The Effect of the Business Cycle on Freshman Major Choice

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Abstract

During economic downturns, college students can alter their postsecondary education decisions through several channels. This paper focuses on college major choice, one higher education decision that might change after a recession, and one that few researchers have explored. Due to data limitations, previous research is unable to provide definitive results on if, or how, matriculating freshmen change college majors during recessions. The data used for this study assuages those limitations and is obtained from the "Freshman Survey," administered by the Cooperative Institutional Research Program (CIRP). Building on what is already known about how students choose college majors and how they respond to information shocks, the theoretical model proposes that during economic downturns, students will switch to fields with higher relative wage and employment opportunities. First, this study finds that freshmen are less likely to have undeclared intended majors after recessions. Then, a multinomial logit empirical technique strongly suggests that after economic downturns, those who declare intended majors are more likely to choose ones that offer higher wages and provide more job security, like Technology, Business, Engineering and Health. University administrators can apply this empirical model to their own institutional-level data. In the presence of substantial budget cuts, administrators can anticipate the majors that will require more resources and those from which they can transfer resources to efficiently meet student demand. More broadly, these conclusions offer better information on labor force composition after recessions, which can enhance forecasting of likely shortages and surpluses in the labor market.

1 Introduction

Connections between higher education decisions and the business cycle have garnered the attention of researchers, policy makers, and university administrators for decades. Declining economic conditions induce university budget cuts, increase student enrollment rates, and encourage higher levels of student debt, stretching the resources of postsecondary institutions and their students (Clark, 2010; Weller, 2012). In the face of tighter budget constraints, college students may alter their postsecondary decisions in several ways. This paper focuses on college major choice, one particular decision channel that students may adjust during recessions, and one which few researches have explored. Identifying changes in student major preferences during economic downturns helps university administrators to anticipate demand for certain courses and reduces uncertainity about future labor market shortages and surpluses.

The "Great Recession" serves as a reminder of how economic downturns constrain higher education resources and alter student incentives. Despite the growing education debt, there is a renewed effort to increase post-secondary enrollment and graduation rates. In President Obama's 2011 Back-To-School Speech, he challenges high school students to continue their education after graduation: "...our country used to have the world's highest proportion of young people with a college degree; we now rank 16th. I don't like being 16th. I like being number one." In addition, the President fostered opportunities for unemployed workers to return to school through programs that give special Federal PELL Grant consideration to those collecting unemployment insurance (Budd, 2009).

Private organizations – like the Lumina Foundation for Education and the Gates Foundation– also support increasing the number of college degree attaining citizens. The Lumina Big Goal 2025 seeks "to increase the percentage of Americans with high-quality degrees and credentials to 60 percent by the year 2025" (Lumina Foundation, 2012). In the summer of 2012, the Gates Foundation announced an additional 9 million dollars in grants supporting access to and completion of higher education degrees (Young, 2012). Initiatives such as these can modify student education decisions.

In the wake of the most recent recession, students' major decisions are under the microscope, as many fear that mounting education debt and the inability of students to pay back college loans will be the next big economic bubble (Cronin and Horton, 2009; Bonner, 2012). Contributing to the increasing education loan default rate are the high U.S. unemployment and underemployment rates for young college graduates, which are now at all time highs of above 50 percent (Yen, 2012). In July 2012, the National College Finance Center launched the "Don't Major in Debt" campaign that provides free loan counseling for students. Although not an explicit goal of the campaign, the name implies that students can choose certain college majors that have better long term benefits than others. Additionally, Carnevale et al. (2012) caution that unemployment risk depends highly on undergraduate field of study. Their study reports that after the most recent recession, the highest unemployment rates for college graduates are in the Architecture, Arts, and Humanities fields; meanwhile, students majoring in fields like Health and Education, enjoy the lowest unemployment rates.

Due to data limitations, previous research is unable to provide definitive results on if, or how, matriculating freshmen change college majors during recessions. The data used for this study assuages those limitations and is obtained from the "Freshman Survey," administered by the Cooperative Institutional Research Program (CIRP) and housed at the University of California Los Angeles's (UCLA's) Higher Education Research Institute (HERI). Only students' major intentions are collected, because the survey is limited to college freshman. Intended majors map to student demand for certain classes and also set students on a major track. Once a major is selected, students will incur switching costs if they deviate from that initial track.

This paper tests the hypothesis that after downturns in the business cycle, *ceteris paribus*, students will choose majors with better relative income or employment opportunities after graduation. For example, after the most recent recession, majors in Health, Education, Business, and Technology were most likely to find jobs, while majors in the Social Sciences, Arts, and Humanities were least likely to be employed (Associated Press, 2012: Atlantic, 2012). These outcomes should result in an expected influx of freshmen intending to major in the former categories.

Section 2 provides background information on the major choice literature and develops a theoretical framework for understanding how students should alter their major decisions after they observe economic downturns. Section 3 thoroughly describes the unique CIRP "Freshman Survey" data used to explore the relationship between freshmen intended major and recessions. This section also describes the one key way this study differs from previous work by including national business cycle indicators as freshman major predictors. Section 4 explains the multinomial logit empirical model used for the identification of a recession's impact on freshman major choice. Section 5 reports the results using the previously outlined data and empirical model. In general, students are more likely to choose majors with better relative wages and employment opportunities after a they observe a recession. This is the first paper that can unambiguously confirm that to be true. Section 5 also explores different subsamples of the population, discussing how the major switching effect differs for males vs. females and blacks vs. whites. Lastly, Section 6 concludes.

2 Background and Theoretical Framework

Because college major choice is pivotal for determining future career paths and earnings over a lifetime, a large literature focuses on understanding how students choose particular disciplines (Arcidiacono, 2004; Arcidiacono et al., 2010; Montmarquette, 2002; Beffy et al., 2010; Berger, 1988; Porter and Umbach, 2006; Dickson, 2010; Wisall and Zafar, 2012; Eide and Waehrer 1998). Despite the extensive body of research on college major choice, no one has unambiguously determined if and how the presence of a recession affects a student's major preference. Because the business cycle informs many higher education decisions, isolating a pure major-switching effect to attribute to business cycle fluctuations is complex.

Fortunately, focusing on freshmen intended majors instead of college graduates' majors simplifies matters, making identification of major-switching effects in the face of economic downturns analytically straightforward. There are only two potential business cycle effects that can alter the proportion of students observed across majors and that are present in a college freshman's decision set: enrollment effects and intended major-switching effects.

2.1 Enrollment Effects

Enrollment effects are any changes to the likelihoods of students majoring in certain disciplines after changes in the business cycle and are a direct result of new and different types of students enrolling in college. Numerous papers scrutinize how changes in the business cycle affect postsecondary enrollment rates (Mattila, 1982; Goldin, 1999; Sakellaris and Spilimbergo, 2000; Card and Lemieuz, 1997), all finding that adverse business cycle conditions increase college enrollment rates. Students who are at the margin of enrolling in college and not enrolling in college are more likely to pursue postsecondary degrees if they observe the labor market declining.

Borrowing basic ideas from Manski and Wise (1983) and Lee (2010), the following model outlines a student's choice between either entering the labor force or enrolling in college: The net present value for student i entering the labor force is captured by

$$NPV^i_{Lt} = \sum_{t=0}^{N} w^i_t h^i_t$$

where w^i_t are the lifetime wages for each time period that student i can expect to earn in the labor market in the absence of a college degree, and h^i_t are the number of hours that student

i can plan to work in each time period in the absence of a college degree.

$$w_t^i = w^i + \varepsilon_{wt}^i$$

$$h_t^i = h^i + \varepsilon_{ht}^i$$

where ε_{wt}^i and ε_{ht}^i represent stochastic shocks to expected wages and work experience for student i in the absence of a college degree.

Next, the net present value for student i student enrolling in college is

$$NPV_{Ct}^i = \alpha_t^i \nu_{0t}^i + (1 - \alpha_t^i)\nu_{1t}^i - T_t^i$$

where ν_{0t}^i is the expected consumption value of going to college for student i at time period t, ν_{1t}^i is the expected investment value of enrolling in college for student i at time period t,[2] α_t^i is the weight student i places on consumption value versus investment value when choosing a major, and T_t^i is the tuition and other costs of college that student i would incur if she decides to enroll in school. These terms are characterized as follows:

$$\nu_{0t}^i = \nu_0^i + \varepsilon_{0t}^i$$

$$\nu_{1t}^i = \nu_1^i + \varepsilon_{1t}^i$$

$$\alpha^i = \alpha^i + \varepsilon_{\alpha t}$$

where ε_{0t}^i, ε_{1t}^i, and $\varepsilon_{\alpha t}$ represent stochastic shocks to expected consumption value, investment value, and the weight student i gives to consumption value when choosing a college major, respectively.

If $NPV_{Lt}^i > NPV_{Ct}^i$, a student will enter the labor force instead of enrolling in school, or

[2] The investment value of enrolling in college is essentially just the transformation of expected wages and work experience, resulting from the human capital accumulation of a college degree.

vice versa. Several factors might cause a student to switch from working in the labor force to enrolling in school during a recession:

1. The opportunity cost of leaving the job market to go to school is lower when wages are declining. This would enter the model through a negative shock to ε^i_{wt}.

2. Before the economy declined she could find a job with just a high school degree, but now she cannot. This scenario would enter the model through a negative shock to ε^i_{ht}.

3. The relative return of a college degree versus a high school diploma is rising. This case would appear as a positive shock to ε^i_{1t}.

4. After observing recessions, she cares more about their labor market opportunities because she has seen first-hand the competitive nature of the job market.[3] This last case would manifest as a negative shock to $\varepsilon_{\alpha t}$.

Characterizing the students at the margin of going to college and not, before and after a recession, is vital to identify the direction of any enrollment effects. Controlling for and signing these enrollment effects is a crucial component to any empirical strategy that hopes to capture major-switching, and is the true focus of this paper.

2.2 Major Switching effects

Similarly, one can frame student's major-switching behaviors using an analogous theoretical model. A student's net present value of a particular college major j is defined as

$$NPV^i_{jt} = \alpha^i_t \nu^i_{0jt} + (1 - \alpha^i_t)\nu^i_{1jt}$$

[3]It might also be that after a recession, students can no longer afford to go to college and drop out of school. I ignore this for the analysis because I assume that this effect would not impact some college majors more than others, as the majority of schools do not price differentiate based on undergraduate major. If, however, it is the true that the likelihood of students dropping out of school varies by major, one would expect to see the highest attrition rates in the high-wage, high-employment opportunity majors based on the summary statistics of major by income in Table 5. Therefore, major-switching effects would be lower bounds in this case.

where, again, ν^i_{0jt} is the expected consumption value for student i for major j at time period t, ν^i_{1jt} is the expected investment value for student i for major j at time period t, and α^i_t is the weight student i places on consumption value versus investment value when choosing a major.[4]

$$\nu^i_{0jt} = \nu^i_{0j} + \varepsilon^i_{0jt}$$

$$\nu^i_{1jt} = \nu^i_{1j} + \varepsilon^i_{1jt}$$

$$\alpha^i = \alpha^i + \varepsilon_{\alpha t}$$

where $\varepsilon_{0t}, \varepsilon_{1t}, \varepsilon_{\alpha t}$ are stochastic error terms representing shocks to expected consumption value, investment value, and weights students place on consumption value, respectively.

If $NPV^i_{jt} > NPV^i_{kt}$, student i will choose major j in time period t. Studies report that students do indeed switch majors when given new information that changes their expectations about investment values of majors (Arcidiacono et al., 2010; Wiswall and Zafar, 2011). Arcidiacono et al. (2010) examine how expected earnings influence students' major choices. They find that if expected earnings were the same across majors, more students would choose Humanities and Social Science majors than the highly technical Math and Science fields. In addition, they show that students' priors about the future wages earned in different majors are generally wrong; in the absence of forecast errors of expected future earnings, 7.5% of the Duke students they surveyed would switch college majors because their expected lifetime wage estimates were usually incorrect. These results suggest that some students will indeed switch majors when expected investment values change.

Additionally, Wiswall and Zafar (2012) show that students' perceptions about potential earnings are ordinarily incorrect and when students receive more accurate information, they tend to change their major choices. These authors advocate for information campaigns that precisely reflect returns to schooling that have proven to work in developing countries

[4]I ignore tuition and other costs because the assumption is that there is no price differentiation between majors.

(Jensen, 2010; Nguyen, 2010).

Clearly, students exploit job market signals when choosing a college major and update their decisions based on the information they receive. Presumably, freshmen could use a recession as an informational labor market signal. Business cycle shocks would enter a students major decision through ε_{1jt}, ε_{1jt}, or $\varepsilon_{\alpha t}$. Two scenarios would cause students to switch intended major in the presence of a recession:

1. The relative investment values between major j and k suddenly change in the presence of a recession. A student would switch from major j to major k if there were sufficiently large negative shocks to ε^i_{1jt} or positive shocks to ε^i_{1kt}.

