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## Event Study: The Effects of Policy Changes for STEM Major Considerations on International Students' Choices of Majors

### Abstract

This thesis explores the behavior of international undergraduate students in response to school policy changes about majors. STEM courses have a work authorization extension two years longer than non-STEM courses, that make it easier for international students to apply for workers' visas and qualify to stay in the US post-graduation. Recently, some school departments reclassified Economics as a STEM major. My research aims to provide insight into how these policy changes within Universities affect the choices that international students make about choosing Economics as a major. From the results, it is not yet clear what impact these changes have on students' behavior and for the time observed, there does not seem to be any significant impact. Despite this, the research suggests factors such as allowing for a longer period of time and focusing on enrolled students as the choice demographic to sharpen the observations and observe more conclusive results.

### Keywords

Policy change, STEM, Economics, International Students

### Disciplines

Economics

EVENT STUDY: THE EFFECTS OF POLICY CHANGES FOR STEM MAJOR  
CONSIDERATIONS ON INTERNATIONAL STUDENTS' CHOICES OF MAJORS

By

Frida Aloo

An Undergraduate Thesis submitted in partial fulfillment of the requirements for the  
WHARTON RESEARCH SCHOLARS

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THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA  
MAY 2021

# **EVENT STUDY: THE EFFECTS OF POLICY CHANGES FOR STEM MAJOR CONSIDERATIONS ON INTERNATIONAL STUDENTS' CHOICES OF MAJORS**

**Frida Aloo**

## **ABSTRACT**

This thesis explores the behavior of international undergraduate students in response to school policy changes about majors. STEM courses have a work authorization extension two years longer than non-STEM courses, that make it easier for international students to apply for workers' visas and qualify to stay in the US post-graduation. Recently, some school departments reclassified Economics as a STEM major. My research aims to provide insight into how these policy changes within Universities affect the choices that international students make about choosing Economics as a major. From the results, it is not yet clear what impact these changes have on students' behavior and for the time observed, there does not seem to be any significant impact. Despite this, the research suggests factors such as allowing for a longer period of time and focusing on enrolled students as the choice demographic to sharpen the observations and observe more conclusive results.

### **Key words:**

Policy change, STEM, Economics, International Students

### **Disciplines:**

Economics and Policy

## 1. INTRODUCTION

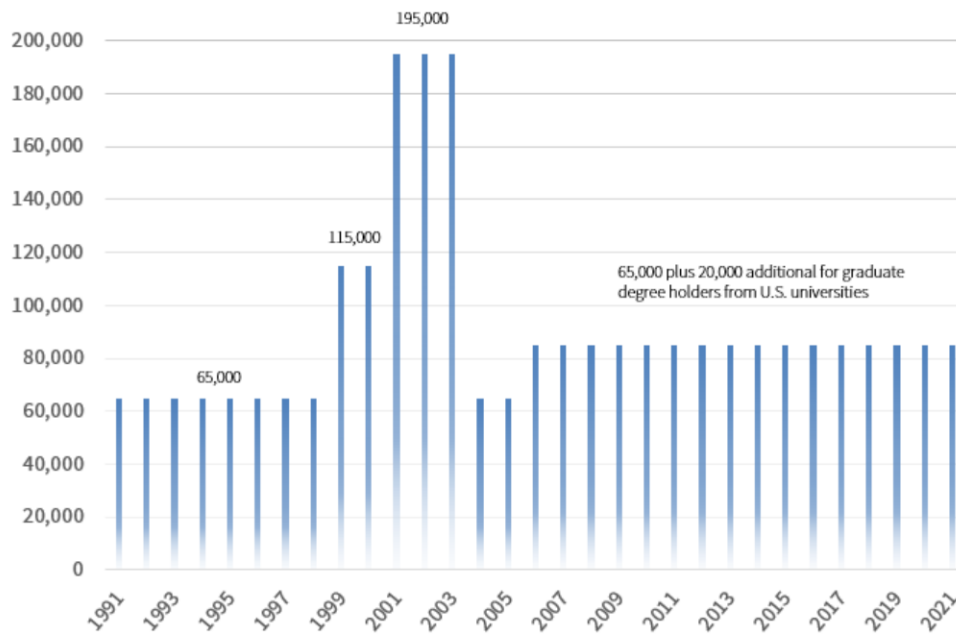
To study in the United States, international students require a student visa. If one is a full-time student at an accredited university, college, academic high school or any other academic institution, they are eligible for an F-1 student visa. This sustains one through the entirety of their status as a student until they graduate. Upon graduation, international students on F-1 visas who are looking to enter the job market are eligible for one year of temporary employment related to their field of study. This is known as Optional Practical Training (OPT) and it allows students to work while remaining on their student visas. F-1 students taking STEM (Science, Technology, Engineering and Mathematics) majors, however, are eligible to apply for a two-year extension on their OPT employment authorization. This implies that while non-STEM students would be eligible for 1 year of OPT, STEM students would be eligible for up to 3 years (Department of Homeland Security, 2020).

