

Team # 15 Project # 1 STEM and Us

Introduction

In this project, we basically analyze how STEM policy influences the whole American Society, including the citizens and the non-citizens. To make the topic more relevant to ourselves, our analysis contains two main parts: (1) how STEM policy influences graduated students, and (2) how STEM policy influences employment situation.

In part (1), we use several data sets to understand how STEM degrees develop into STEM jobs. In part (2), we use data sets from 2007 and 2014 to compare the employment situations and working conditions before and after the announcement of the STEM policy.

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Part 1. Influences of STEM policy on graduated students

1. Our Objective

In this part of analysis, we want to know how STEM policy influence graduated students. We first separate our data into 2 categories: one category includes citizens and the other category includes non-citizens. Then, we further separate our data into STEM-major data and non-STEM-major data. By doing the separations, we can easily do comparisons between influences of STEM policy to citizens and influences of STEM policy to non-citizens and between employment status of STEM majors and employment status of non-STEM majors.

2. Our Concerns

1. Is it true that graduated students with STEM degrees can easily find jobs?
2. Do levels of degrees influence employment rate of STEM students? Do levels of degrees influence employment rate of non-STEM students?
3. Which fields will STEM graduated students enter and which fields will non-STEM graduated students enter?

3. Our Findings

Before we start to analyze data, we should clean and preprocess data. For example, we categorize people according to their degree field as stem or non-stem.

We also separate data into two parts according to people's citizenship status.

Below shows the structure of our processed data.

Show entries

Search:

	ST	AGEP	CIT	SCHL	FOD1P	OCCP	STEM	OCCP.TYPE
1	1	64	1	24	6000		0	0
2	1	57	1	23	6000		0	0
3	1	55	1	21	5507	5000	0	OFF
4	1	24	1	21	6206	5620	0	OFF
5	1	62	1	21	6200		0	0
6	1	41	1	21	5404	2010	0	CMS

7	1	77	1	21	2399	0	0
8	1	73	1	21	6004	0	0
9	1	31	1	22	6201	800	0 FIN
10	1	52	1	21	1901	7630	0 RPR

Showing 1 to 10 of 50 entries

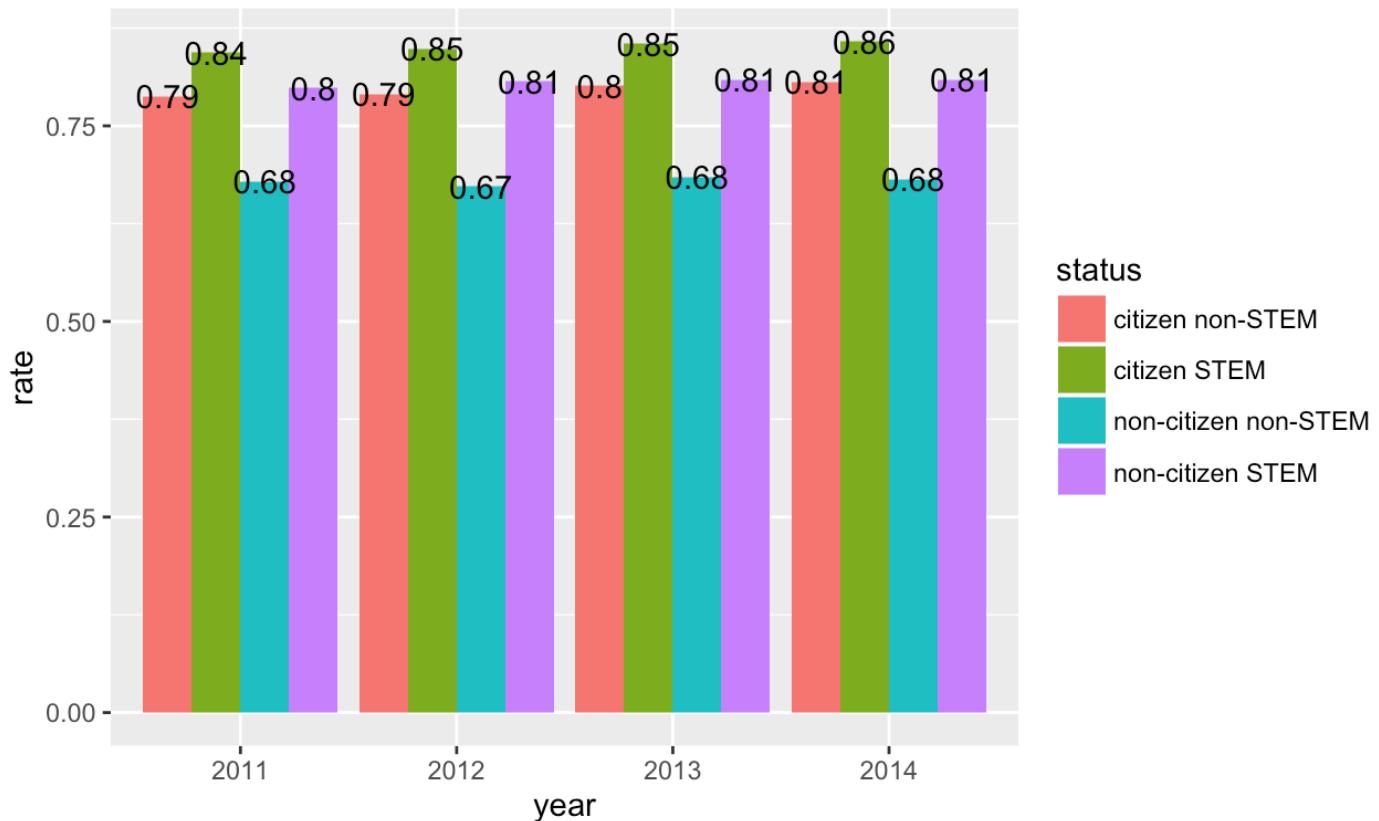
Previous 1 2 3 4 5 Next

(1) Rate of Employment

The first plot we obtained explains how the rate of employment varies among citizens or non-citizens with stem or non-stem degree.