2. Students care more about investment values of a major after they observe recessions. A student would switch from major j to major k if there were sufficiently large negative shocks to $\varepsilon_{\alpha t}$.

If students care about their first jobs and salaries out of college when making their major choices, then changes in the business cycle should provide students with updated information about job and wage prospects in the approaching years (Lee, 2010). However, even if students make decisions based purely on rational expectations (Berger, 1988), starting salary is still an important component in those expectations. When students graduate in a particularly unhealthy economic climate, it can affect the wages and employment opportunities they receive over their entire careers. Kahn (2010) and Oreopolous et al. (2012) provide evidence of this labor market "scarring." Kahn (2010) reports that the effects of graduating in a poor economy are large, persistent, and negative. Therefore, rational students should consider economic climates when choosing their majors.

One can hypothesize the types of majors students are more likely to choose after recessions by examining the relative investment values of majors across time. While relative differences in investment values might be changing over time, the relative rankings of those values are not changing. Lee (2010) examines majors in the early 1980s and discovers that the relative investment values are highest for Engineering, Science, Business and lowest for Liberal Arts and Education majors. Rumberger and Thomas (1993) and Hamermesh and Donald (2008) show a similar investment value rankings ranking for the late 1980s and the 1980s through the early 2000s, respectively. They find that Engineering, Health, Science, Math, and Business majors rank highest followed by Social Science, Education and Humanities majors.

Furthermore, future employment stability differs between college majors. Job opportunities in the Government, Health Care, Public Safety, Education, Energy, Accounting, Technology, and Military sectors usually experience less of a decline during economic downturns than do other types of jobs (Shatkin, 2008). A recent survey after the recession of 2009 found that unemployment rates for new college graduates were highest for Architecture, Humanities, Social Sciences, and Arts majors. Earnings were lowest for those majors (excluding Architecture) as well (Carnevale et al., 2012). If high-wage and high-employment-opportunity majors do not suffer as much relative to low-wage and low-employment-opportunity majors, then the former are the majors that students should switch to if there are shocks to investment values of majors. Similarly, if students care more about investment value of majors after recessions, they should choose higher ranking employment and wage opportunity majors more often.

3 Data

Data constraints are the main barrier to answering whether students alter college major decisions after recessions. Few datasets collect information on student demographics and major choices over an extended time period, making it difficult to observe several recessions and major choice simultaneously. Previous papers that explore the relationship between the business cycle and college major choices use two main data sources: *High School and Beyond* and the Integrated Postsecondary Education System's (IPED's) "Completions Survey."

Lee (2010) analyzes how the business cycle influences college major decisions and obtains ambiguous results, using data from the *High School & Beyond* survey that provides student-level panel data on college enrollment, college major, and demographic characteristics during the 1980's. He obtains his business cycle variables from the College Placement Council's (CPC's) salary survey and the U.S. and state unemployment rates from the Bureau of Labor Statistics (BLS). Lee exploits the period from 1982-84 as a time of severe recession and 1985-1988 as a time of economic recovery. He uses a mixed conditional logit model, employing individual student characteristics as well as major-specific characteristics to model major choice. Lee's findings are ambiguous and statistically insignificant for the majority of the cases he studies. This outcome could result because Lee is not working with a balanced panel; 80 percent of the students sampled made their major decisions in 1983 and are not observed after 1984, the threshold year.

The Integrated Postsecondary Education Data System (IPEDS) collects institutional-level data on the number of students graduating with degrees in different disciplines. These data are problematic because the intended majors of students beginning college are not observed, and it is hard to know whether changes in institutional proportions are a result of enrollment, major-switching, or a function of the time it takes students to graduate (Bradley, 2012).

An alternate data source that collects student major information over an extended time period is the Cooperative Institutional Research Program's (CIRP's) Freshman survey housed in the Higher Education Research Institute (HERI) at the University of California, Los Angeles (UCLA). These data have never before been used to investigate the relationship of student major and the business cycle, and this is the first paper to do so. These data have the advantage of observing freshmen intended majors before they enroll in classes, so the identification of the major switching effect is not muddled by students' time-to-degree decisions (Bradley, 2012). In addition, the student-level nature of the data enables one to control for enrollment effects, addressing another identification problem of previous approaches (Bradley, 2012).

3.1 Higher Education Research Institute Data

Every year CIRP offers a survey of college freshmen that institutions can administer to their students. Schools who opt into the survey must pay HERI a fee for the survey materials and the data analysis provided after survey completion. HERI requires the survey to be administered to first-time, full-time freshmen before they begin fall semester classes. As recommended by HERI, the large majority of institutions conduct the survey during their freshmen orientations in a proctored setting, ensuring the highest response rates and the most accurate information.[5]

Consequently, the majors observed in these data are intended majors of college freshmen and not the majors with which students graduate, as in other data sources. This characteristic has both favorable and unfavorable implications for the research question at hand. First, because only intended majors are observable, students' major preferences have not been altered by what they learn about the consumption values of majors in college. This type of information is irrelevant for this analysis, and if it can be eliminated, identification of major switching effect is more straightforward. However, because the majors with which students graduate is not observable, it is more difficult to make conclusions about how the business cycles affect the general composition of the labor market.

This particular study uses data from 191 institutions that participated in "The Freshman Survey" thirty out of the thirty eight years from 1971-2008,[6] and where the state of the institution in observable. To protect the identity of the institutions, HERI requires that five or more institutions from the same state to be present in the sample before they reveal the

[5]The "Freshman Survey" data obtained for research purposes are restricted access data and only granted to researchers after a thorough proposal process to ensure the identities of the institutions and the students are protected.

[6]Data outside this date range were unavailable.

state identity of the institution.[7]

3.1.1 HERI Institutions Compared to a National Sample

Table 1 reports the composition of schools in the HERI sample used for analysis versus the national universe of four-year universities.[8] Private institutions account for 82.6 percent of all of the institutions in the HERI sample versus about 75.6 percent of all national institutions. Because the cost of attending private universities is generally higher than the cost of attending public universities, the average student in the HERI sample might be more financially secure than the average college freshman. Strong evidence of this fact is reported in Table 2 when student level characteristics are compared to a nationally representative sample of college freshmen.

More importantly, the observed institutions in this study are more heavily weighted towards religious and liberal arts institutions than the nationally representative sample of institutions. The discrepancy in the proportion of liberal arts colleges has important implications for this analysis because of the different experience average students have at liberal arts institutions versus at other types of private and public institutions. The Annapolis Group, an alliance of the majority of liberal arts colleges in the country, commissioned a study that found its graduates reported extreme differences in their college experience and the value of their college degrees compared to students at other types of private and flagship public institutions. For example, 87 percent of students at liberal arts colleges graduated in four years versus 76 percent at other private institutions and 51 percent of students at national flagship public institutions. Because students at liberal arts institutions graduate faster, on average, than students at other types of universities, liberal arts students are more likely to complete their degrees. Also, the intended majors with which they start will more closely

[7]The states observed for the 191 institutions include CA, CT, GA, IL, IN, IA, MD, MA, MI, MN, MO, NY, NC, OH, PA, TX, VA, and WI.

[8]Data for the national universe of schools come from IPEDS and the *Digest of Education Statistics* from the NCES.

mirror the majors with which they will graduate because they have less time to absorb the switching costs of changing majors (Brunello and Winter-Ember, 2003; Messer and Wolter, 2007).

Furthermore, 79 percent of students who attended the liberal arts colleges in the survey reported the quality and breadth of academic preparation equipped them well for being accepted to graduate school or finding their first job. Only 73 percent of students at other private universities and 64 percent of students at national flagship public schools reported the same level of preparation, respectively (Day, 2011).

Finally, the percentage of institutions classified as a Historically Black College or University (HBCU) in the HERI sample is comparable to the national average, with 3.7 percent in the HERI sample versus 3.9 percent, nationally. However, as reported in Table 2, there is a disparity in percentage of students in the sample identifying as black compared to the nationally representative proportion of black freshmen.

3.1.2 HERI Students Compared to a National Sample

One beneficial characteristic of the HERI data is the observable level of detail for student demographic characteristics. These characteristics are important major determinants and ones that should be measured to control for changes in enrollment when trying to identify major-switching effects. Montmarquett et al. (2002) find that women are less influenced than men by expected earnings when making their college major choice. This finding is reasonable given that men are traditionally the main breadwinners of a household, so they are more sensitive to future earnings possibilities than women (Hamermesh and Donald, 2008). Therefore, men are more likely than women to major in disciplines like Business, Engineering, and Technology. Wiswall and Zafar (2012) report strong taste parameter estimates for men in the Business and Economics disciplines and for women in the Arts and Humanities disciplines. Porter and Umbach (2006) cite several studies that confirm women are less likely to major in the Sciences and Engineering than men and are more likely to major in fields like Education, Nursing, and the Humanities. Gender-role reinforcement and minority status within a discipline might be to blame for these observed gender differences (Lackland, 2001; Kanter, 1993).

The same theories apply to why racial differences might affect major choice. Minority students are less likely to choose a major where they are one of the few present in that major (Kanter, 1993). For this reason, there might be sorting on race by major as well. Dickson (2010),[9] who specifically studies race and gender differences in college major choice, finds a 16 percentage point gap between white women compared to white men when examining the likelihoods of choosing Engineering and Technology majors. Additionally, white males are more likely to major in Business than white and Hispanic women and Asian and Hispanic males. Furthermore, Dickson (2010) finds that women are more likely to major in the Humanities than are men. Asians are less likely to major in the Humanities than whites and Hispanics (Dickson, 2010). She cannot say anything about race and gender differences in the Social Sciences because she uses that major category as her reference major.

Income and age are also important determinants in the major choice literature (Porter and Umbach, 2006; Montmarquette et al. 2002; Berger, 1988). Students who have a higher relative family incomes may place less weight on the investment value of a major when choosing a major because they might have more family income to support them later in life. The opposite might be true for older more non-traditional students who may place more weight than the average student on the investment value of a major. Presumably, students who go back to school after taking time off might care less about the consumption value of a college degree and might be more concerned with how their degree will impact their labor market opportunities.

HERI provides a publicly available sample of students and sample weights that approx-

[9] One difficulty in interpreting Dickson's results is that she does not report race and gender likelihood coefficients separately but instead the interaction terms of race and gender.

imate national trends for college freshmen through the year 1999. To see if any strong student-level selection occurs in the data used for this paper, Table 2 compares the restricted access data provided by HERI for this study to the national trends for the years 1980-1999.[10]

In the freshmen survey data, income is reported as a categorical variable. Following the technique used in Hout (2004), income becomes a numeric variable by taking the midpoint of each category and converting it to 2008 dollars to adjust for inflation. Age is also a categorical variable, but each category maps to a one year change in age, so this is not converted to actual age. The age category "3" maps to reporting an age of 18. Therefore, the higher the age is above 3, the more non-traditional is the freshman sample.

After conducting a difference in means test for the observable demographic variables, the differences between the two samples are confirmed as statistically significant, although they are not large. One option to address this selection problem is to weight the data to more closely resemble the national trends. Unfortunately, all of the student and institutional-level variables required to apply the reported national norm weights cannot be observed. Therefore, I must recognize how these samples differ to generalize my results to the national context.

Papers like Wiswall and Zafar (2011) are also unable to weight their sample to more closely resemble the population. They address this problem by recognizing the differences in the two samples and discussing how those differences might affect the results when students are selecting a major. In the present context, because the sample has a greater percentage of private and liberal arts institutions, the students are richer, whiter, of more traditional age,

[10] Although intended major and the other important demographic characteristics are observable for the years 1971-2008, I only use data for 1980-2008 in the final model. The identification strategy used in this paper is not feasible with long periods of economic turmoil and little recovery. As discussed in the next section, identification of the major switching effect relies on periods of negative economic shocks followed by observable periods of recovery, like the period of stagflation in the 1970s. Because the 1970s is viewed as a entire decade of economic turmoil, including these years in the model muddles the identification of major switching effects.

and more likely female than a more nationally-representative sample of students. Although the students in this sample do differ slightly from the representative sample, the direction of the differences turns out to be quite fortunate. A more representative sample of students would be more likely to change their majors after recessions than students in this sample because, as outlined previously in this section, male, minority, poorer and older students care more about the investment value of a major than do their counterparts. Therefore, the effects in this study can be viewed as conservative estimates of major switching after recessions compared to a national sample of college students.