The value of a 2-year OPT extension offered by a STEM degree is very high. Usually, after the OPT time expires, students often try their luck in an annual lottery for the limited spots available to secure a H-1B skilled worker visa. This is a temporary nonimmigrant visa that allows employers to petition for highly educated foreign professionals to work in specialty fields that have a minimum prerequisite of a Bachelor's degree or equivalent. In some cases, students who are not lucky enough in the lottery are forced to leave the US just one year after graduation. The 2-year OPT extension made possible by STEM courses thus affords students more chances to try their luck at the H-1B visa lottery.

This extension is even more important when the limited number of H-1B visas offered per year is taken into consideration. Since the H-1B category was created in 1990, Congress has limited the number of H-1Bs made available each year. The current annual statutory cap is

65,000 visas, with 20,000 additional visas for foreign professionals who graduate with a master's degree or doctorate from a U.S. institution of higher learning. In recent years, the limit has been reached only a few days after the petition submission period begins (American Immigration Council, 2020). In 2019, the odds for selection for the H-1B visa were 38% for undergraduate degrees and 21% for advanced degrees (Mittal, 2020). This means that the more chances an international student has to participate in the lottery, the better their odds at being selected. The 2-year OPT extension serves just that purpose.

Figure 1: Annual Cap on H-1B Visas, 1991 to 2020



Source: U.S. Citizenship and Immigration Services.

Students can qualify for the 2-year OPT extension by taking STEM courses. Courses are considered STEM or non-STEM based on a formal classification, called the federal Classification of Institutional Programs (CIP) code. CIP provides a taxonomic scheme that supports the accurate tracking and reporting of the fields of study that students undertake (NCES, 2020).

A lot of international students study or are interested in studying Economics, which is not considered STEM by the United States Department of Homeland Security. Specific Economic courses however, such as Econometrics and Quantitative Economics are considered STEM (Department of Homeland Security, 2020). In response, a number of economics departments across different schools with significant presence of international students have reclassified some Economics courses as STEM. This was done with the intent of making Economics a STEM major, which would qualify any international student graduating with this major for the 2-year OPT extension. Many departments chose to have their undergraduate and graduate economics programs carry the CIP code for Econometrics and Quantitative Economics. This involved a tweak to the federal classification code from Economics - 45.060 to Econometrics and Quantitative Economics - 45.0603 (Economist, 2018). This formal change to classify Economics as a STEM major would allow students to extend their OPT authorization.

Using this paper, I will explore the statistical evidence on the behavioral changes of international students in response to policy changes about STEM classification for Economics. Particularly, I will be looking into how these changes affect the number of international students who graduate with Economics degrees over time after the classification changes.

## 2. LITERATURE REVIEW

International undergraduate students in the US make up an increasing share of the number of students receiving STEM degrees at institutions of higher education in the US, having doubled from around 11% in the 1980s to around 22% in 2017. This figure is even higher for graduate students, with STEM degrees in this demographic accounting for 54% for STEM Master's degrees and 44% for STEM doctorate degrees (Congressional Research Service, 2018). Evidently, STEM degrees are popular among international students. Gogol (2020) posits that STEM majors are the best majors for international students. He offers that this is due to the fact STEM degrees offer people higher starting salaries because businesses are willing to pay for the perceived intelligence required for a STEM degree. Additionally, a STEM degree opens more employment opportunities for international students as well as opportunities to secure permanent residence in the US after graduation.