[Code](#)

Employment Rate of Different Degree/Citizenship Type v.s. Time

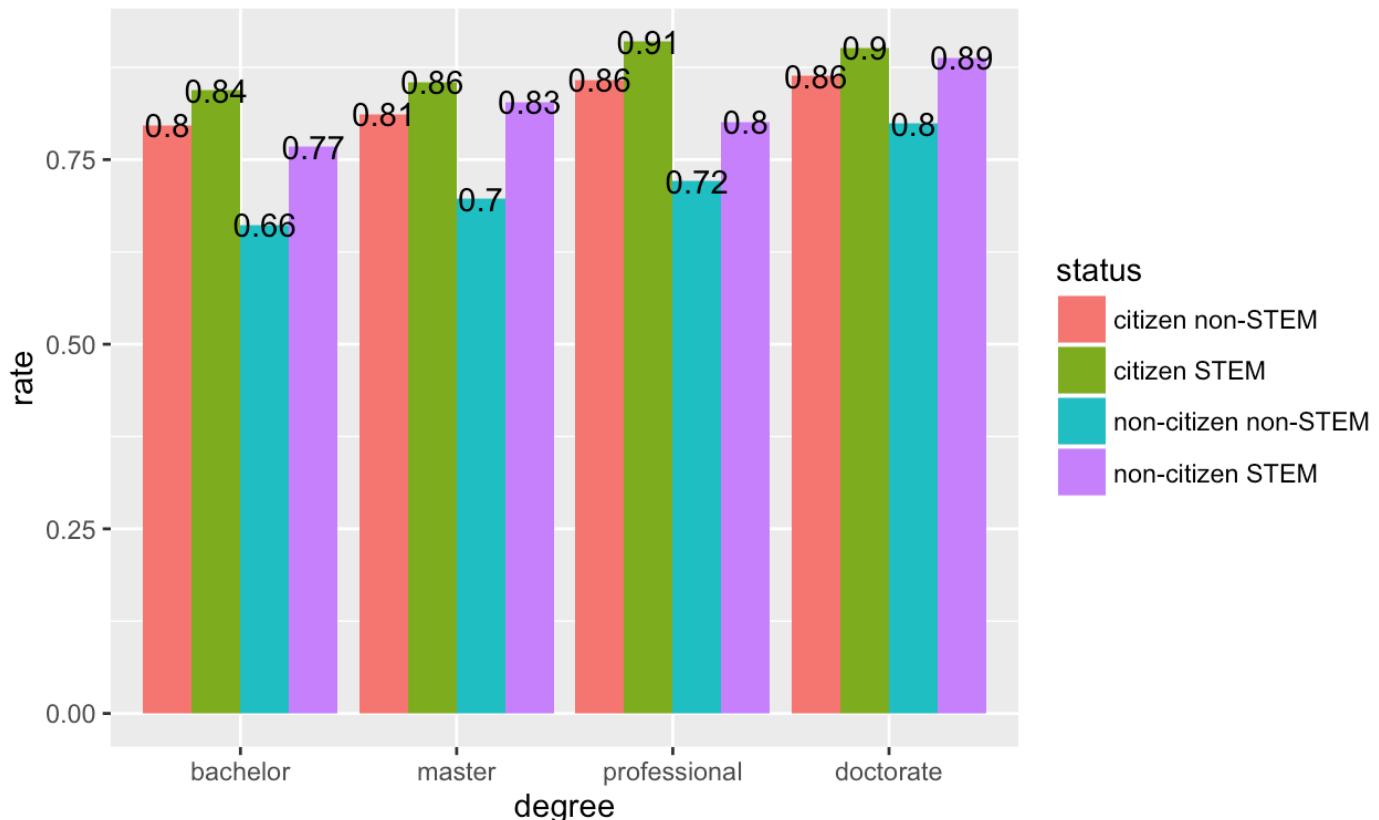


From the plot we can see that the rate is quite stable at least in recent years, and in general Citizens other than non-citizens, STEM degrees other than non-STEM degrees are more favorable in employers' eye.

Now we start to think how advanced degree influences the employment rate. From the following figure, we see how important it is for non-citizens to get a higher degree, since for citizens with either STEM or non-STEM degree, the rate stays somewhat stable among different degree groups, while for non-citizens, the rate can change significantly.

[Code](#)