While the CIRP "Freshman Survey" data provide a broad range of student demographic information, one disadvantage is that response rates differ for all variables collected. Only variables for which there are high response rates over the entire sample period can be included in the model because of fears of sample selection based on survey nonresponse. Table 3 lists response rates for those in my model: gender, race, income, and age. All the variables listed have student response rates of over 89 percent of the sample. These response rates are comparable for the nationally representative sample provided by HERI. Therefore, there is no reason to believe that response rates for students in my sample would differ from the response rates from students in a national sample.

3.1.3 HERI data and Major Heterogeneity

This analysis considers thirteen major categories. Table 4 details high-wage majors versus low-wage majors and high-employment-opportunity majors versus low-employment-opportunity majors, as outlined in Section 2.2 of the paper. The Education major is unique because it is considered a low-wage major and a high-employment-opportunity major, so it is unclear how students will respond to this major when they observe business cycle shocks. Figure 1 displays the proportions of students intending to major in each discipline averaged over all years in the sample.

As mentioned in Section 3.1.2, a student's demographic characteristics are critical for determining which major a student chooses. Table 5 summarizes important demographic characteristics by major; this table provides cursory evidence that students indeed sort into majors across income, age, gender and race. In general, richer students sort into majors with lower wages and lower job market opportunities like English, History, Humanities, and Social Sciences.[11]

The summary statistics by major for age, gender, and race also reveal expected trends. Older (more non-traditional) freshmen major in high-wage and high-employment-opportunity majors that are less likely to require graduate study such as Technology, Engineering, Business, and Education. Presumably, an older student is less likely to return to college to major in something that has a lower investment value after graduation. Furthermore, there is a larger share of male students majoring in Engineering, Technology, Physical Sciences, Business, Math, and History, respectively, than their share of the total freshmen population. This conforms to what Mountmarquette et al. (2002) proposes: males care more about investment values of majors than do females.

Asian students constitute more than their representative share in the Biology, Health, Engineering, Technology, Physical Sciences, and Math majors. Black freshmen report intended majors at higher rates in Technology, Health, Social Sciences, Biology, and Business fields. Finally, white students represent more than their total share of the population in Education, English, Humanities, Mathematics, Physical Sciences, History, and Business.

Table 6, which ranks majors by average student high school GPA, summarizes how certain students sort into majors based on ability levels. This information conforms to what previous studies report about how a student's ability affects her major choice. HERI reports GPA on a 1-8 scale with 1 being a D, 8 being an A, and 5 being a B. The mean for all student is around a 6.1, or a B+ according to their scale. Those who perform better on average in high

[11]The Business major is the exception and the only high-family-income major in the top 5 that is not considered a low-wage, low-employment-opportunity major.

school choose more technical majors like Math, Physical Sciences, Biology, and Engineering. The variables Academic, Art, Math, Write, and Confidence are student self reported ability scores in these areas on a scale of 1-6. It is clear that students sort into majors for which they believe they have the highest abilities. Response rates are not high enough for many of these variables over a long enough time period for them to be included in the empirical model, but this table provides interesting information on which types of students choose certain majors.

3.2 Business Cycle Data

To correctly identify the effects of observed recessions on students' major decisions, the business cycle variables must capture the information shock of an economic downturn. The few previous papers that have asked a similar question have used a variety of data to model the business cycle which signal both changes in expected future earnings and labor market opportunities (Lee, 2010; Bradley, 2012). Lee (2010) uses the most comprehensive set of business cycle variables. Employing indicators for wages and unemployment at the national and state levels, and obtains ambiguous results. Because there are so many business cycle variables in Lee's model, it is analytically intractable for him to try to parse out the effects of the information shock of the recession on student major choice. The timing of fluctuations in wages and unemployment is syncopated during a recession, with increases in unemployment usually lagging behind decreases in wages. It is perilous to speculate to which movements in these variables students are more likely to respond because previous studies show that both factors play important roles in a student's major decision.

In addition, student responses to certain economic indicators are not expected to be to be symmetric. For example, how students' major choices respond to a 3 percent increase in unemployment when unemployment is initially 4 percent might be different than how students change their major decisions when initial unemployment is 8 percent. Fortunately, the recession troughs reported by the National Bureau of Economic Research's (NBER's) Business Cycle Dating Committee are business cycle indicators that capture both changes to wages and unemployment and allow for student response asymmetry. The recession troughs are the periods where national recessions are thought to bottom out before they begin periods of recovery. The NBER has no fixed definition of what determines trough dates and uses various measures of broad economic activity in its analysis: real GDP, economy-wide employment, and real income. The committee may also use sector specific information in its evaluation. The trough years observed for the sample period used in this model are 1980, 1982, 1991, and 2001.[12]

Figures 2-4 show how major proportions are changing over time with trough years indicated in the graph. After trough years, defined kinks appear in the reported major proportion lines, which simply provides suggestive evidence that students are in some way responding to this new information. Employing a full econometric model that controls for other factors that influence college major choice is the next step in determining how students respond to adverse business cycle information.

4 Empirical Model

This analysis uses a multinomial logit technique similar to that used in Dickson (2010) and Porter and Umbach (2006). Taking individual student level variables from the CIRP "Freshman Survey" along with the recession trough data from the NBER, I estimate the following empirical model for freshman intended major choice:

$$Pr(M_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=0}^{K} e^{\beta_k' x_i}}$$

[12] I considered using state-level business cycle indicators in addition to national recession troughs, but similar to the results seen in Lee (2010), no coherent story develops for these state-level variables.

for

$$j = 0, 1, 2, 3, 4, ..., K$$

where K is the number of broad intended major categories in the data. M is the intended major choice of the student, which is a function of the demographic and time series variables included in vector X. X also includes year and state dummy variables, and university trend variables.[13]

By controlling for demographic characteristics, this empirical strategy compares similar students across time to assess whether or not the presence of a recession has any real effect on the majors students choose. If different types of students are enrolling in college after they observe recessions, controlling for observable demographic characteristics partially alleviates this issue to allow for more precise identification of the major-switching effect. If, however, certain unobservable student characteristics are potentially correlated with major choice after recessions, then I must use techniques to hypothesize the direction of these effects to appropriately bound any major-switching effects.

In addition, the school a student attends undoubtedly influences major choice. For example, a student attending the Georgia Institute of Technology is much more likely to choose an Engineering major than a student attending the University of Georgia. The large number of major categories and the computationally intensive multinomial logit routine does not make it analytically tractable to add 191 institutional dummy variables, so I determine the average number of students over time at each institution majoring in the different major categories and include those control variables in the model. This is the first best alternative that also

[13]One important identifying assumption for the multinomial logit model is independence of irrelevant alternatives (IIA). This assumption claims that the odds of preferring one major over another do not depend on the presence or absence of other irrelevant majors. Previous papers that use multinomial or conditional logit to model major choice fail to test for this IIA assumption (Porter and Umbach, 2006; Dickson, 2010; and Lee, 2010). However, Lee (2010) mentions that even in the presence of an endogenous choice set (or a violation of IIA) his model would return consistent parameter estimates. I test the validity of the IIA assumption using the Hausman-McFadden test. The test suggest that some of the majors fail to meet the IIA condition. I can collapse on more similar majors in future iterations of this paper using nested logit, which relaxes the IIA assumption. For now, the relative risk ratios are reported using multinomial logit.

captures any proclivity a student may have for a particular major given the institution he or she attends.

My model differs from previous models asking this question by including national business cycle troughs. Contemporaneous and lagged dummy variables for recession troughs, allow me to estimate the change in the relative risk ratios (rrr's) of different freshmen major intentions relative to a reference major. If $rrr > 1$, then the average student is many times more likely to choose that major during a trough year compared to the reference major, and if the $rrr < 1$, then a student is less likely to choose that major during a trough year compared to the reference major.

The results are reported as rrr's between the remaining majors and the reference major, English. The English intended major possesses a steady share of the student totals over time. As shown in Figure 4, the share of English majors was 2.0 percent in 1980 and 2.7 percent in 2008. The proportion never deviates by more than 0.6 percentage points away from its mean of 2.6. English does not appear to fall victim to the cyclical choice pattern that seems to plague other majors. Therefore, students are less likely to switch into or out of that major when business cycle fluctuations occur, making the English major a good reference point. Also, according to Table 5, English majors are the richest students compared to their peers in other majors; they might care less about the investment value of majors because they potentially have more financial support from their families. Additionally, because English is seen as a typically low-wage and low-employment opportunity major, theory suggests that this would not be a major the marginal student would want to choose after observing a recession. Imagine instead a major like Business as the reference major. It would prove challenging to hypothesize the direction of the relative risk of Engineering majors relative to Business.

The contemporaneous trough indicator is the variable of interest in the model. The direction of the relative risk ratio for this variable will most closely capture the major-switching effect. The contemporaneous business cycle variable is less likely to contain any enrollment effect because it is difficult for students to observe a recession and decide to enroll in a four-year university in the same year. Strong enrollment effect should materialize in the lags of trough variables because it takes time to apply to and be accepted into a four-year university; Typically, students decide whether they are going to college by the year prior to enrollment. Four lags of the trough variables are included in the model to also control for any enrollment effect.

5 Results

A logit model for student decisions to declare an intended major reveals that freshmen are more likely to report an intended major in a trough year than in a non-trough year. The log odds of not declaring an intended major versus declaring an intended major falls by .48 in a trough year. Therefore, I estimate the main empirical model conditional on declaring an intended major, using the freshmen whose relevant demographic information (gender, race, age, and income) is observable from the years 1980-2008.

The results conform to what theory and anecdotal evidence suggest: students alter their college major intentions when they observe shocks to the business cycle. This is the first paper that can unambiguously declare the direction in which students alter their major intentions during a recession. Table 7 reports a summary of the relative risk ratios (rrr's) for the contemporaneous trough variable for each of the twelve major categories compared to the reference major English. The full multinomial logit output can be found in Appendix Tables A1-A10. As previously stated, the focus remains on the contemporaneous business cycle term to identify the major-switching effects; it is this term that, theoretically, is least affected by enrollment effects.

The first column in Table 7 lists the rank and magnitude of the relative risk ratios of the contemporaneous trough variable for the majors over the full sample of freshmen included in the model. The second column lists the majors' rankings and magnitudes of the contemporaneous trough for females, the third column for males, the fourth column for whites, and the fifth column for blacks. Table 8 displays the tiers of majors whose magnitudes are not statistically different from one another.[14] If majors are in the same tier, one cannot decipher which of the majors the students would prefer, on average, after a recession. However, if two majors are in different tiers, then, on average, students prefer a major in the higher of the two tiers after a recession.

A recession's effect on the likelihood that students will choose Technology is the strongest for the full sample of students, as well as for each subgroup. Institutions should expect an increase in the demand for classes required for a Technology major after a recession. This is an interesting result because Technology classes are some of the most expensive classes to offer, given the resources required. This should be a particular concern for university administrators, given their strained budgets during economic downturns.

Unsurprisingly, Business and Engineering majors fall into the second tier of increased major demand across the full sample and all subsamples. The Social Science major never rises above the penultimate tier for any of the subgroups, which is expected given that it is a low-wage, low-employment opportunity major. In general, the rankings of the majors conform to theoretical priors. Majors that typically pay higher wages and have more employment opportunities have larger rrr's relative to English majors, and majors for which wages and employment opportunities are not as substantial have smaller magnitudes relative to the reference major.

The major rankings are fairly consistent across columns in Table 7 with varying magnitudes. The Education major ranks higher for females compared to males, as expected, and the Health major ranks higher for males compared to females. The magnitudes of the relative risk ratios is partially a function of the number of students choosing that major on

[14]The majors in the same tiers for the same model have overlapping 95 percent confidence intervals.

average in that category. Therefore, the very large rrr for females and Technology majors is most likely a result of the small number female technology majors, on average. However, the rrr's for black students are higher in every category, which implies that black students care more about recessions than white students when making their college major decisions.

The Fine Arts and Biology majors stand out as the two exceptions to the hypothesis that high-wage, high-employment majors will be preferred after recessions. Previous psychological literature suggests that the result for Fine Arts majors is not as odd as it may seem. Csikszentmihalyi and Getzels (1973) report that Fine Arts majors compared to students who major in other disciplines have low levels of "superego strength" which indicates that these students do not conform to cultural or social standards. They also describe artists as "resolute and accustomed to making their own decisions." Shelton and Harris (1979) confirm that those who major in the Arts possess an "assertive boldness." Students who choose to major in Art already know they are making a risky financial decision and are probably students that place a very low priority on the investment value of their college major. That weight is unlikely to change by enough after a recession to induce them to switch majors to another field. Therefore, any shocks to investment value, like a recession, would have no visible effect on their decision to be an Art major. It is probably not the case that more students are majoring in Fine Arts after a recession, but instead the exact same students who chose an Art major before a recession are going to choose an Art major after a recession. If there are any changes at all in the number of students choosing to major in English after a recession, then the $rrr > 1$ for the Fine Arts major.