Several studies have found that students choose their present-day major choice based, in part, on future benefits. Researchers at the Federal University of Rio Grande do Norte in Brazil conducted a study on the evolutionary analysis of future discounting and found that individuals adjust their career choices according to socioeconomic conditions and taking into account discounting of future rewards (Leitão, Álvaro and Araújo Lopes, 2013). A similar study carried out at the University of Montreal in Canada found that expected earnings is an essential variable in the choice of college major (Montmarquette, Cannings and Mahseredjian, 2001). These findings seem to support Gogol's theory, in that international students are likely to pick STEM majors based on their perceptions of the future rewards available through these majors.

This theory is however challenged by the findings from a study carried out at Royal St George's College. The researchers conducted a survey in which both international and domestic



students were asked to list their primary reason for choosing to enroll in STEM majors. 80% of respondents indicated that they enrolled in their respective STEM majors because of their interest in the fields. While the study asserted that these findings were surprising, it provided a caveat that international students may well have decided what they wanted to study before applying for colleges. Their reasons for choosing certain degrees in STEM, whether due to their knowledge of the larger pool of opportunities offered by a STEM degree or otherwise, were already well established before they came to the United States (Adhikari, 2017).

Regardless of major or motivation, there is a clear propensity of international students to stay in the United States post-graduation. A report by the National Center for Science and Statistics deduced that there is a propensity of international students with temporary visas at graduation to stay in the U.S, with the 5-year stay rate at around 70% and the 10-year stay rate at around 62% (Finn, 2018). The Kauffman Foundation put out a report that most international students: 74% chose to study in the US because of future employment opportunities, while 48% asserted that they would like to remain in the US post-graduation, with 41% being undecided (Kauffman Foundation, 2016).

Economics is a popular major among international students because of the vast array of opportunities it offers to students post-graduation. However, Economics is not considered STEM by the United States Department of Homeland Security. Specific Economic courses however, such as Econometrics and Quantitative Economics are considered STEM (Department of Homeland Security, 2020). The American Institute for Economic Research argues that Economics deserves STEM recognition, as it employs mathematics for precise communication, broadens the application of STEM tools and Economics majors meet the labor market needs (Gomez, 2018).

In response to increasing concerns from international students, some Economics departments at top universities including Yale, Columbia, Princeton, Brown and MIT have reclassified some Economics courses as STEM, so as to allow students to explore this major while broadening their post-graduation options (Redden, 2018). A study by the National Science Foundation showed that there had been a sharp decline in international students enrolling in US universities since the Trump administration unveiled its America First agenda. Some top universities have thus used their expansion of STEM classification to Economics to attract students who would benefit from the longer visa extension offered by a STEM classified degree. Some students applying to graduate Economics programs cited one of their reasons for choosing one program over another as being the STEM designation for Economics. The American Economic Association has no say on the reclassification of programs, which is left up to the discretion of individual universities. As such, universities have a lot of power on whether courses can be reclassified as STEM or not (D'Souza, 2018).

### **3. QUESTIONS AND HYPOTHESES**

In this paper, I explore the effects of the reclassification of Economics as a STEM major on the major choices of international students across select top US universities. My broad research question is: How do STEM policy changes affect the choices that international students make about their majors? I seek to answer this question by exploring the following specific questions:

1. Since schools changed Economics to STEM have the number of international students taking Economics across different years increased?

## 2. How is changing Economics to STEM beneficial for international students?

To answer these specific questions and therefore the broad research question, I have come up with the following hypotheses:

- 1) Classifying economics as STEM increased the number of international students in economics.
- 2) Students change into economics after STEM reclassification because of benefits such as visa extension and increased employment opportunities.