Employment Rate v.s. Degree/Citizenship Type



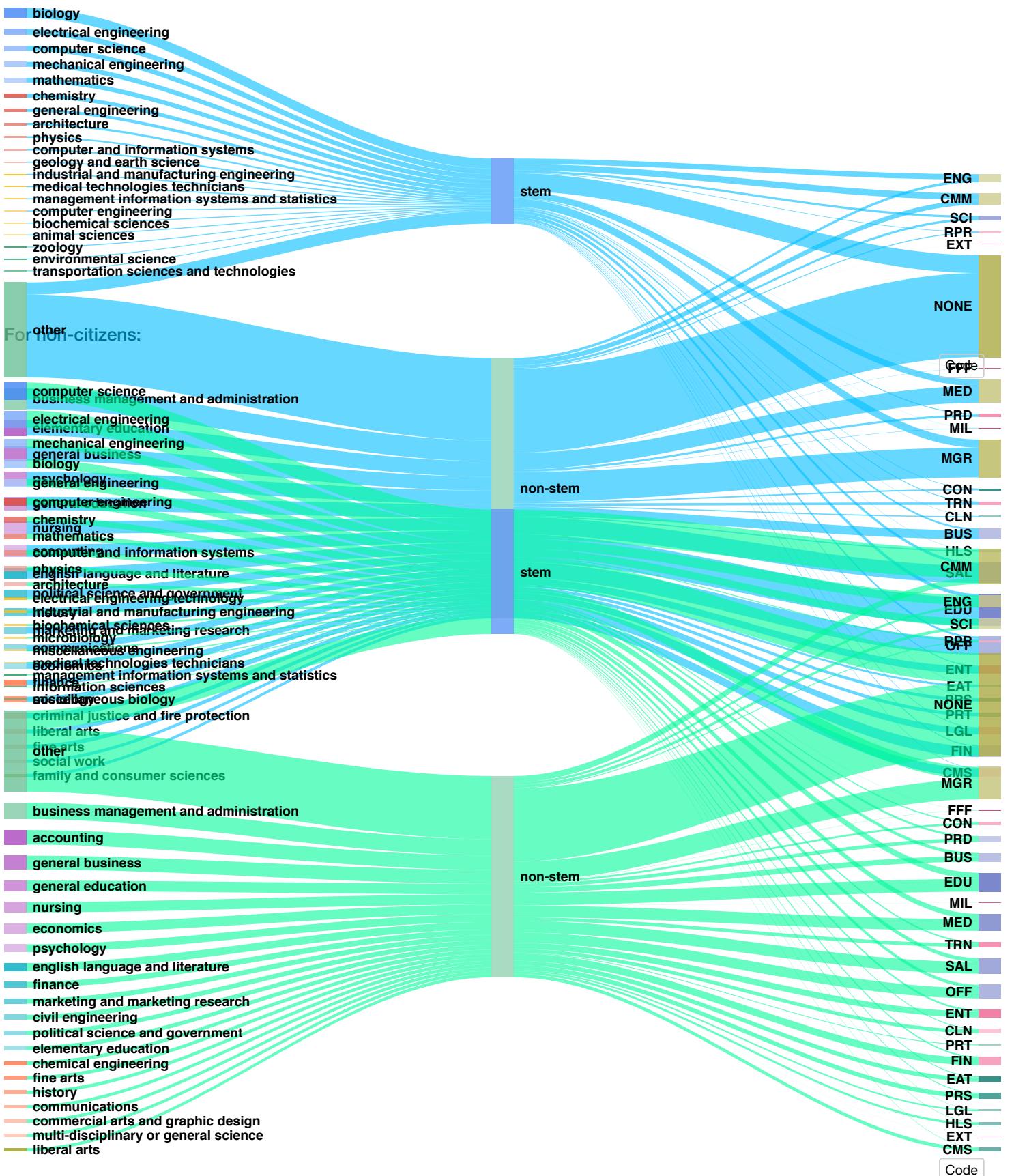
(2) STEM degrees and STEM jobs

Now we want to have a closer look at how STEM degrees develop into STEM jobs. From these sankey plots, we see the component of STEM degrees and how STEM degree people separate into different industries after graduation for both citizens and non-citizens. First, apparently, more people pursue a non-STEM degree. In STEM degrees, as for popularity, biology outperforms both CS and EE among citizens while it's the opposite among non-citizens. This is quite reasonable since foreign students need to consider more about getting a job. For both STEM and non-STEM degree groups, the industry they choose after graduation varies a lot.

[Code](#)

For citizens:

[Code](#)

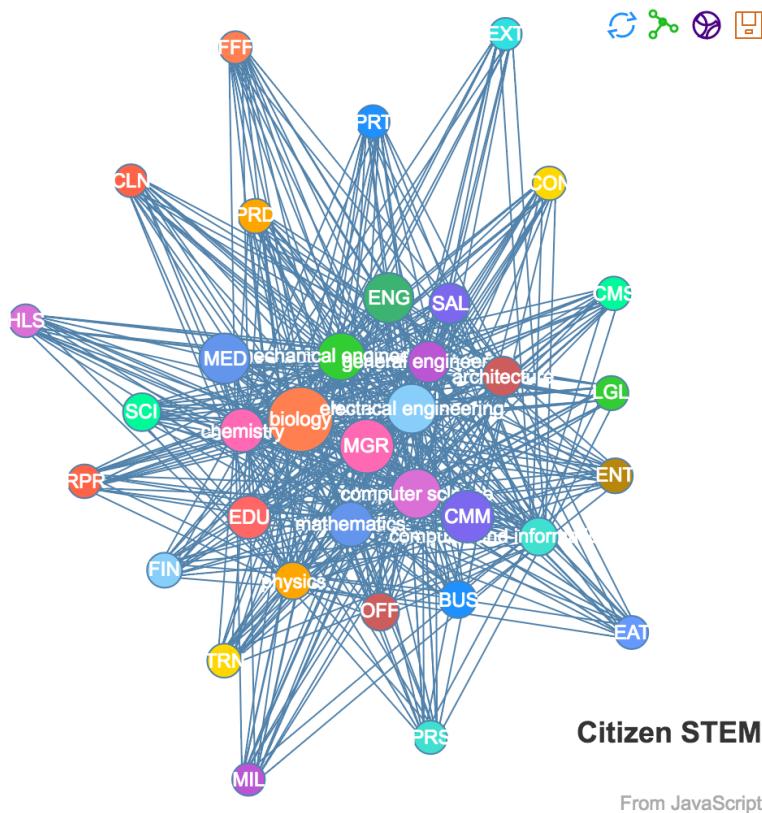


(3) Industry Choice After Graduation

To further study how people of specific STEM degree go into different industries, we draw the following circular plots. Each plot corresponds to either citizen or non-citizen and either STEM degree or non-STEM degree. These figures suggest a lot of information but due to the time constraints, we will not talk much about them during this presentation.

visualization #1 Citizen STEM

[Code](#)

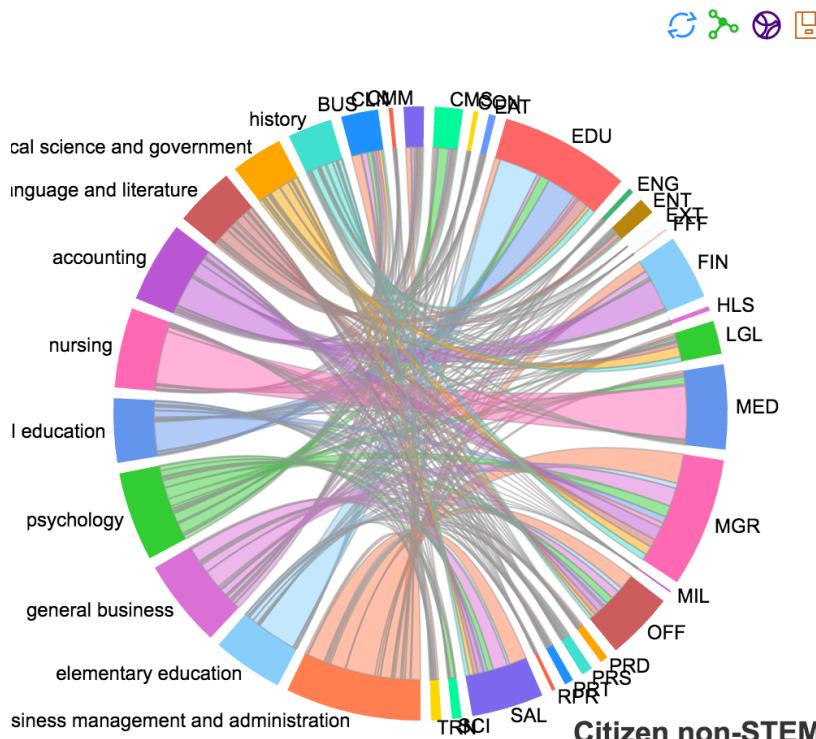


Citizen STEM

From JavaScript

visualization #2 Citizen Non-STEM

[Code](#)