The unexpected results for Biology majors are more difficult to explain. Combining evidence from Arcidiacono et al. (2010) and Stinebrickner and Stinebrickner (2011), students would prefer to major in less challenging disciplines, *ceteris paribus*. When students receive updated information, many times they choose to change out of the more technical majors like Math and Science to majors like Humanities and Social Sciences. If students' expectations are altered so that the investment value to Biology majors after a recession changes its relative rank in the major spectrum, then students might switch out of Biology majors into fields that are less challenging. Stinebrickner and Stinebrickner (2011) also show that students are not very likely to switch into a Biology major after receiving updated information but, most of the time, will switch out of the major.

There might be concern that some enrollment effects are present in the contemporaneous trough term. Each demographic variable can be regressed on the remaining variables in the model. By observing the magnitude and the significance level of the contemporaneous trough term and if there are priors about the direction of correlation between the observable demographic variables and any unobservable variables, then any remaining enrollment effects can be signed. Table 10 reports the results for the OLS regressions of the demographic variables on the other variables in the empirical model. The contemporaneous trough for males and whites are positive and significant meaning that in trough years more males and whites enroll in school. The contemporanous trough variable is negative and significant for age and income. This is not surprising if older students choose not to enroll in school in trough years and that the average student is poorer in a trough year. Even though there appear to be enrollment effects across these variables, these should not affect the estimated major-switching effects because these variables are controlled for in the multinomial logit model.

Table 11 reports OLS regression results for some of the variables not included in the multinomial logit model because of their low response rates in the HERI survey. Students have lower high school GPAs, SAT Math scores, and SAT Verbal scores in business cycle trough years. Because these ability measures are not included in the model, these enrollment effects might bias the results of the major-switching effects. However, since lower ability students usually choose low-wage and low-employment opportunity majors, the estimated major-switching effects should be interpreted as lower bounds if these student ability enrollment effects are present One exception to this would be the Business major. Business is a high-wage, high-employment opportunity major and also a major that lower ability students prefer. The estimates of the major-switching effects for Business therefore may be overestimated and should be interpreted as a combined major-switching and enrollment effect.

The relative rrr's for the first through fourth lags of the trough variable are reported in the Appendix Tables A1-A10. It is important to interpret these ratios as a combination of enrollment effects and major switching effects. When the direction of the rrr relationship changes for the lags of the trough variable compared to the contemporaneous term, then the enrollment effect and major switching effect are thought to be moving in different directions with the enrollment effect dominating.

6 Conclusion

This is the first paper to empirically show an unambiguous relationship between the business cycle and the majors that college students choose. First, this study finds that freshmen are less likely to have an undeclared intended major during a recession trough. Those who do report an intended major during a recession are generally more likely to choose majors that pay higher wages and have more job security like Technology, Business, Engineering, and Health majors. Finally, lower ability students are more likely to enroll in college during a recession. These students are more likely to choose low-wage, low-employment opportunity majors which might also bias the major-switching effects for high-wage, high-employment opportunity majors downwards.

The results of this paper should be interpreted as conservative estimates of student major-switching responses after recessions, as this sample is more heavily weighted towards wealthy, white, female, and liberal arts students. A more nationally representative sample than the CIRP "Freshman Survey" might more closely capture an average student's response to a recession.

This paper helps researchers to better understand how students make their major decisions. Because of data limitations, previous studies have been unable to identify whether students respond to business cycle signals when choosing college majors. The data used here improve upon the student-level college major data and introduce a new variable that characterizes the business cycle. While recession troughs may seem like obvious business cycle indicators, previous papers focus on levels of wages and unemployment. Students may not initially have perfect information about wage and unemployment variables to factor into their major decisions. However, students should have a basic understanding of how the economy is performing, and this is best captured by the recession trough data from the NBER. The information shock of a recession trough induces students to switch their intended majors in the direction that theory and anecdotal evidence suggests.

Knowing the types of majors students are more likely to choose during recessions helps administrators plan for fluctuations across field of study. University administrators armed with the information of a recession's major-switching effects can then allocate resources accordingly. Also, if economists and other researchers know how students switch their majors during recession years, then the forecasting of labor market shortages and surpluses in certain fields will become more accurate.

7 References

Arcidiacono, Peter. 2004. "Ability sorting and the returns to college major." *Journal of Econometrics*, Vol. 121, No. 1-2: 343-375.

Arcidiacono, Peter, V. Joseph Hotz, and Songman Kang. 2010. "College Major Choices using Elicited Measures of Expectations and Counterfactuals." *National Bureau of Economic Research.* Working Paper #15729.

Associated Press. 2012. "Half of recent college grads underemployed or jobless, analysis says." *Cleveland.com* <www.cleaveland.com>.

Beffy, Magali, Denis Fougre, and Arnaud Maurel. 2010. "Choosing the Field of Study in Post-Secondary Education: Do Expected Earnings Matter?" Working Paper. <www.amaurel.net/IMG/pdf/Choosing-the-Field-of-Study.pdf>.

Berger, Mark C. 1988. "Predicted Future Earnings and Choice of College Major." Industrial & *Labor Relations Review.* Vol. 41, No. 3: 418-429.

Bonner, Bill. 2012. "Student Loan Bubble Sets Up to Be Subprime Disaster Part Deux." *The Daily Reckoning.* <www.dailyreckoning.com>.

Bradley, Elizabeth S. 2012. "The Effect of the Business Cycle on Enrollment, Major, and Time-to-Degree Decisions of College Students." Working Paper.

Brunello, Giorgio and Rudolf Winter-Ebmer. 2003. "Why do Students Expect to Stay Longer in College? Evidence from Europe." *Economic Letters.* Vol. 80, No. 2: 247-253.

Carnevale, Anthony P., Ban Cheah and Jeff Strohl. 2012. "Hard Times: College Majors, Unemployment and Earnings: Not All College Degrees Are Created Equally." *Georgetown Public Policy Institute: Center on Education and the Workforce.*

Clark, Kim. 2010. "The Great Recessions Toll on Higher Education." *U.S. News.* September 10, 2010. <www.usnews.com>.

Csikszentmihalyi, Mihaly and Jacob W. Getzels. 1973. "The Personality of Young Artists:

An Empirical and Theoretical Exploration." *British Journal of Psychology.* Vol. 64, No.1: 91-104.

Cronin, Joseph M. and Howard E. Horton. 2009. "Will Higher Education Be the Next Bubble to Burst?" *The Chronicle of Higher Education.* Vol. 55, No. 7: A56.

Dickson, Lisa. 2010. "Race and Gender Differences in College Major Choice." *The ANNALS of the American Academy of Political and Social Science.* Vol. 627: 108-124.

Eide, Eric and Geetha Waehrer. 1998. "The Role of Option Value of College Attendance in College Major Choice." *Economics of Education Review.* Vol. 17, No.1: 73-82.

Goldin, Claudia. 1999. "Egalitarianism and the returns to education during the great transformation of American education." *Journal of Political Economy.* Vol 107: S65-S94.

Hamermesh, Daniel S. and Stephen G. Donald. 2008. "The Effect of College Curriculum on Earnings: Accounting for Non-ignorable Non-response Bias." *Journal of Econometrics.* Vol. 144: 479-491. Hardwick Day. 2011. "The Value and Impact of the College Experience: A Comparative Study." *The Annapolis Group.*

Hout, Michael. 2004."Getting the Most Out of the GSS Income Measures." *GSS Methodological Report 101.*

Jensen, Robert. 2010. "The (Perceived) Returns to Education and the Demand for Schooling." *Quarterly Journal of Economics.* Vol. 125 No.2): 515-548.

Kahn, Lisa. 2010. "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy." Working Paper.

Kanter, R. M. 1993. *Men and Women of the Corporation.* BasicBooks. New York, NY.

Lackland, A. C. 2001. "Students' choices of college majors that are gender traditional and nontraditional." *Journal of College Student Development.* Vol.42, No.1: 3947.

Lee, Uisok. 2010. "The Impact of Labor Market Conditions on Choice of College Major." *UMI Dissertation Publishing.* ProQuest LLC.

Lumina Foundation. 2012. “Goal 2025.” *Lumina Foundation.* <www.luminafoundation.org>.

Manski, Charles F., and David A. Wise. 1983. *College Choice in America.* Havard University Press.

Mattila, J.P. 1982. “Determinants of male school enrollments: A time-series analysis.” *Review of Economic Statistics.* Vol. 64: 242-251.

Messer, Dolores and Stefan C. Wolter. 2007. “Time-to-Degree and the Business Cycle.” *IZA* Discussion Paper No. 2787.

Montmarquette, Claude, Kathy Cannings, and Sophie Mahseredjian. 2002. “How do young people choose college majors?” *Economics of Education Review.* Vol. 21, No. 6: 543-556.

National Center for Education Statistics. 2008. “Degree-granting institutions and branches, by type and control of institution and state or jurisdiction: 2007-2008.”*Digest of Education Statistics.*

Nguyen, Trang. 2010. “Information, Role Models and Perceived Returns to Education: Experimental Evidence from Madagascar. ” MIT Working Paper.

Oreopolous, P., Till von Wachter, and Andrew Heisz. 2012. “Short- and Long-Term Career Effects of Graduating in a Recession.” *American Economic Journal: Applied Economics*, forthcoming.

Porter, Stephen R., and Paul D. Umbach. 2006. “College Major Choice: An Analysis of Person-Environment Fit.” *Research in Higher Education.* Vol. 47, No 4: 429-449.

Rumberger, Russel W. and Scott L. Thomas. 1993. “The economic returns to college major quality and performance: A multilevel analysis of recent graduates.” *Economics of Education Review.* Vol. 12, No. 1: 1-19.

Sakellaris, Plutarchos and Antonio Spilimbergo. 2000. “Business cycles and investment in human capital: International evidence on higher education.” Carnegie-Rochester conference Series on Public Policy, Vol. 52: 221-256.

Shatkin, Laurence. 2009. "150 Best Recession Proof Jobs." *Jist Publishing.* St. Paul, MN.

Shierholz, Heidi, Natalie Sabadish and Hilary Wething. 2012."The Class of 2012: Labor market for young remains grim." *Economic Policy Institute.* <www.epi.org>.

Shelton, Jeffrey and Thomas L. Harris. 1979. "Personality Characteristics of Art Students." *Psychological Reports.* Vol. 44, No. 3: 949-950.

Stinebrickner, Todd R. and Ralph Stinebrickner. 2011. "Math or Science? Using Longitudinal Expecations Data to Examine the Process of Choosing a College Major." *National Bureau of Economic Research.* Working Paper No. 16869.

U.S. Department of Education and U.S. Department of Labor. "Student Financial Assistance Resources." *Opportunity.Gov.* <www.federalstudentaid.ed.gov/opportunity>.

Weissmann, Jordan. 2012. "53% of Recent College Grads Are Jobless or Underemployed-How?" *The Atlantic.* <www.theatlantic.com>.

Weller, Christian. 2012."Student Loan Debt Seems to Rise No Matter What the Economy Does." *Center of American Progress.* <http://www.americanprogress.org/issues/higher-education/news/2012/05/03/11517/student-loan-debt-seems-to-rise-no-matter-what-the-economy-does/>.

Wiswall, Matthew and Basit Zafar. 2011. "Belief updating among college students: evidence from experimental variation in information," *Federal Reserve Bank of New York.* Staff Reports 516.

Yen, Hope. 2012. "1 in 2 new graduates are either jobless or underemployed. " *Associated Press.* <http://news.yahoo.com/1-2-graduates-jobless-underemployed-140300522.html>.

Young, Jeffrey R. 2012. "Gates Foundation Gives $9-million in Grants to Support 'Breakthrough' Education Models." *The Chronicle of Higher Education.* <chronicle.com>.

8 Tables and Figures

Table 1: Institutional Characteristics

Sample of Institutions	**Public (%)**	**Religious (%)**	**HBCU (%)**	**Liberal Arts (%)**
HERI Sample	17.42	37.76	3.73	55.60
National Universe	24.41	33.33	3.90	15.00-25.00†

Notes: † This percentage depends on the source reporting.

Table 2: HERI Trends Sample vs. My Sample: 1980-1999

Variables	**Trends(weighted)**	**My Sample**	**Difference**$_{MySample-Trends}$
Male	52.88%	48.04%	-4.84% ***
Black	10.72%	7.53%	-3.19%***
White	82.33%	84.33%	2.00% ***
Asian	3.74%	5.32%	1.58%***
Income	$94,791.34	$110,161.30	$15,369.96***
Age	3.26	3.22	-0.04***

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
The "Trends" data are publically available through HERI and depict a nationally representative sample of the population. The "My Sample" data are the restricted access data obtained through HERI.