## 4. METHODOLOGY

For this research, I have taken a quantitative data analysis approach. I aimed to examine the top schools for Economics, particularly those that implemented policy changes to reclassify Economics as a STEM major. Within these schools, I aimed to measure the effect of these policy changes on the student population by observing the behavior of students' decisions in terms of majors, before, during and after the years during which these policy changes were implemented. As such, I conduct a longitudinal event study, with my population of interest being international undergraduate students who graduated with Economics degrees for the years 2012 to 2019 across selected institutions. The variables involved are event years as the independent variable, with the STEM classification as the causal effect. Here, event years are used as opposed to calendar years. Event years are calculated as the difference between the STEM year change and the current year. The STEM year change is depicted using 0. As such, if a school reclassified Economics in 2016, the year 2012 would be depicted on the x-axis of the event study graph as -4, 2013 as -3, 2014 as

-2, all the way up to 2016 which is depicted as 0, 2017 as 1, 2018 as 2 and 2019 as 3. The outcome variable is the number of international students graduating with Economics degrees from selected institutions.

To explore the data itself, I looked into databases including from the National Center for Education Statistics, the United States Department of Education and College Scorecard. I scraped data from these databases and compiled a list of 28 of the top institutions for Economics in the U.S. I also noted the years during which the Economics departments of each of these schools reclassified Economics as a STEM major, based on looking into different news articles about these changes. I then did an extensive data scrape on the recorded number of international undergraduate students graduating with Economics degrees from 2012 to 2019 for each of these institutions.

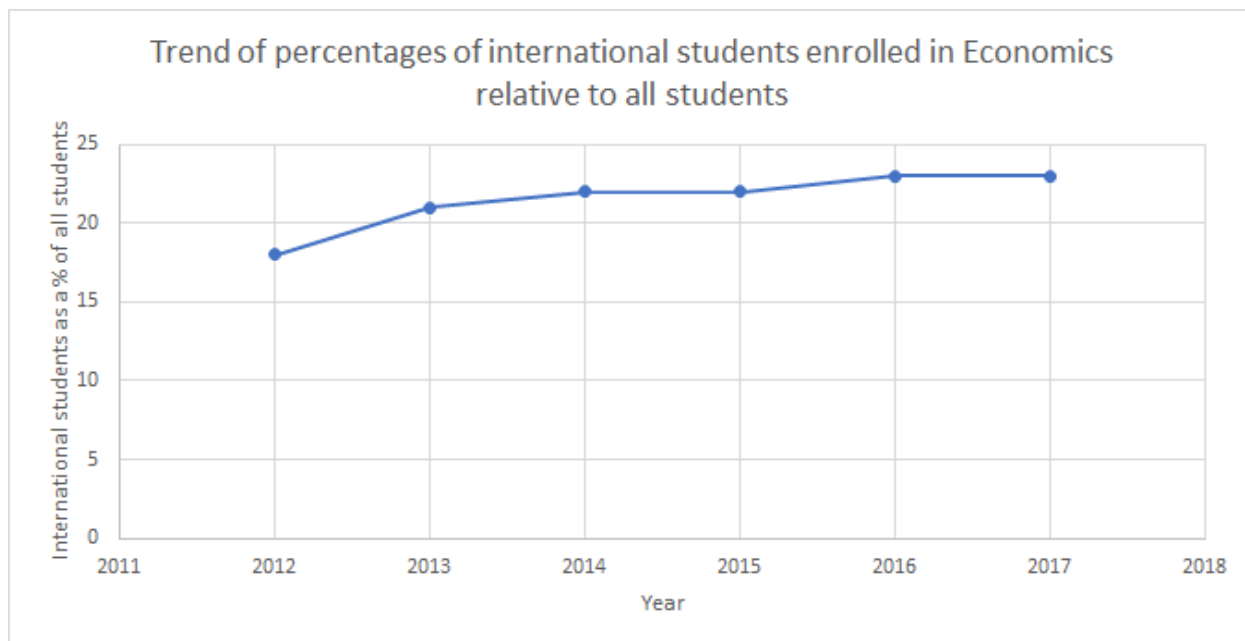
For the purposes of graphical data visualization, I grouped the data on the 28 schools into four categories, based on the year which the school departments reclassified Economics as a STEM major. The earliest change in the schools in this list occurred in 2016 and the latest one was in 2020. As such, I came up with four distinct average groups: 2016 average, 2017 average, 2018 average and the control variable which consists of the average for schools that reclassified in 2019 and 2020. The average number for 2019 and 2020 were used as the control variable in a difference in differences (DID) technique model so as to explore whether there's a difference in behavior between those schools exposed to reclassification changes and those that did not. The schools in this category were chosen because they have experienced reclassification changes more recently and therefore not enough time has passed to observe changes. I then used these averages to graph an event study graph of the number of international undergraduate students graduating in Economics against the year since STEM reclassification.