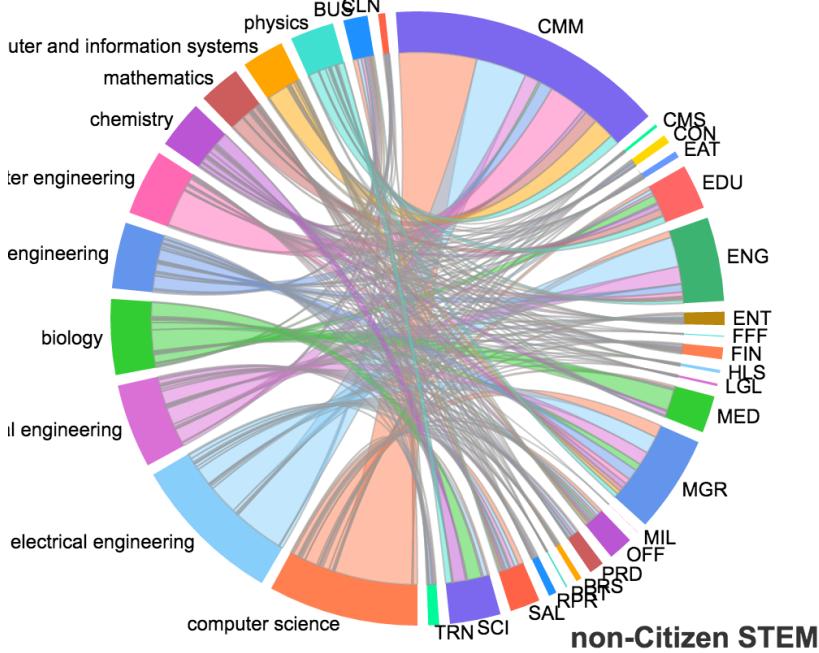
Citizen non-STEM

From JavaScript

visualization #3 Non-Citizen STEM

[Code](#)

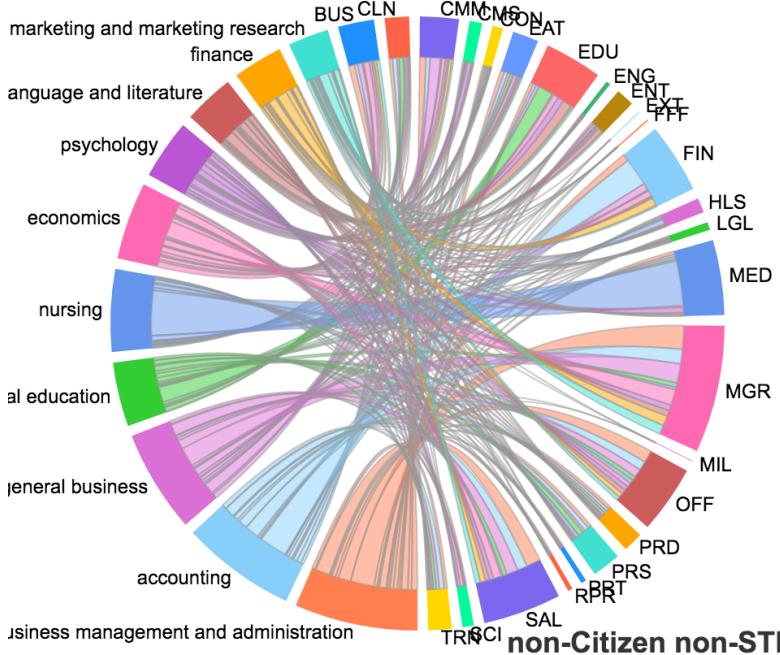




From JavaScript

visualization #4 Non-Citizen Non-STEM

Code



From JavaScript

Part 2. Influences of STEM policy on employees

1. Our Objective

In this part of analysis, we want to know how STEM jobs have changed along with the announcement of the STEM policy. Two data sets are being used: data of 2007, which is the last year before STEM policy, and data of 2014, the latest obtainable under-STEM-policy data. For each data set, we categorize our data into two classes: STEM-job data and non-STEM-job data. By doing the separations, we can look at the differences of STEM and non-STEM jobs before and after STEM policy went out.

2. Our Concerns

1. Will the STEM/non-STEM job allocation change?
2. Among STEM/non-STEM jobs, will gender proportion and class of work be influenced by the STEM policy?
3. How did the working conditions, such as wage and working hours change?
4. Will the STEM policy further influence people's immigration behavior?

3. Our Findings

[Code](#)

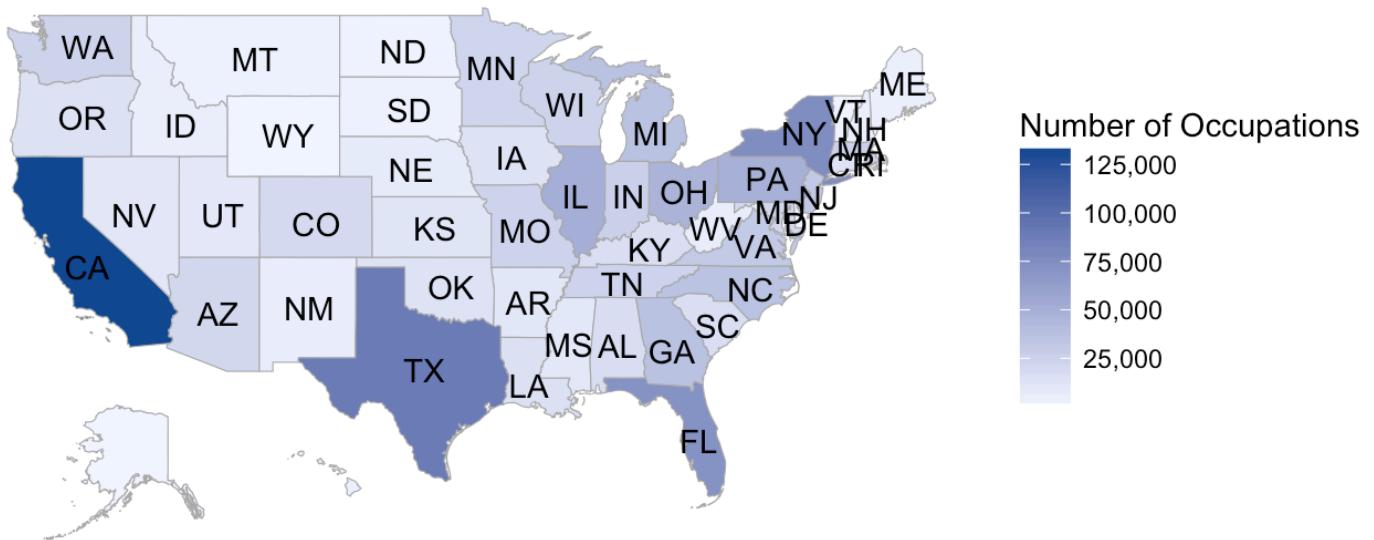
(1) Job Allocation in US

The first thing we studied is whether the STEM/non-STEM job allocation has changed geographically. According to the first two figures, we can see that the allocation of non-STEM jobs barely changed after STEM policy went out. According to the last two figures, we see for STEM jobs, something happened on the east coast.