Table 3: Response Rates

Variables	**My Sample**	**Trends**
Major	94.23	N/A
Male	99.90	100.0
Race	98.20	98.47
Income	89.03	89.11
Age	99.27	99.37

Notes: The "Trends" data are publically available through HERI and depict a nationally representative sample of the population. The "My Sample" data are the restricted access data obtained through HERI.

Table 4: High-Wage vs. Low-Wage Majors/High-Employment-Opportunity versus Low-Employment-Opportunity Majors

High Wage	**Low Wage**	**High Employment**	**Low Employment**
Biology	Education	Biology	English
Business	English	Business	History
Engineering	History	Education	Humanities
Health	Humanities	Engineering	Fine Arts
Mathematics	Fine Arts	Health	Social Sciences
Physical Sciences	Social Sciences	Mathematics	
Technology		Physical Sciences	
		Technology	

Table 5: Demographic Summary Statistics by Major: Sorted by Family Income

Major	**Income($)**	**Age**	**Male(%)**	**Asian(%)**	**Black(%)**	**White(%)**
English	133,923.20	3.21	31.54	4.78	5.01	88.10
History	132,113.20	3.23	48.22	4.89	6.49	85.05
Business	122,722.60	3.27	55.20	4.97	8.07	83.88
Humanities	121,792.10	3.23	34.53	3.96	5.08	88.09
Social Sciences	119,204.80	3.23	28.95	5.88	9.09	80.98
Biology	117,183.40	3.20	40.33	11.66	8.25	76.20
Physical Sciences	112,968.90	3.22	61.03	7.23	5.32	85.26
Fine Arts	111,426.60	3.26	44.01	5.31	5.56	86.74
Math	107,124.70	3.17	50.26	6.38	4.91	86.77
Engineering	104,067.80	3.25	81.33	8.75	6.68	81.54
Health	102,743.80	3.22	29.50	8.77	10.45	76.97
Education	94,047.69	3.26	23.65	1.77	5.21	90.69
Technology	90,398.65	3.26	66.95	8.09	11.23	77.66
All Majors	113,452.80	3.24	46.64	6.34	7.68	82.78

Notes: "Income" represents family income in 2008 dollars. "Age" is a categorical variable with 3.0 equivalent to age 18.

Table 6: Ability Summary Statistics by Major: Sorted by HSGPA

Major	HSGPA	SATM	SATV	Academic	Art	Math	Write	Confidence
Math	6.83	679.93	587.62	4.36	2.66	4.58	3.30	3.88
Physical Sci	6.70	656.15	608.88	4.33	2.87	4.08	3.52	3.95
Biology	6.62	622.96	594.21	4.17	2.94	3.66	3.53	3.81
Engineering	6.47	653.93	576.77	4.23	2.87	4.20	3.34	3.90
English	6.45	604.07	643.95	4.19	3.27	2.99	4.36	3.87
Health	6.37	587.26	553.34	4.00	2.76	3.52	3.43	3.70
History	6.37	605.79	613.26	4.18	2.81	3.20	3.83	3.96
Humanities	6.20	598.41	612.72	4.04	3.40	3.08	3.81	3.81
Social Sci	6.03	590.25	582.30	3.92	2.85	3.16	3.61	3.66
Technology	5.95	616.48	562.47	3.97	2.83	3.77	3.32	3.74
Fine Arts	5.89	585.77	573.88	3.87	3.99	3.18	3.55	3.65
Business	5.77	582.96	538.65	3.86	2.62	3.51	3.35	3.70
Education	5.73	540.53	525.28	3.67	2.71	3.06	3.34	3.48
All Majors	6.13	602.35	575.46	4.00	2.89	3.47	3.52	3.76

Notes: HSGPA is on a 1.00 to 8.00 scale with 6.00 equivalent to a B+ average. "Academic," "Art," "Math," "Write," and "Confidence" are all student self-rated ability scores on a 1-6 scale.

Table 7: Summary of Contemporaneous Trough Relative Risk Ratios

All		**Female**		**Male**		**White**		**Black**	
Technology	4.01***	Technology	8.42***	Technology	2.40***	Technology	3.68***	Technology	7.27***
Engineering	1.98***	Business	2.28***	Health	1.85***	Business	1.91***	Engineering	3.78***
Business	1.90***	Engineering	2.04***	Engineering	1.77***	Engineering	1.89***	Business	3.40***
Fine Arts	1.56***	Fine Arts	1.63***	Business	1.54***	Fine Arts	1.51***	Fine Arts	2.49***
Health	1.47***	Mathematics	1.50***	Physical Sciences	1.43***	Health	1.40***	Health	2.20***
Mathematics	1.35***	Education	1.34***	Fine Arts	1.36***	Mathematics	1.33***	History	2.12***
Physical Sciences	1.35***	Health	1.34***	Mathematics	1.14	Physical Sciences	1.31***	Education	2.10***
History	1.16***	Humanities	1.20***	History	1.08	History	1.11***	Mathematics	2.07**
Education	1.12***	History	1.14***	Humanities	0.98	Education	1.09**	Physical Sciences	1.80***
Humanities	1.12***	Physical Sciences	1.08	Biology	0.92	Humanities	1.08*	Social Sciences	1.55**
Social Sciences	1.00	Social Sciences	1.08*	Social Sciences	0.84**	Social Sciences	1.01	Humanities	1.46*
Biology	0.82***	Biology	0.74***	Education	0.69***	Biology	0.82**	Biology	1.16
N=2,100,515		N=1,102,014		N=998,931		N=1,744,144		N=136,832	

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.
The relative risk ratios are ranked by magnitude for each separate demographic category. If a major's relative risk ratio (rrr) is greater than 1.00, then students are more likely to choose that major relative to English after a recession. If rrr=1.00 then a student is just as likely to choose that major relative to English after a recession. If $rrr < 1.00$ then a student is less likely to choose that major after a recession. For example, if for females the rrr for a Business major =2.28 then the average female is 2.28 times more likely to choose an English major during a recession trough year than in a non-recession trough year. The complete multinomial logit results can be found the Appendix tables A1-A10.

Table 8: Contemporaneous Trough Relative Risk Ratio Tiers

Tiers	All	Female	Male	White	Black
Tier 1	Technology	Technology	Technology	Technology	Technology
Tier 2	Business, Engineering	Business, Engineering	Engineering, Health Business	Business, Engineering	Business, Engineering
Tier 3	Fine Arts, Health	Fine Arts	Fine Arts, Physical Sciences	Fine Arts, Health, Math, Physical Sciences	Education, Fine Arts, Health, History, Math
Tier 4	Math, Physical Sciences	Education, Health, Math	History, Humanities, Math	Education, History, Humanities, Social Sciences	Humanities, Physical Sciences, Social Sciences
Tier 5	Education, History, Humanities	History, Humanities	Biology, Education, Social Sciences	Biology	Biology
Tier 6	Social Sciences	Physical Sciences, Social Sciences			
Tier 7	Biology	Biology			
	N=2,100,515	N=1,102,014	N=998,931	N=1,744,144	N=136,832

Notes: Tiers represent overlapping 95% confidence intervals of the contemporaneous trough relative risk ratios. The complete multinomial logit results can be found the Appendix tables A1-A10.

Table 9: Summary of Demographic Variables' Relative Risk Ratios

Male		**Black**		**Asian**		**Age**	
Engineering	8.22***	Technology	2.51***	Technology	3.55***	Education	1.07***
Technology	4.51***	Engineering	2.09***	Health	3.18***	Social Sciences	1.06***
Physical Sciences	3.18***	Business	1.92***	Biology	2.91***	Business	1.05***
Mathematics	2.08***	Social Sciences	1.86***	Engineering	2.90***	Humanities	1.02*
Business	2.58***	Health	1.83***	Business	2.26***	History	1.00
History	1.87***	Biology	1.64***	Physical Sciences	1.75***	Fine Arts	1.00
Fine Arts	1.69***	History	1.45***	Social Sciences	1.60***	Technology	0.97***
Biology	1.46***	Fine Arts	1.10***	Fine Arts	1.52***	Health	0.97***
Humanities	1.17***	Humanities	1.06**	Mathematics	1.46***	Engineering	0.94***
Health	0.96***	Physical Sciences	1.01	History	1.14***	Biology	0.91***
Social Sciences	0.88***	Mathematics	0.96	Humanities	0.92***	Physical Sciences	0.90***
Education	0.71***	Education	0.92***	Education	0.81***	Mathematics	0.81***
N=2,100,515		N=2,100,515		N=2,100,515		N=2,100,515	

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.
This table represents the estimated relative risk ratios for the different demographic variables by major using the multinomial logit technique. The complete multinomial logit results can be found the Appendix tables A1-A10.

Table 10: Estimated OLS Enrollment Effects by Observable Demographic Characteristics

	Male	Age	Income	White
Trough_t	0.016^{***} (0.003)	$-.006^{*}$ (0.004)	$-11,862.87^{***}$ (491.49)	0.016^{***} (0.002)
Trough_{t-1}	0.011^{***} (0.002)	$-.007^{**}$ (0.003)	$-12,330.77^{***}$ (362.07)	0.012^{***} (0.001)
Trough_{t-2}	$-.020^{***}$ (0.003)	0.061^{***} (0.004)	$6,454.29^{***}$ (522.34)	-0.064^{***} (0.002)
Trough_{t-3}	$-.002$ (0.002)	0.020^{***} (0.003)	$1,582.48^{***}$ (320.30)	-0.004^{***} (0.001)
Trough_{t-4}	$-.004$ (0.003)	0.016^{***} (0.004)	$5,153.66^{***}$ (520.49)	-0.013^{***} (0.002)
Male		0.114^{***} (0.001)	$6,524.68^{***}$ (108.70)	0.011^{***} (0.000)
Age	0.088^{***} (0.001)		$-2,058.52^{***}$ (95.05)	0.001^{***} (0.000)
Family Income	0.000^{***} (0.000)	0.000^{***} (0.000)		0.000^{***} (0.000)
American Indian	-0.015^{***} (0.003)	0.002 (0.003)	$-4,489.67^{***}$ (477.59)	
Asian	0.001 (0.001)	0.032^{***} (0.002)	$-24,311.20^{***}$ (247.02)	
Pacific Islander	-0.004 (0.007)	-0.081^{***} (0.007)	$5,481.36^{***}$ (1,272.76)	
Black	-0.62^{***} (0.001)	$-.0.062^{***}$ (0.002)	$-46,690.56^{***}$ (194.28)	
Mexican	-0.015^{***} (0.002)	$-.009^{***}$ (0.003)	$-44,720.72^{***}$ (373.85)	
Puerto Rican	$-.002$ (0.003)	-0.070^{***} (0.004)	$-23,127.73^{***}$ (601.27)	
Other Latino	$-.019^{***}$ (0.003)	-0.021^{***} (0.003)	$-29,348.89^{***}$ (523.88)	
Other	-0.001 (0.002)	0.001 (0.003)	$-12,902.35^{***}$ (380.57)	
Constant	0.152^{***} (0.009)	3.172^{***} (0.013)	$87,699.84^{***}$ (1390.42)	0.906^{***} (0.005)
Year Dummies	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes
Institutional Dummies	Yes	Yes	Yes	Yes
No. of Obs	2,473,214	2,473,446	2,473,446	2,473,446