The number of international students graduating with Economics degrees each year might generally fluctuate because of a variation of reasons, including the fact that the total number of international students graduating from these schools each year might fluctuate as well. To account for this, I calculated the percentages of international students graduating with Economics degrees, over the total number of international students graduating from each of these institutions over the years 2012 to 2019. I then again calculated averages of these percentages for each of the four groups earlier created, to come up with the average ratios across the eight years. These average ratios were then graphically represented using an event study graph to observe any changes in the trend in the share of international undergraduate students with Economics degrees over total graduating international undergraduates.

## 5. FINDINGS

\_\_\_\_\_ After compiling the number of Economics degrees conferred each year by U.S. institutions on international students, I found that this number has been increasing steadily across the years. This reinforces the idea that the general trend is a growing interest in Economics among international students. The share of international students graduating in Economics, relative to all graduating Economics students, increased by 5 percentage points, from 18% in 2012 to 23% in 2017 as shown in the figure below.

*Figure 1: Trend in the share of international students graduating with Economics degrees relative to all graduating Economics students*



Pulling from various news articles and school websites, I came up with the following list of 28 schools with top Economics programs in the U.S. as well as the years their departments reclassified Economics as a STEM major.

*Table 1: A list of 28 schools with some of the top Economics programs in the U.S.*

<b>Institution</b>	<b>STEM change year</b>
MIT	2016
Pomona College	2017
Williams College	2017
Middlebury	2017
Yale	2018
Columbia	2018
Harvard	2018
Cornell	2018
Northwestern	2018
UChicago	2018
NYU	2018
U Wisconsin-Madison	2018
Duke	2018

Brown	2018
U Minnesota-Twin Cities	2018
Boston College	2018
Rochester University	2018
Dickinson College	2018
Barnard College	2018
Claremont McKenna	2018
Stanford	2019
Dartmouth	2019
UC-Berkeley	2019
UCLA	2019
UC-San Diego	2019
Carnegie Mellon	2019
U Michigan-Ann Arbor	2019
UPenn	2020

Grouping these schools into the four categories based on their Economics STEM reclassification year resulted in the following table on the number of graduating international students in Economics each year.

*Table 2: Average number of international undergraduate students graduating with Economics degrees in each of the categories per year*

<b>Average</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
<b>2016 Average</b>	3.00	4.00	3.00	2.00	3.00	2.00	0.00	2.00
<b>2017 Average</b>	12.00	7.00	13.00	9.00	12.00	12.00	11.00	11.00
<b>2018 Average</b>	41.00	46.00	53.00	55.00	59.00	55.00	54.00	55.00
<b>Control variable Average</b>	57.00	61.00	72.00	88.00	95.00	79.00	84.00	75.00