[Code](#)

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joining factor and character vector, coercing into character vector
```

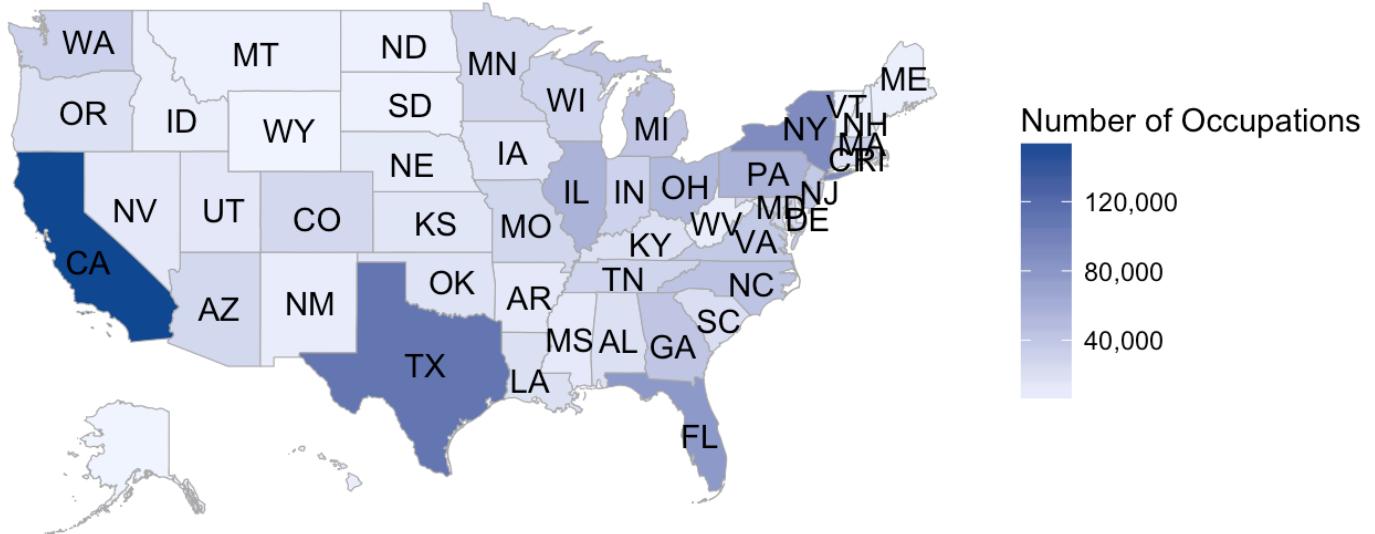
Before STEM Policy: NON-STEM Job Allocation



[Code](#)

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joining factor and character vector, coercing into character vector
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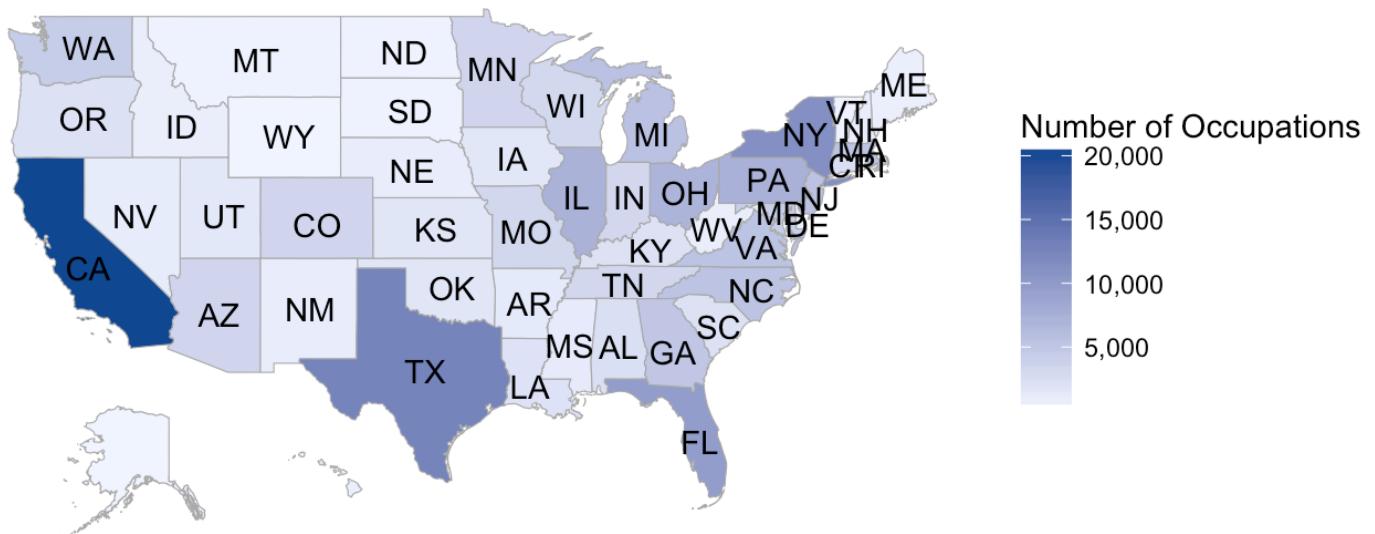
After STEM Policy: NON-STEM Job Allocation



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joining factor and character vector, coercing into character vector
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[Code](#)

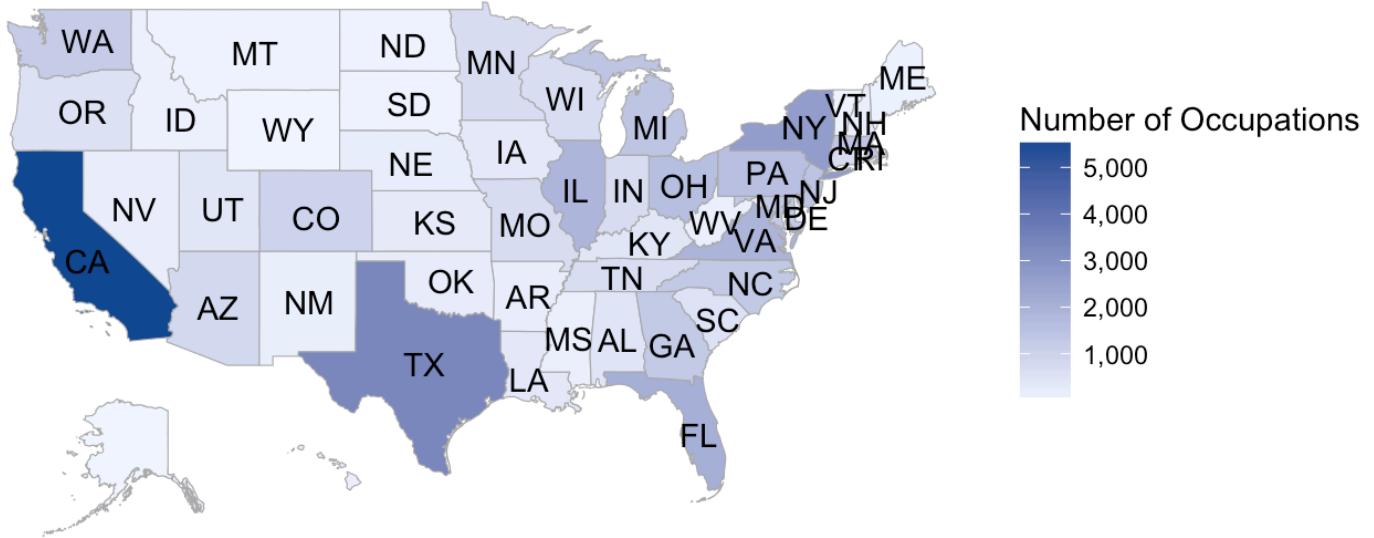
Before STEM Policy: STEM Job Allocation



[Code](#)

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joining factor and character vector, coercing into character vector
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After STEM Policy: STEM Job Allocation

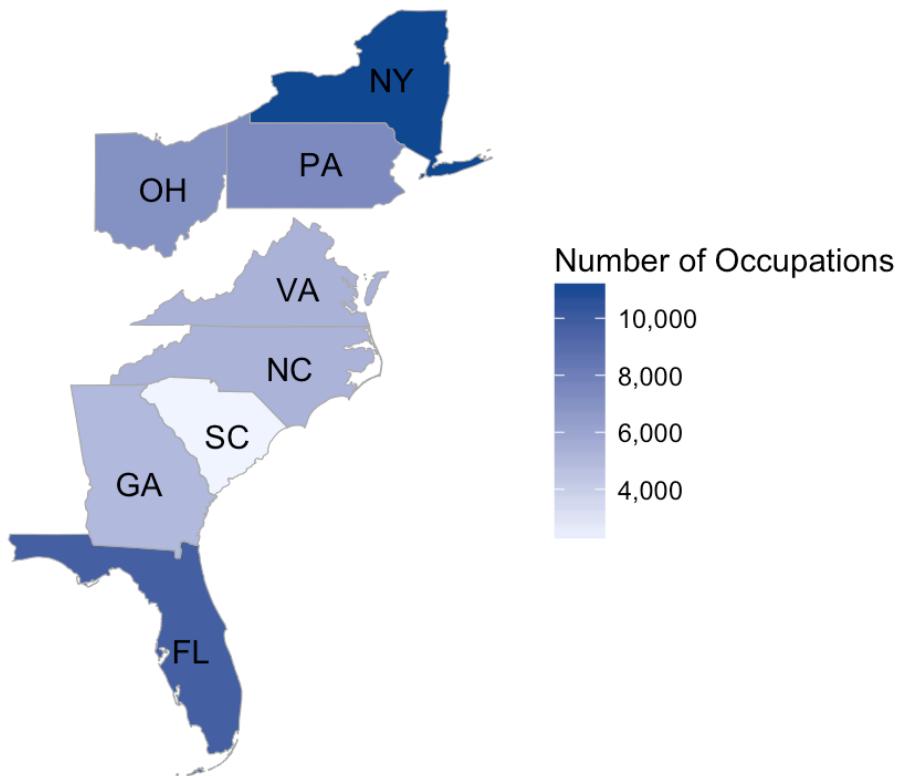


If we take a closer look at these states, we can see relevant jobs in NY and FL tended to diffuse towards neighboring states, among which, Virginia has the most significant increase in terms of the amount of STEM jobs.

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joining factor and character vector, coercing into character vector
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Code

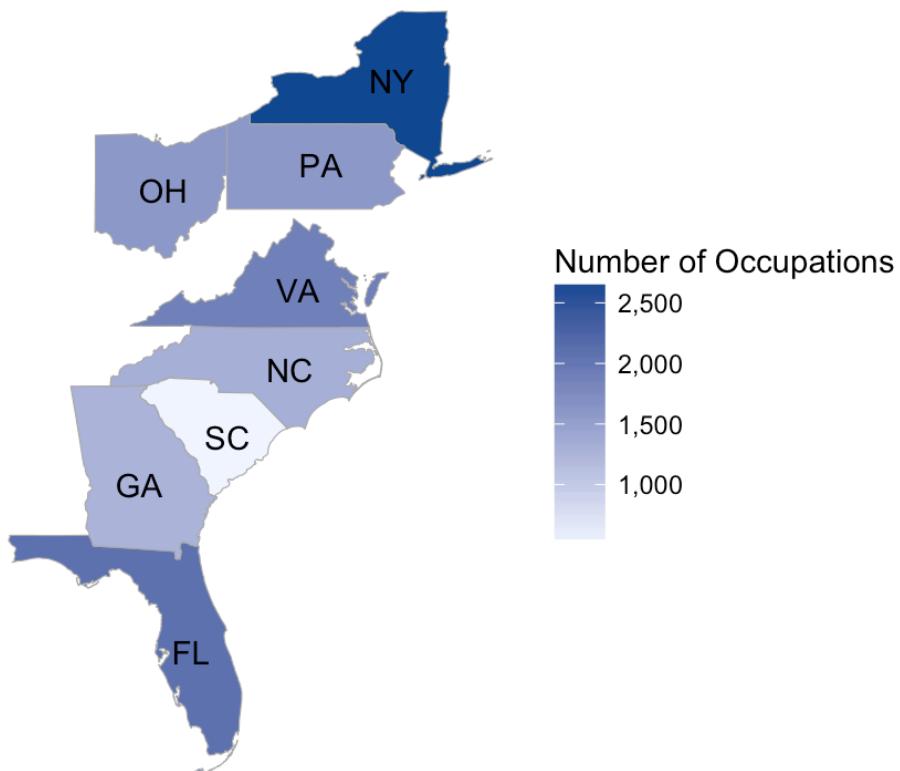
Before STEM Policy: STEM Job Allocation



joining factor and character vector, coercing into character vector

Code

After STEM Policy: STEM Job Allocation