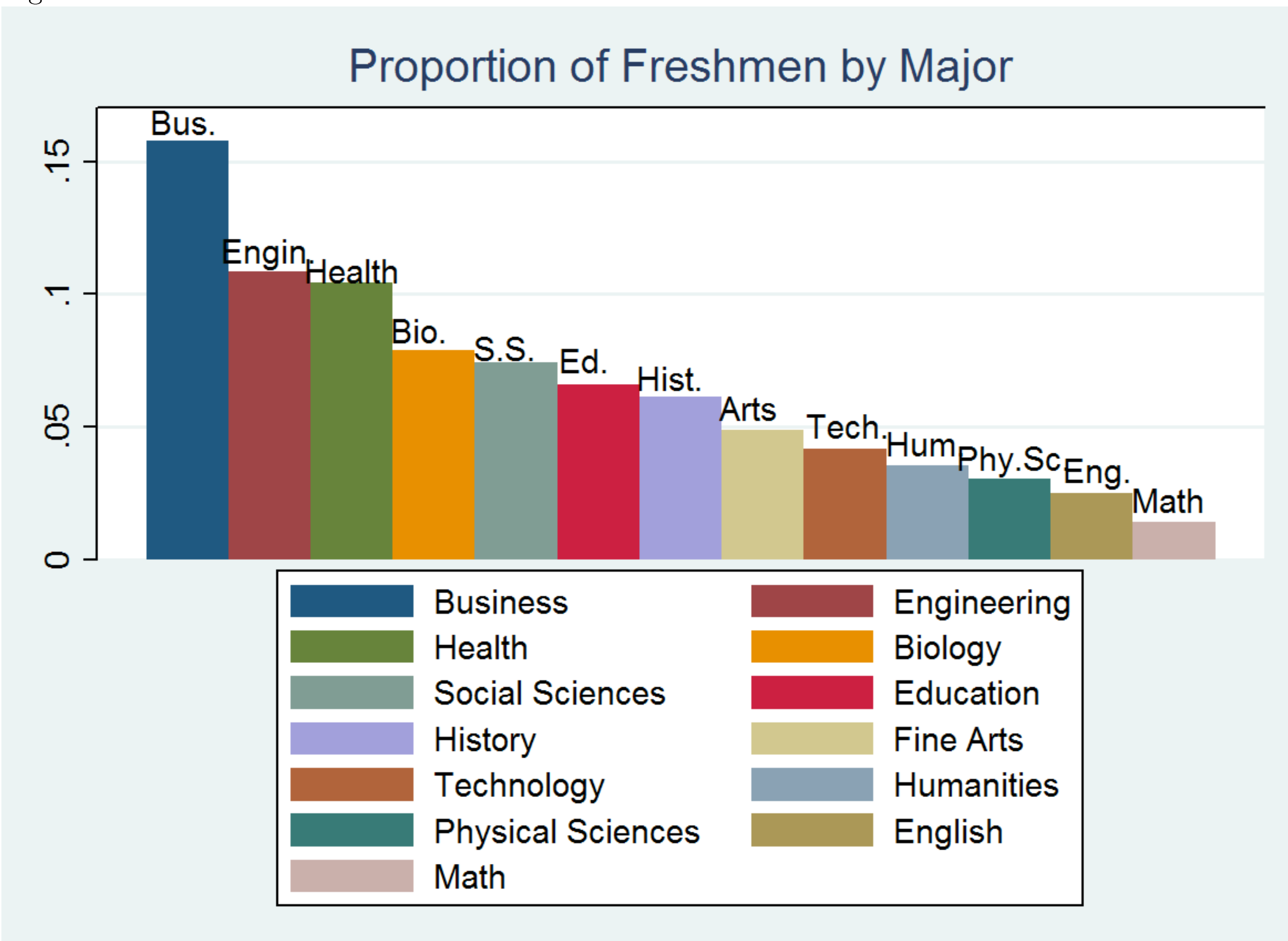
Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Robust standard errors in parentheses.

Table 11: Estimated OLS Enrollment Effects by Student Ability Measures

	HSGPA	SATM	SATV
Trough_t	-0.255^{***} (0.009)	-54.461^{***} (0.493)	-97.07^{***} (0.527)
Trough_{t-1}	0.051^{***} (0.007)	-12.657^{***} (0.454)	-14.17^{***} (0.497)
Trough_{t-2}	$-.025^{***}$ (0.007)	-10.109^{***} (0.452)	-10.19^{***} (0.494)
Trough_{t-3}	-0.325^{***} (0.009)	-49.271^{***} (0.492)	-95.17^{***} (0.524)
Trough_{t-4}	-0.284^{***} (0.007)	-62.721^{***} (0.518)	-95.96^{***} (0.539)
Male	-0.402^{***} (0.002)	32.104^{***} (0.149)	0.470^{***} (0.151)
Age	-0.117^{***} (0.002)	-9.757^{***} (0.148)	-10.676^{***} (0.159)
Family Income	0.000^{***} (0.000)	0.000^{***} (0.000)	0.000^{***} (0.000)
American Indian	-0.032^{***} (0.008)	7.102^{***} (0.674)	20.178^{***} (0.693)
Asian	-0.58^{***} (0.003)	23.969^{***} (0.250)	-20.654^{***} (0.287)
Pacific Islander	-0.037^{***} (0.017)	-19.455^{***} (1.463)	3.413^{**} (1.492)
Black	-0.838^{***} (0.004)	-73.000^{***} (0.371)	-57.757^{***} (0.373)
Mexican	-0.320^{***} (0.006)	-45.693^{***} (0.565)	-42.417^{***} (0.575)
Puerto Rican	-0.242^{**} (0.010)	-36.124^{***} (0.882)	-26.868^{***} (0.908)
Other Latino	-0.354^{***} (0.007)	-32.537^{***} (0.566)	-27.955^{***} (0.593)
Other	-0.176^{***} (0.006)	-8.598^{***} (0.457)	-8.305^{***} (0.482)
Constant	6.814^{***} (0.028)	599.875^{***} (2.626)	640.420^{***} (2.603)
Year Dummies	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes
Institutional Dummies	Yes	Yes	Yes
No. of Obs	2,459,140	1,218,382	1,215,170

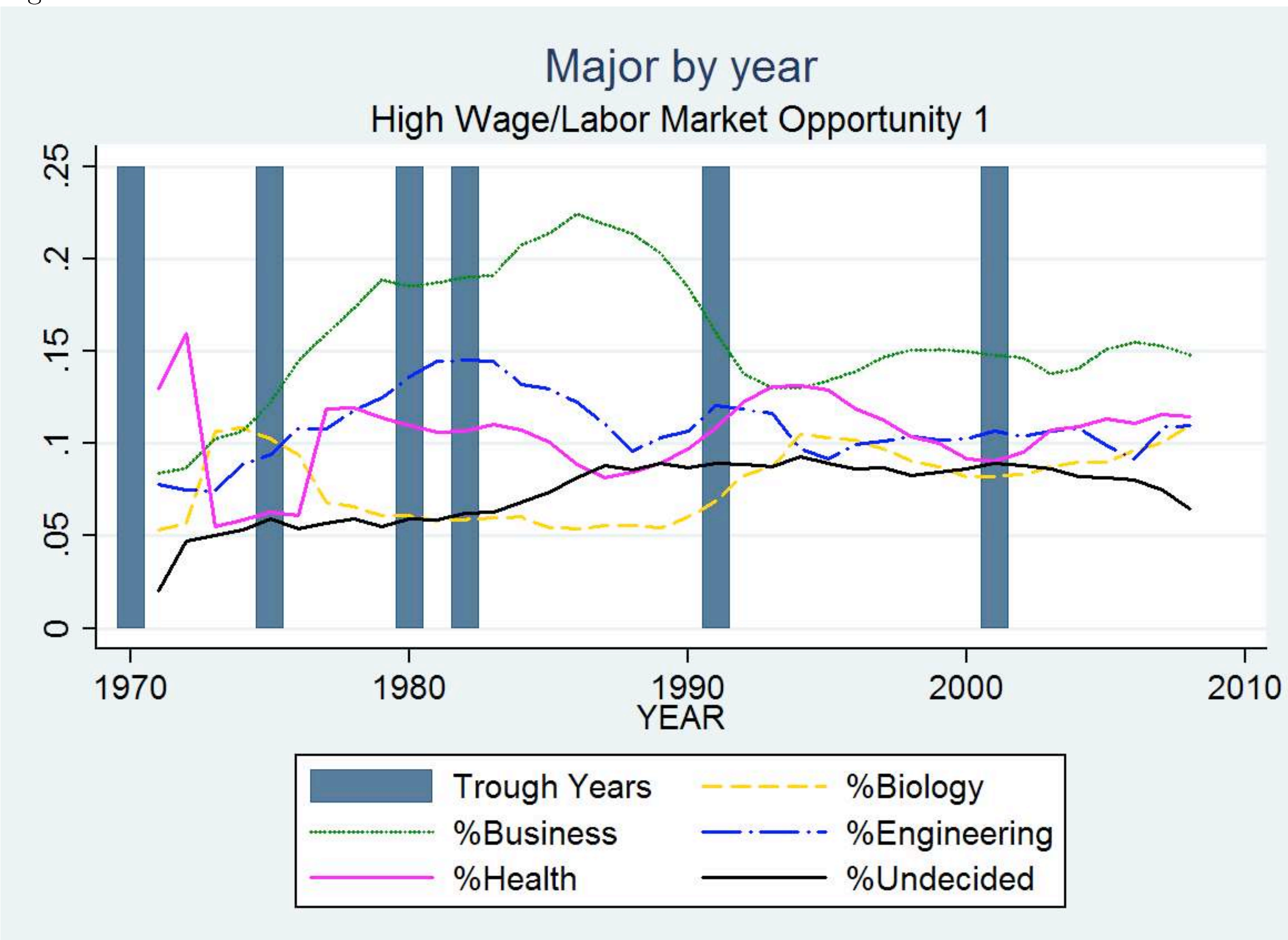
Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.
Robust standard errors in parentheses.

Figure 1:



Proportion of Freshmen by Major
0
.05
.1
.15
Bus.
Engin.
Health
Bio.
S.S.
Ed.
Hist.
Arts
Tech.
Hum
Phy.Sc
Eng.
Math
Business
Engineering
Health
Biology
Social Sciences
Education
History
Fine Arts
Technology
Humanities
Physical Sciences
English
Math

Figure 2:



Major by year
High Wage/Labor Market Opportunity 1
0
.05
.1
.15
.2
.25
1970
1980
1990
2000
2010
YEAR
Trough Years
%Biology
%Business
%Engineering
%Health
%Undecided

Figure 3:

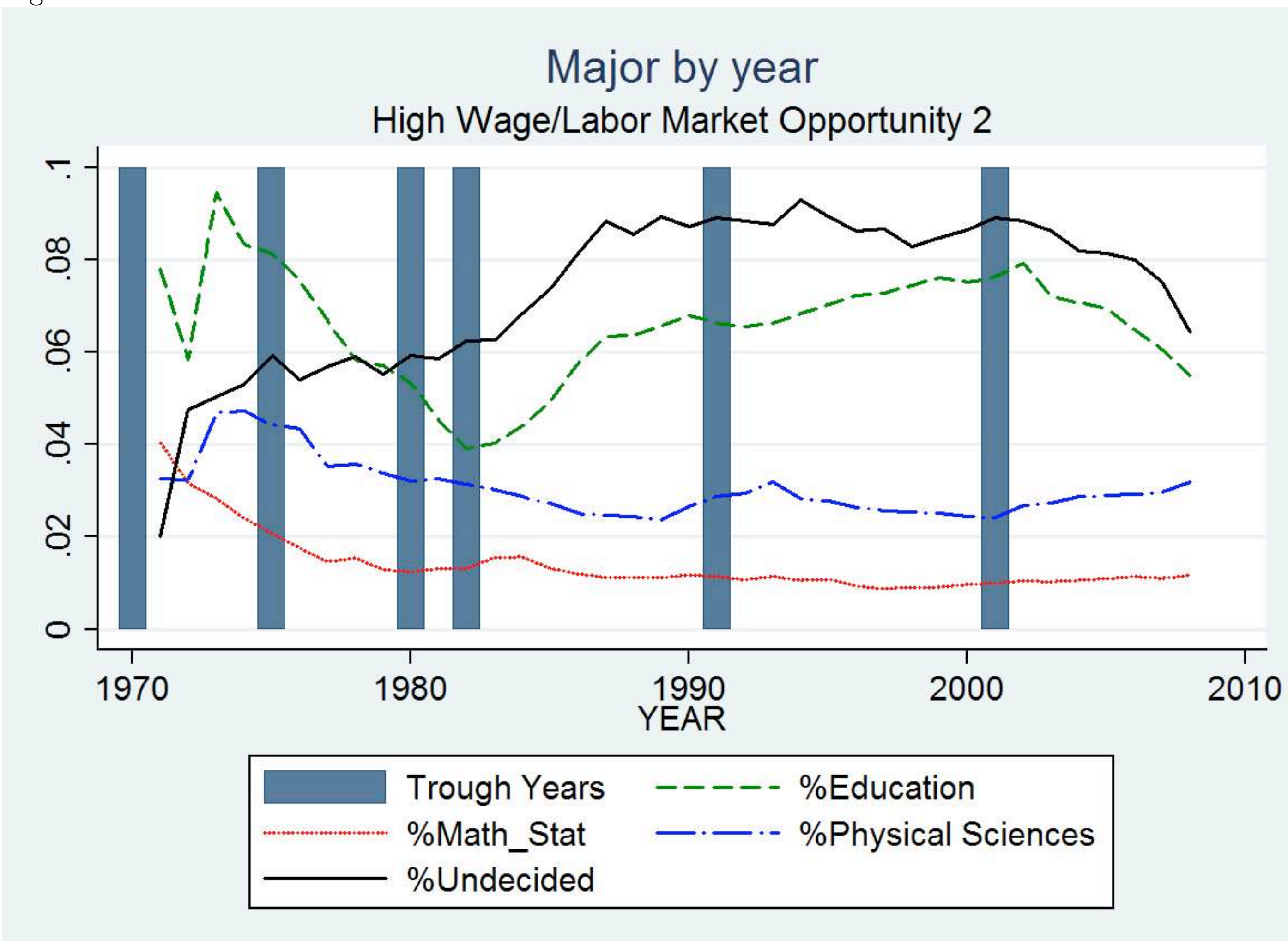
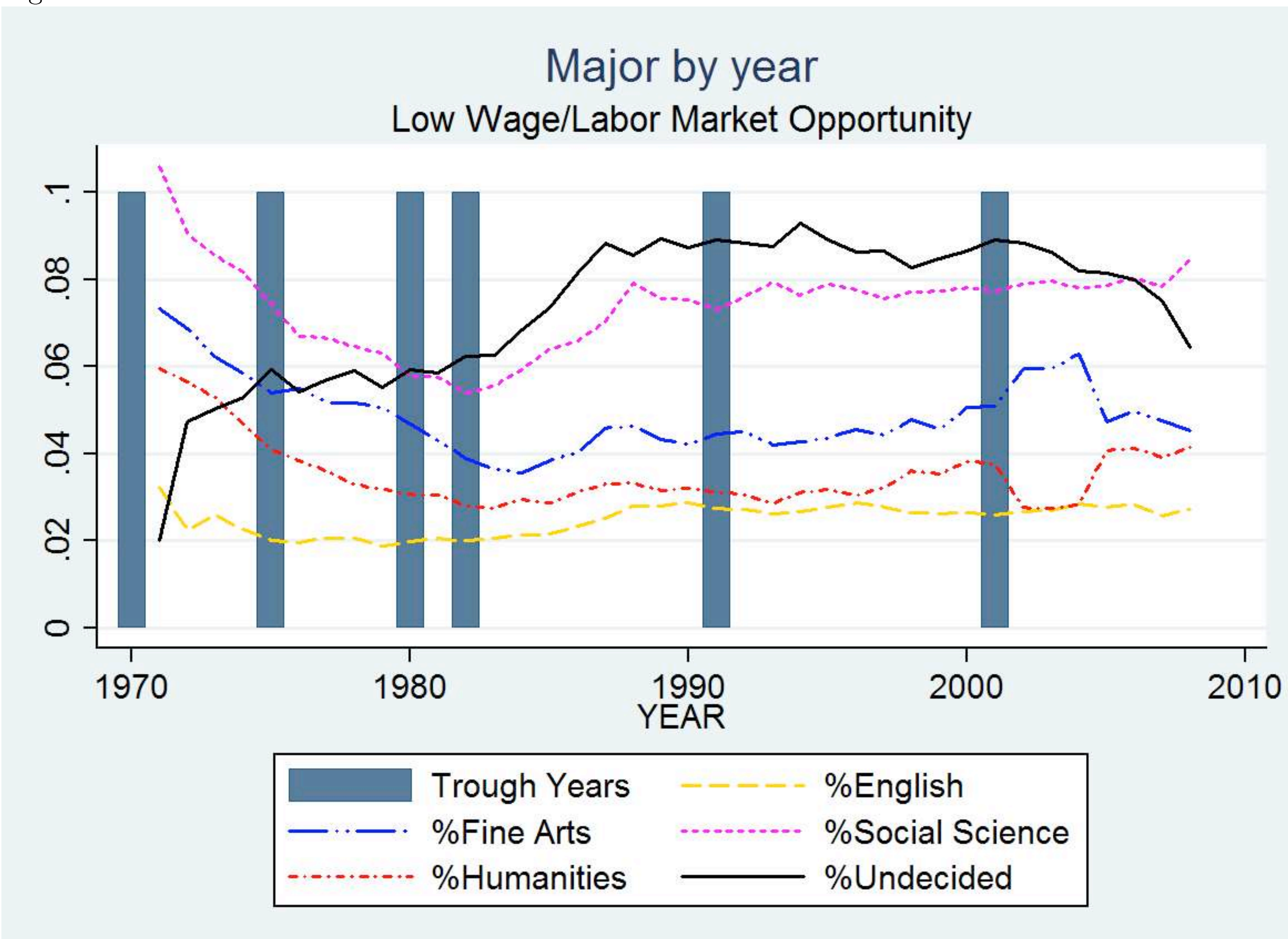

Major by year
High Wage/Labor Market Opportunity 2
0
.02
.04
.06
.08
.1
1970
1980
1990
2000
2010
YEAR
Trough Years
%Education
%Math_Stat
%Physical Sciences
%Undecided

Figure 4:



Major by year
Low Wage/Labor Market Opportunity
0
.02
.04
.06
.08
.1
1970
1980
1990
2000
2010
YEAR
Trough Years
%Fine Arts
%Humanities
%English
%Social Science
%Undecided

A Tables and Figures

Table A.1: Multinomial Logit Relative Risk Ratios for Full Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough_t	0.824*** (0.031)	1.900*** (0.069)	1.125*** (0.046)	1.984*** (0.076)	1.559*** (0.065)	1.468*** (0.055)
Trough_{t-1}	0.793*** (0.028)	0.962 (0.036)	1.308*** (0.049)	1.080** (0.039)	1.380*** (0.053)	0.899*** (0.031)
Trough_{t-2}	0.839*** (0.029)	0.968 (0.033)	1.245*** (0.047)	1.026 (0.0374)	1.370*** (0.050)	1.014 (0.036)
Trough_{t-3}	0.788*** (0.027)	0.882*** (0.029)	1.096** (0.041)	0.958 (0.034)	1.320*** (0.050)	0.933** (0.034)
Trough_{t-4}	0.809*** (0.028)	0.938* (0.032)	1.128*** (0.043)	0.917** (0.034)	1.041 (0.041)	0.966 (0.034)
Male	1.457*** (0.015)	2.579*** (0.025)	0.0705*** (0.008)	8.22*** (0.087)	1.691*** (0.019)	0.958*** (0.010)
American Indian	0.793*** (0.031)	0.570*** (0.022)	0.715*** (0.030)	0.691*** (0.029)	0.978 (0.041)	0.743*** (0.029)
Asian	2.910*** (0.060)	2.25*** (0.046)	0.810*** (0.022)	2.898*** (0.061)	1.524*** (0.037)	3.181*** (0.066)
Pacific Islander	0.777** (0.081)	0.741*** (0.078)	0.938 (0.116)	0.706*** (0.078)	0.903 (0.107)	1.068 (0.110)
Black	1.644*** (0.037)	1.921*** (0.041)	0.919*** (0.022)	2.093*** (0.047)	1.102*** (0.028)	1.831*** (0.040)
Mexican	1.161*** (0.040)	1.265*** (0.042)	1.068* (0.040)	1.168*** (0.042)	0.872*** (0.035)	1.301*** (0.044)
Puerto Rican	1.269*** (0.070)	1.161*** (0.063)	1.020 (0.061)	1.137** (0.064)	1.045 (0.065)	1.313*** (0.071)
Other Latino	1.403*** (0.058)	1.647*** (0.061)	0.816*** (0.040)	1.430*** (0.062)	1.229*** (0.058)	1.399*** (0.058)
Other	1.439*** (0.042)	1.143*** (0.033)	0.783*** (0.027)	1.268*** (0.039)	1.210*** (0.040)	1.327*** (0.039)
Family Income	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)
Age	0.913*** (0.008)	1.050*** (0.009)	1.070*** (0.010)	0.938*** (0.009)	0.999 (0.010)	0.966 (0.009)
Constant	5.457*** (0.416)	245.509*** (17.387)	12.772*** (0.961)	1.278*** (0.107)	2.716*** (.217)	7.921*** (0.591)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	2,100,515	2,100,515	2,100,515	2,100,515	2,100,515	2,100,515

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.2: Multinomial Logit Relative Risk Ratios for Full Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
Trough_t	1.155***	1.122***	1.354***	1.355***	1.003	4.008***
	(0.046)	(0.049)	(0.077)	(0.060)	(0.039)	(0.182)
Trough_{t-1}	1.078**	0.746***	0.911*	0.863***	0.977	1.790***
	(0.039)	(0.031)	(0.051)	(0.037)	(0.039)	(0.079)
Trough_{t-2}	1.119***	0.721***	0.896*	0.874***	0.979	1.505***
	(0.041)	(0.030)	(0.051)	(0.037)	(0.034)	(0.068)
Trough_{t-3}	1.044	0.697***	0.877**	0.866***	0.892***	1.166***
	(0.037)	(0.028)	(0.048)	(0.036)	(0.031)	(0.053)
Trough_{t-4}	1.061	1.020	0.906*	0.884***	0.924**	1.050
	(0.039)	(0.041)	(0.052)	(0.038)	(0.033)	(0.049)
Male	1.875***	1.167***	2.078***	3.179***	0.880***	4.512***
	(0.020)	(0.014)	(0.032)	(0.038)	(0.009)	(0.052)
American Indian	0.859***	1.140***	0.642***	0.948	0.835***	0.690***
	(0.035)	(0.049)	(0.046)	(0.045)	(0.033)	(0.032)
Asian	1.141***	0.920***	1.460***	1.750***	1.598***	3.547***
	(0.026)	(0.024)	(0.046)	(0.045)	(0.034)	(0.081)
Pacific Islander	0.901	0.951	0.648**	0.752**	0.732***	0.654***
	(0.102)	(0.121)	(0.123)	(.102)	(0.081)	(0.086)
Black	1.454***	1.063**	0.962	1.012	1.861***	2.515***
	(0.034)	(0.028)	(0.035)	(0.028)	(0.0413)	(0.060)
Mexican	1.316***	0.938	0.859***	0.900**	1.394***	1.100**
	(0.046)	(0.038)	(0.050)	(0.040)	(0.048)	(0.0466)
Puerto Rican	1.166***	1.188***	0.718***	0.930	1.468***	1.213***
	(0.067)	(0.074)	(0.077)	(0.066)	(0.080)	(0.075)
Other Latino	1.468***	1.191***	0.830***	0.925	1.575***	1.430***
	(0.062)	(0.057)	(0.062)	(0.051)	(0.065)	(0.072)
Other	1.224***	1.299***	0.868***	1.143***	1.237***	1.323***
	(0.037)	(0.043)	(0.045)	(0.041)	(0.0365)	(0.045)
Family Income	1.000*	1.000***	1.000***	1.000***	1.000***	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	1.004	1.020*	0.810***	0.904***	1.060***	0.966***
	(0.009)	(0.011)	(0.012)	(0.010)	(0.010)	(0.010)
Constant	2.204***	1.135	0.741***	0.712***	3.586***	0.862*
	(0.173)	(0.099)	(0.084)	(0.065)	(0.268)	(0.072)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	2,100,515	2,100,515	2,100,515	2,100,515	2,100,515	2,100,515

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.3: Multinomial Logit Relative Risk Ratios for Female Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough_t	0.741***	2.277***	1.343***	2.037***	1.635***	1.340***
	(0.034)	(0.063)	(0.064)	(0.111)	(0.083)	(0.059)
Trough_{t-1}	0.862***	1.096**	1.478***	1.047	1.443***	0.957
	(0.036)	(0.046)	(0.650)	().055)	(0.068)	(0.039)
Trough_{t-2}	0.895***	1.060	1.366***	0.988	1.432***	1.061
	(0.037)	(0.045)	(0.061)	(0.053)	(0.068)	(0.044)
Trough_{t-3}	0.850***	0.964	1.204***	0.900**	1.400***	0.985
	(0.034)	(0.040)	(0.053)	(0.047)	(0.050)	(0.030)
Trough_{t-4}	0.824***	0.985	1.204***	0.839***	1.032	0.977
	(0.034)	(0.042)	(0.054)	(0.045)	(0.052)	(0.040)
American Indian	0.798***	0.596***	0.723***	0.726***	1.030	0.772***
	(0.038)	(0.028)	(0.036)	(0.043)	(0.054)	(0.035)
Asian	2.473***	2.591***	0.767***	2.966***	1.562***	2.665***
	(0.059)	(0.063)	(0.024)	(0.082)	(0.045)	(0.064)
Pacific Islander	0.852	0.800*	0.932	0.812	0.864	1.143
	(0.105)	(0.100)	(0.135)	(0.122)	(0.124)	(0.137)
Black	1.670***	1.953***	0.786***	2.767***	0.888***	1.862***
	(0.049)	(0.050)	(0.023)	(0.081)	(0.028)	(0.047)
Mexican	1.178***	1.471***	1.062	1.415***	0.805***	1.263***
	(0.049)	(0.060)	(0.048)	(0.072)	(0.0410)	(0.052)
Puerto Rican	1.302***	1.173**	0.969	1.228***	1.003	1.281***
	(0.085)	(0.077)	(0.068)	(0.097)	(0.077)	(0.082)
Other Latino	1.404***	1.272***	0.838***	1.510***	1.274***	1.407***
	(0.069)	(0.046)	(0.048)	(0.092)	(0.074)	(0.069)
Other	1.455***	1.271***	0.782***	1.366***	1.291***	1.321***
	(0.051)	(0.046)	(0.032)	(0.060)	(0.053)	(0.047)
Family Income	1.000***	1.000***	1.000***	1.000***	1.000***	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.941***	1.047***	1.074***	0.932***	1.053***	1.016
	(0.011)	(0.012)	(0.013)	(0.013)	(0.014)	(0.011)
Constant	5.194***	261.581***	13.621***	0.797	2.816***	8.767***
	(0.491)	(23.193)	(1.244)	(0.113)	(0.283)	(0.795)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	1,102,014	1,102,014	1,102,014	1,102,014	1,102,014	1,102,014

