STEM fields	law	medicine	business	other fields*
Engineering	97	31 (31.96%)	-	-	-	19 (19.59%)	-
Biology	189	149 (78.84%)	-	-	72 (38.10%)	-	58 (30.69%)
Math/CS	90	40 (44.44%)	-	-	-	11 (12.22%)	17 (18.89%)
Physics	75	42 (56.00%)	11 (14.67%)	-	13 (17.33%)	-	14 (18.67%)
foreign educated immigrant			other STEM fields	law	medicine	business	other fields*
Engineering	227	106 (46.70%)	79 (34.80%)	-	-	18 (7.92%)	-
Biology	125	47 (37.60%)	17 (13.60%)	-	-	-	20 (16%)
Math/CS	129	31 (24.03%)	11 (8.53%)	-	-	12 (9.30%)	-
Physics	146	71 (48.63%)	51 (34.93%)	-	-	-	10 (6.85%)

Note: All respondents have obtained their graduate degree in the U.S. "Other fields" are non-STEM, non-professional fields including "all others" category and "social sciences" category. Empty cells are categories with an actual size of population less than 10 persons, which makes it less meaningful to present. The neglected percentages in empty cells may make a difference in fields where the total number of switchers is small, thus the total percentage switched will be larger than the sum of percentages switched in such fields because of the empty cells.