In general, the state allocation of jobs didn't change dramatically after the STEM policy went out. It could be plausible since STEM policy is in effect for foreign students while the job allocation depends more on the locational choices of different companies.

(2) Working Conditions: What to Pay and What to Get

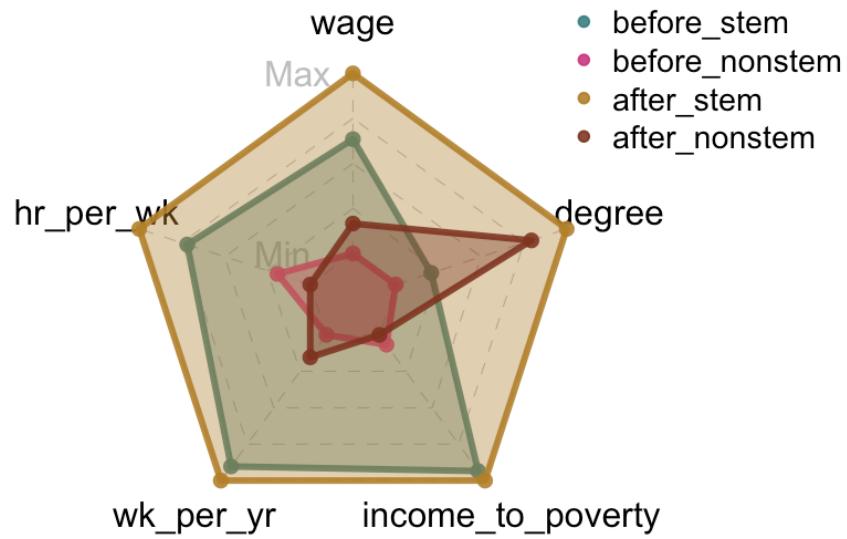
The second figure we got is a radar chart considering income, working hours/weeks, degree level and income-to-poverty index.

STEM jobs used to be the kind of jobs in which you need to pay more in order to get more. The good thing was, you didn't need to have an advanced degree to get such kind of jobs. However, after STEM policy went out, the requirement of degree in STEM jobs raised sharply. Though the change in non-STEM jobs is great too, STEM jobs is still the group which requires the highest average degree attainment.

We can also read more information from this figure, such as, currently, the better income/degree performance appears in STEM jobs instead of non-STEM jobs and the gap is quite obvious. However, speaking of income/working hours, non-STEM job could be a better choice.

[Code](#)
[Code](#)

Changes in Working Conditions After STEM Policy Went Out



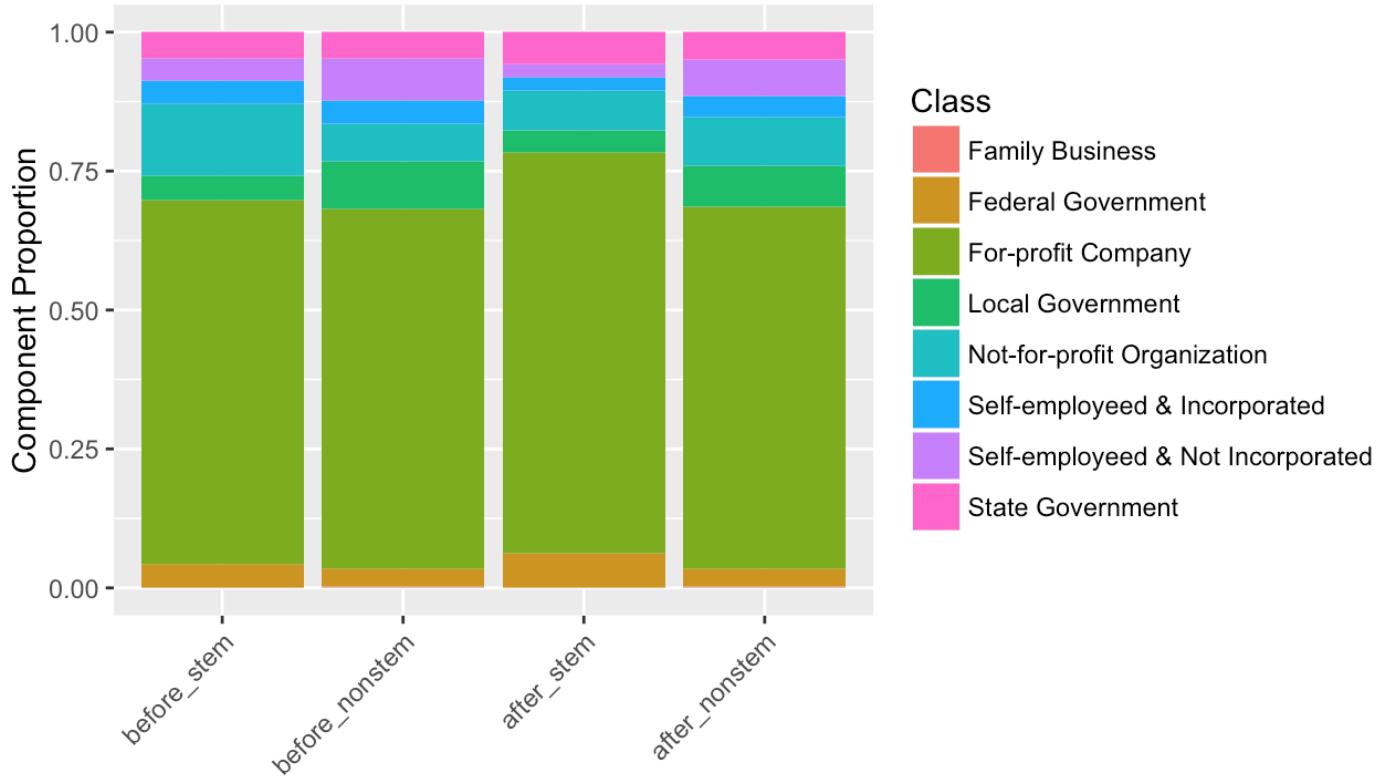
(3) Class/Gender Structure of STEM Jobs

Now let's study the class of work structure and gender structure in STEM/non-STEM jobs.

While the class of work structure of non-STEM jobs remains almost the same after STEM policy went out, we could tell the change of STEM jobs structure in the past decade. Currently, less STEM jobs are of self-employed or for not-for-profit organizations. Instead, STEM people tend to stay at for-profit companies. This change could be relevant to both the change of the STEM industries and the thought conversion of STEM people. It's likely that for these people, for-profit company is the option which allows better self-fulfillment.