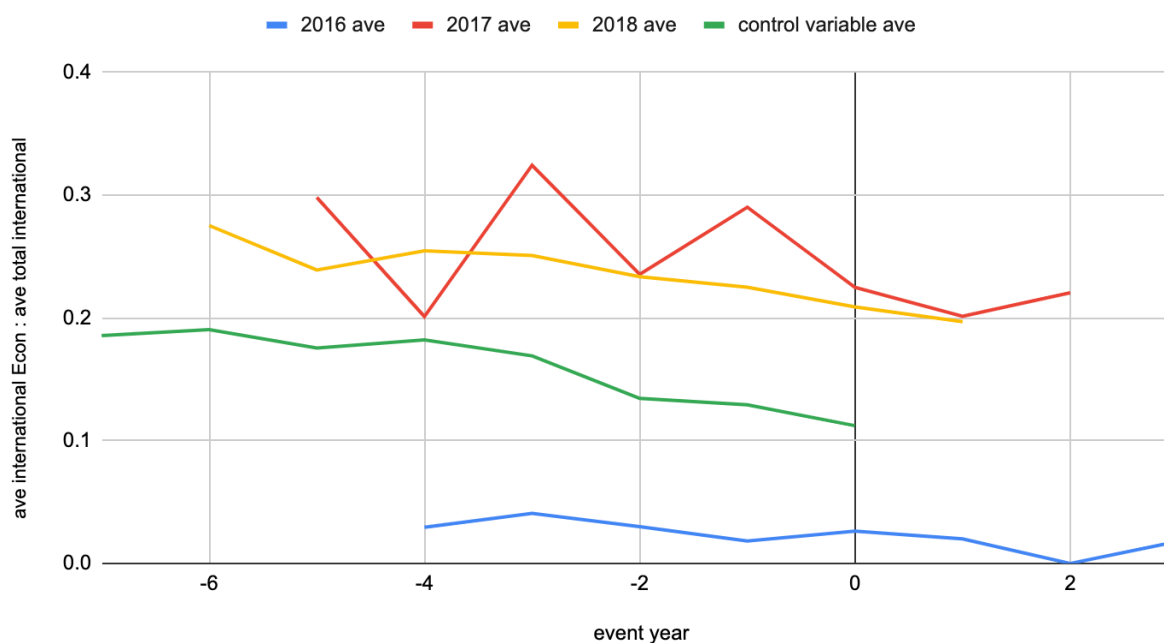


<b>2016 Average</b>	0.02941	0.04082	0.03000	0.01818	0.02632	0.02000	0.00000	0.01786
<b>2017 Average</b>	0.24658	0.21875	0.33621	0.23894	0.27692	0.23333	0.21477	0.21154
<b>2018 Average</b>	0.23278	0.22239	0.23348	0.22981	0.21474	0.19569	0.17825	0.17101
<b>Control variable Average</b>	0.18508	0.19261	0.18999	0.19203	0.17932	0.13751	0.13672	0.11258

Plotting these values using an event study resulted in the Figure 3 below.

*Figure 3: Event study on change in the average percentage of international Economics graduates out of total Economics graduates since STEM reclassification*

### Event study of average % of international Economics graduates since STEM reclassification of Economics



Similar to the study involving average numbers, there does not seem to be a significant increase in the average percentages of international Economics graduates out of total international graduates from each category after the STEM reclassification. For the 2016 and 2017 averages, the average percentages seem to slightly decrease then increase after the STEM reclassification year.

## 6. DISCUSSION

The historically limited consideration for STEM courses puts international students at a disadvantage because it limits their post-graduation options. Some international students may be forced to choose STEM majors that would allow them to extend their options, even though they may not necessarily be interested in them. Economics as a major is attractive to many students because it offers many options for career paths that students can explore. As such, changing the classification of Economics programs to STEM could be a step towards making the major even more valuable to international students.

According to Economics departments at schools such as Yale, Pomona and MIT, the Economics programs they offer meet the criteria to be considered under the Econometrics and Quantitative CIP code, due to their quantitative and analytical nature. In fact, the STEM classification for Economics programs in schools offers them a recruiting edge over their competitors that students also apply to (Redden, 2018). Some students applying to graduate Economics programs cited one of their reasons for choosing one program over another as being the STEM designation for Economics. Therefore, understanding how policy changes for STEM major considerations affects international students' choice of majors will be important to school departments that particularly have a large presence of international students. This is especially true for courses such as Economics that have already been considered STEM in other similar institutions. Changing Economics to STEM can be a strategic selling point for schools and simultaneously benefit international students who go to these schools.

Especially as the Trump administration has taken an increasingly "America First" approach, international students are being increasingly cautious and forward thinking with the

choices they make even in undergraduate school. It is imperative that schools are aware of the quandaries that their students face as they balance passion vs practicality and how they too can get involved. International students are an important segment of many schools and these choices are therefore just as important for schools as they are for students.