[Code](#)

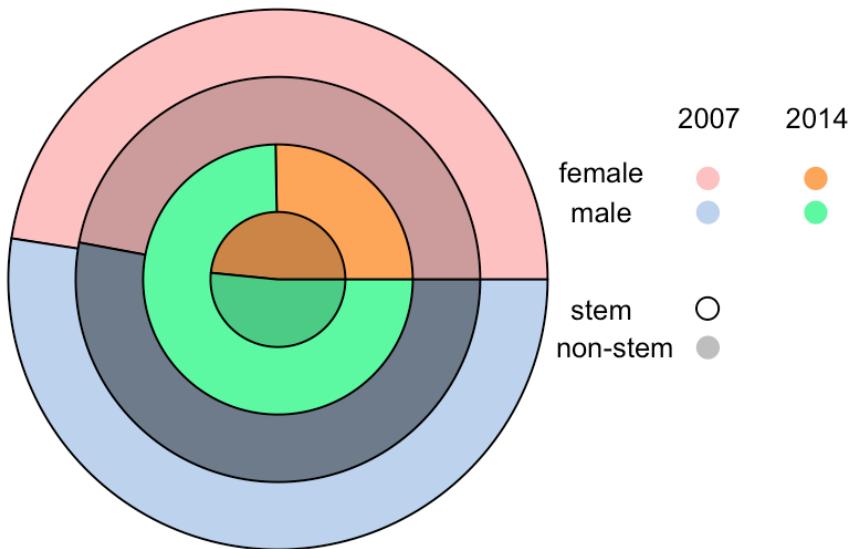
Changes in Class of Work After STEM Policy Went Out



If we try to address the gender proportion in jobs, we get some more interesting findings. First of all, the gender equality seems to be quite tenable in non-STEM jobs. However, when speaking of STEM jobs, the percentage of female employees dropped significantly after STEM policy went out. What could be the potential reasons? If it is relevant to STEM policy, does this mean that STEM policy is more appealing to male foreign students compared to female, and therefore more males come to US and stay? Yet, if we consider the fact that the proportion of non-US-born employees in the STEM jobs is actually not that big, we should realize that STEM policy could not be the major cause. In other words, there're some other factors that are currently influencing the gender structure in STEM jobs, and we should pay attention to this huge gender gap.

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Changes in Gender Proportion of Jobs After STEM Policy Went Out

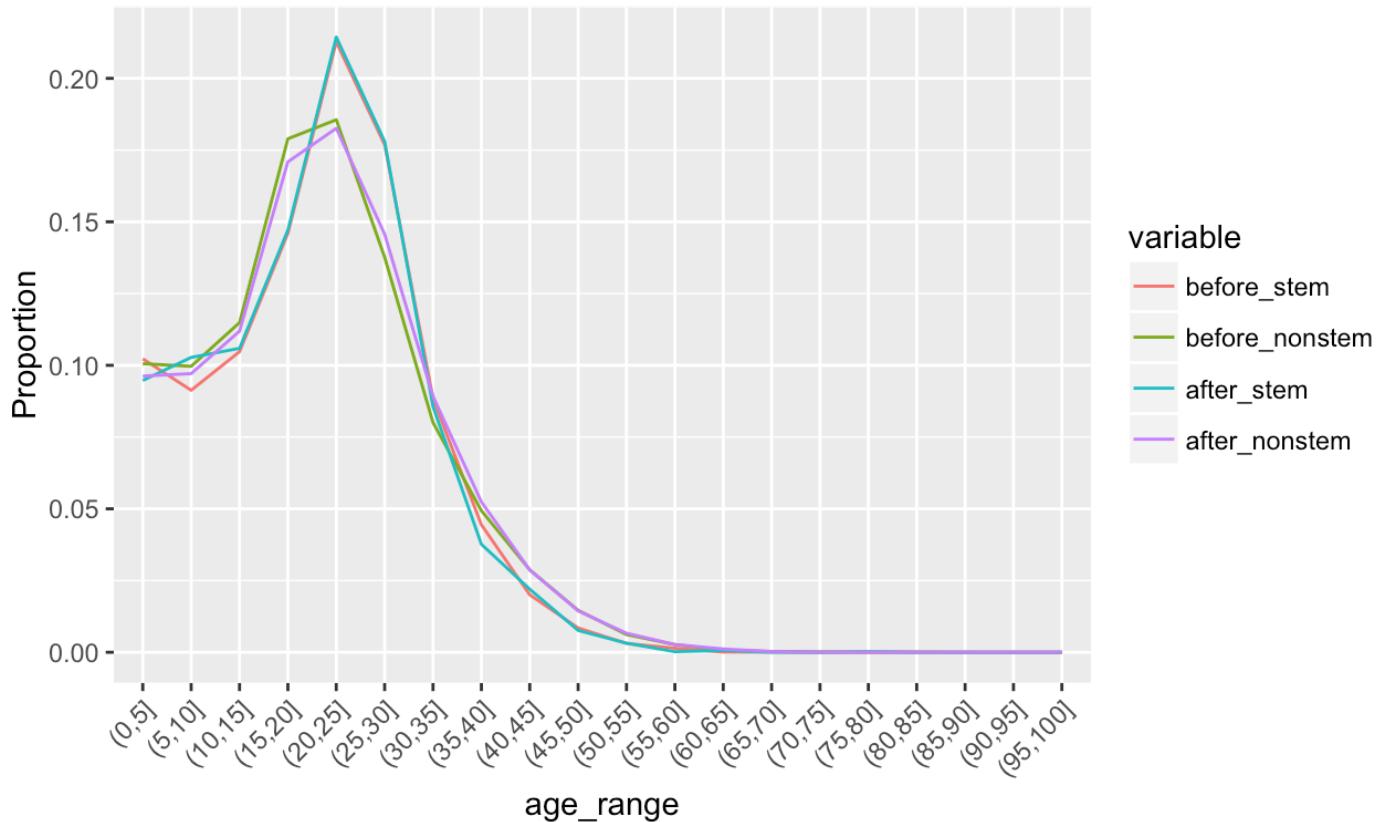


(4) Immigration Behaviors

If we assume the STEM policy does attract a lot of foreign students to come and study in US, does it mean that this policy will further influence them to stay in US permanently? To answer this question, we draw the following figure and we know the answer is NO. The figure generally presents the distribution of age of entry among immigrants to US. We can see from the plot that the proportion of immigrants who came to US during their age of schooling didn't change much as the STEM policy being published, either for STEM or non-STEM people.

Code

Changes in Age of Entry Among Immigrants



Some Problems We Faced

1. When we do the circular plot, we originally want to use *circlize* package in R, but we find that the plots from this package are not dynamic. Then, we are thinking whether we can do dynamic circular plot without directly using JavaScript. After searching, we find an interesting package *recharts*, which can be used to draw dynamic circular plots. Thanks to this package, we can derive the major vs working field mappings.
2. One problem we meet is that there is no STEM/non-STEM classification for each major. Therefore, we go to the official website for STEM/non-STEM classifications and finally decide the classification for each major.
3. The other problem is that which variables we should use during our analysis. For example, which variables can reflect the employment status? As for this, we decide to study the employment status of current year, then we use the variable OCCP.

Summary

We know more about STEM after this project. We learn how STEM degrees relate to different industries and we have a basic understanding what our job will be like.

As graduating STEM degree students in NY, our career future is promising. In spite of NY and CA, some other states including Texas and Virginia also provide a good amount of job opening. Considering working conditions only, it's a fair choice for us to further pursue a PhD degree.

However, the current gender disparity in STEM jobs is a question worth thinking about. The female proportion dropped from 47% to 25% and this is non-negligible.

Above is the project of our team. Thank you all for listening!