The results from the study are inconclusive as to whether these policy changes led to an uptick in Economics enrollments by international students. In the years following the event year for each group of schools (as depicted by 0 on the graphs), there is no clear upward trend in the graph of the average number of undergraduate international students graduating in Economics. The graph lines for each category seem to be more or less flat. This can appear to suggest that the share and number of international Economics graduates is not impacted by a change in STEM classification. This however does not mean that these changes do not impact international students. For the event study graph using the average share of international students graduating in Economics out of total international undergraduate students, the 2016 and 2017 average depict a small drop before the plot lines tend upwards. It is not necessarily conclusive whether this upward trend is going to be long lasting. This can mean that the STEM reclassification of Economics may have an effect on the behavior of international undergraduate students, but this is not fully observable on the graph.

These inconclusive results may be due to some limitations in the data and methods used as outlined below:

- The reclassification changes made are fairly recent. The earliest reclassification change in the data collected was made just three years before the control variable year (2019), which is the latest data collected on graduations. As such, the observation time for the impact of the changes lies within a range of less than or equal to three years. This is not

enough time to observe the impact of the reclassification changes, as effects often have a lag. These changes therefore could have a longer term effect that may not be observable on the event study.

- The study used data on graduating students, who may have already made their major choices by the time the changes were implemented. Due to the recency of the changes, a more accurate demographic to use might have been currently enrolled students. These students are making choices in real time as the changes are implemented. Therefore, observing their behavior in response to these changes might give more insight into the impact of these changes. However, it is important to note that even with currently enrolled students, time must still be allowed to pass to observe the long term effect of the reclassification changes.
- The figures used for the purpose of this event study are averages of raw numbers across different schools. These averages might lead to an overlooking of certain factors. For example, in MIT, the number of international students graduating with Economics degrees across all years is notably low. This could be due to the fact that students typically pick MIT for their engineering programs. As such, grouping these schools together on the basis of STEM reclassification year then averaging their numbers might lead to a false appearance of students behavior, since the schools have different reputations for different programs to begin with. A school that is popular for Economics might observe a larger impact than a school that is not necessarily known for attracting specifically Economics students. These schools were however chosen because they had among the best Economics programs in the country and had implemented reclassification

changes. Additionally, I chose averages to display the data due to ease of visualization, calculation and presentation.

In a further analysis, it might be important to consider these limitations and use a more accurate demographic of currently enrolled students. This data was scanty and difficult to obtain during my research. It might also be useful to observe the changes over a continued period of time to capture the long term effects of the changes after the lag has subsided. It might also be important to conduct interviews and surveys with currently enrolled and recently graduated international students in Economics on what influenced their decision to take up Economics majors. This might give first hand insight on if the reclassification changes had any impact on their behaviour and observe whether the qualitative findings would support the quantitative data.

## **7. CONCLUSION**

International students often have to make choices with future benefits in mind. Among these choices is the choice of major to pursue. Economics is a popular major among students, including international students. Recently, many of the top schools in Economics reclassified Economics as a STEM major. These decisions were made with the intention to appeal to international students and broaden their future opportunities. STEM majors afford international students a three-year extension of their visa through a temporary extension called the Optional Practical Training. Non-STEM majors only allow students a one-year extension. Having a three-year extension as opposed to a one-year extension allows students more time and chances to try for the lottery employment visa, without which they cannot continue to stay in the U.S. In this research, I explored the impact of these STEM reclassifications across different institutions on the behavior of international students regarding enrolling in Economics as a major. Not

enough time has passed to allow for the lag of the effects to pass and the impacts of the changes to be observed. As such, it is not yet clear what impact these changes have on students' behavior and for the time observed, there does not seem to be any significant impact. Despite this fact, this research suggests factors such as allowing for a longer period of time and focusing on enrolled students as the choice demographic to sharpen the observations and observe more conclusive results.

## **8. FURTHER RESEARCH**

Beyond exploring how these changes impact the behaviour of international students, it will be helpful to explore what effect these changes have on the U.S. economy from a labor market angle. International students contribute significantly to the U.S. economy, including through innovation, providing skilled labor to U.S. employers; particularly in science and engineering fields, bring many diverse perspectives and overall contribute to a stronger U.S. economy (Di Maria, 2020).

These policy changes to reclassify Economics as a STEM major could potentially make it easier for international students to enter the US labor market and contribute to the U.S. economy in driving American innovation and growth and contributing to overall economic health. More research can be initiated to explore what impact these choices have on the U.S. economy when these students join (or do not) the U.S. labor market.

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