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.4: Multinomial Logit Relative Risk Ratios for Female Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
Trough_t	1.142***	1.200***	1.496***	1.076	1.080*	8.423***
	(0.056)	(0.062)	(0.116)	(0.066)	(0.049)	(0.573)
Trough_{t-1}	1.118**	0.775***	1.049	0.896*	1.090**	1.671***
	(0.050)	(0.038)	(0.080)	(0.051)	(0.045)	(0.122)
Trough_{t-2}	1.180***	0.753***	0.937	0.930	1.092**	1.438***
	(0.052)	(0.038)	(0.073)	(0.053)	(0.046)	(0.108)
Trough_{t-3}	1.109**	0.734***	0.943	0.914	0.981	1.216***
	(0.049)	(0.036)	(0.072)	(0.051)	(0.041)	(0.091)
Trough_{t-4}	1.010**	1.053	0.925	0.916	0.981	1.132
	(0.050)	(0.051)	(0.072)	(0.052)	(0.041)	(0.087)
American Indian	0.925	1.184***	0.618***	0.914	0.847***	0.646***
	(0.046)	(0.061)	(0.061)	(0.059)	(0.039)	(0.043)
Asian	1.198***	0.869***	1.452***	1.668***	1.437***	4.145***
	(0.032)	(0.027)	(0.060)	(0.053)	(0.036)	(0.128)
Pacific Islander	0.905	0.906	0.587**	0.723*	0.790*	0.853
	(0.122)	(0.139)	(0.158)	(0.131)	(0.102)	(0.158)
Black	1.498***	0.981	1.011	1.207***	1.822***	3.260***
	(0.041)	(0.031)	(0.047)	(0.043)	(0.047)	(0.097)
Mexican	1.414***	0.966	0.929	1.008	1.467***	1.368***
	(0.061)	(0.047)	(0.071)	(0.067)	(0.60)	(0.083)
Puerto Rican	1.223***	1.102	0.760**	1.022	1.482***	1.213**
	(0.084)	(0.082)	(0.099)	(0.096)	(0.94)	(0.105)
Other Latino	1.594***	1.182***	0.745***	0.904	1.645***	1.601***
	(0.081)	(0.068)	(0.080)	(0.067)	(0.80)	(0.122)
Other	1.353***	1.288***	0.834**	1.214***	1.258***	1.470***
	(0.050)	(0.051)	(0.060)	(0.060)	(0.045)	(0.073)
Family Income	1.000**	1.000***	1.000***	1.000***	1.000***	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	1.017	1.015	0.836***	0.934***	1.059***	1.036**
	(0.013)	(0.014)	(0.18)	(0.015)	(0.012)	(0.015)
Constant	1.815***	1.453***	0.689**	0.845	4.462***	0.523***
	(0.182)	(0.156)	(0.106)	(0.109)	(0.405)	(0.064)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	1,102,014	1,102,014	1,102,014	1,102,014	1,102,014	1,102,014

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.5: Multinomial Logit Relative Risk Ratios for Male Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough_t	0.918	1.535***	0.692***	1.769***	1.360***	1.848***
	(0.065)	(0.103)	(0.056)	(0.120)	(0.103)	(0.131)
Trough_{t-1}	0.650***	0.776***	0.976	0.940	1.181**	0.776***
	(0.042)	(0.048)	(0.069)	(0.058)	(0.081)	(0.051)
Trough_{t-2}	0.712***	0.814***	1.000	0.909	1.189**	0.918
	(0.046)	(0.051)	(0.072)	(0.057)	(0.083)	(0.061)
Trough_{t-3}	0.657***	0.736***	0.885*	0.843***	1.122*	0.823**
	(0.041)	(0.045)	(0.062)	(0.052)	(0.076)	(0.054)
Trough_{t-4}	0.757***	0.854**	0.963	0.874**	1.008	0.943
	(0.050)	(0.054)	(0.071)	(0.056)	(0.072)	(0.064)
American Indian	0.757***	0.523***	0.718***	0.636***	0.891	0.656***
	(0.054)	(0.035)	(0.568)	(0.043)	(0.066)	(0.047)
Asian	3.972***	2.186***	0.927	3.238***	1.543***	4.798***
	(0.163)	(0.090)	()0.053	(0.132)	(0.071)	(0.199)
Pacific Islander	0.644**	0.632**	0.995	0.606**	0.912	0.953
	(0.130)	(0.125)	(0.240)	(0.120)	(0.200)	(0.191)
Black	1.541***	1.849***	1.436***	1.757***	1.492***	1.623***
	(0.067)	(0.076)	(0.067)	(0.073)	(0.068)	(0.070)
Mexican	1.085	1.025	1.136*	0.985	0.922	1.393***
	(0.067)	(0.061)	(0.080)	(0.059)	(0.063)	(0.086)
Puerto Rican	1.203*	1.155	1.179	1.121	1.093	1.354***
	(0.124)	(0.114)	(0.134)	(0.111)	(0.121)	(0.140)
Other Latino	1.356***	1.428***	0.800**	1.310***	1.127	1.379***
	(0.103)	(0.105)	(0.076)	(0.097)	(0.094)	(0.108)
Other	1.366***	0.984	0.804***	1.144***	1.069	1.324***
	(0.069)	(0.049)	(0.052)	(0.057)	(0.060)	(0.069)
Family Income	1.000***	1.000***	1.000***	1.000***	1.000***	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.875***	1.027*	1.058***	0.908***	0.937***	0.883***
	(0.013)	(0.014)	(0.017)	(0.013)	(0.014)	(0.013)
Constant	9.256***	720.087***	10.660***	14.727***	6.153***	7.038***
	(1.245)	(90.200)	(1.471)	(1.967)	(0.857)	(0.961)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	998,931	998,931	998,931	998,931	998,931	998,931

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.6: Multinomial Logit Relative Risk Ratios for Male Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
$Trough_t$	1.083 (0.077)	0.977 (0.079)	1.141 (0.103)	1.426*** (0.106)	0.842** (0.062)	2.397*** (0.179)
$Trough_{t-1}$	0.928 (0.060)	0.671*** (0.050)	0.715*** (0.062)	0.742*** (0.052)	0.748*** (0.0496)	1.556*** (0.107)
$Trough_{t-2}$	0.953 (0.062)	0.642*** (0.049)	0.778*** (0.068)	0.745*** (0.053)	0.744*** (0.050)	1.320*** (0.093)
$Trough_{t-3}$	0.881** (0.056)	0.607*** (0.045)	0.742*** (0.063)	0.738*** (0.051)	0.697*** (0.046)	0.988 (0.069)
$Trough_{t-4}$	0.958 (0.064)	0.926 (0.069)	0.845** (0.074)	0.814*** (0.058)	0.797*** (0.054)	0.946 (0.069)
American Indian	0.740*** (0.053)	1.049 (0.082)	0.646*** (0.070)	0.917 (0.070)	0.814*** (0.060)	0.677*** (0.050)
Asian	1.138*** (0.050)	1.085 (0.056)	1.645*** (0.088)	2.023*** (0.090)	2.175*** (0.094)	3.749*** (0.159)
Pacific Islander	0.835 (0.176)	1.014 (0.235)	0.663 (0.192)	0.712 (0.162)	0.595** (0.129)	0.529*** (0.116)
Black	1.327*** (0.058)	1.247*** (0.063)	0.872** (0.054)	0.834*** (0.041)	1.988*** (0.087)	2.011*** (0.087)
Mexican	1.107 (0.069)	0.874*** (0.063)	0.753*** (0.067)	0.755*** (0.053)	1.227*** (0.078)	0.899 (0.060)
Puerto Rican	1.110 (0.115)	1.389*** (0.160)	0.675** (0.109)	0.866 (0.101)	1.396*** (0.147)	1.205* (0.126)
Other Latino	1.274*** (0.097)	1.214** (0.107)	0.874 (0.098)	0.883 (0.077)	1.425*** (0.111)	1.292*** (0.103)
Other	1.030 (0.054)	1.310*** (0.075)	0.858** (0.065)	1.023 (0.058)	1.202*** (0.0639)	1.180*** (0.063)
Family Income	1.000 (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000 (0.000)	1.000*** (0.000)
Age	0.974* (0.014)	1.021 (0.017)	0.774*** (0.016)	0.873*** (0.014)	1.062*** (0.016)	0.912*** (0.013)
Constant	6.503*** (0.875)	1.021 (0.157)	2.039*** (0.366)	2.235*** (0.324)	2.395*** (0.329)	6.206*** (0.837)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	998,931	998,931	998,931	998,931	998,931	998,931

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.
Standard errors in parentheses.
Using English as the reference major.

Table A.7: Multinomial Logit Relative Risk Ratios for White Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough_t	0.820***	1.911***	1.091**	1.892***	1.511***	1.398***
	(0.034)	(0.074)	(0.047)	(0.078)	(0.067)	(0.056)
Trough_{t-1}	0.793***	0.946	1.296***	1.038	1.369***	0.870***
	(0.031)	(0.035)	(0.052)	(0.041)	(0.057)	(0.033)
Trough_{t-2}	0.830***	0.966	1.246***	1.013	1.378***	0.970
	(0.032)	(0.036)	(0.051)	(0.041)	(0.058)	(0.038)
Trough_{t-3}	0.768***	0.877***	1.071*	0.949	1.312***	0.890***
	(0.029)	(0.032)	(0.043)	(0.037)	(0.054)	(0.034)
Trough_{t-4}	0.823***	0.943	1.130***	0.907**	1.055	0.938
	(0.032)	(0.036)	(0.047)	(0.037)	(0.046)	(0.037)
Male	1.419***	2.658***	0.677***	8.845***	1.672***	0.920***
	(0.016)	(0.027)	(0.008)	(0.102)	(0.020)	(0.010)
Family Income	1.000***	1.000***	1.000***	1.000***	1.000***	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.917***	1.029***	1.052***	0.899***	0.969***	0.975**
	(0.009)	(0.010)	(0.011)	(0.009)	(0.010)	(0.010)
Constant	5.239***	260.495***	13.246***	1.346***	2.837***	7.708***
	(0.433)	(19.883)	(1.068)	(0.123)	(0.244)	(0.624)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	1,744,144	1,744,144	1,744,144	1,744,144	1,744,144	1,744,144

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.8: Multinomial Logit Relative Risk Ratios for White Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
Trough_t	1.105**	1.079*	1.329***	1.314***	1.012	3.684***
	(0.046)	(0.049)	(0.081)	(0.062)	(0.042)	(0.182)
Trough_{t-1}	1.045	0.733***	0.897*	0.862***	0.985	1.696***
	(0.041)	(0.033)	(0.055)	(0.040)	(0.038)	(0.084)
Trough_{t-2}	1.112***	0.704***	0.908	0.883***	0.983	1.462***
	(0.044)	(0.032)	(0.056)	(0.041)	(0.039)	(0.074)
Trough_{t-3}	1.019	0.679***	0.878**	0.846***	0.887***	1.156***
	(0.040)	(0.030)	(0.053)	(0.039)	(0.034)	(0.058)
Trough_{t-4}	1.074*	1.006	0.919	0.896**	0.944	1.025
	(0.043)	(0.044)	(0.057)	(0.042)	(0.037)	(0.054)
Male	1.938***	1.146***	2.077***	3.274***	0.852***	4.776***
	(0.021)	(0.014)	(0.034)	(0.042)	(0.010)	(0.060)
Family Income	1.000	1.000***	1.000***	1.000***	1.000	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.993	1.007	0.750***	0.868***	1.045***	0.931***
	(0.10)	(0.012)	(0.012)	(0.010)	(0.011)	(0.010)
Constant	2.188***	1.083	0.941	0.821**	3.202***	1.080
	(0.185)	(0.101)	(0.114)	(0.080)	(0.259)	(0.098)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	1,744,144	1,744,144	1,744,144	1,744,144	1,744,144	1,744,144

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.9: Multinomial Logit Relative Risk Ratios for Black Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough_t	1.157	3.398***	2.097***	3.780***	2.494***	2.197***
	(0.209)	(0.593)	(0.411)	(0.687)	(0.497)	(0.387)
Trough_{t-1}	1.134	1.423**	1.658***	1.661***	1.780***	1.179
	(0.160)	(0.198)	(0.260)	(0.246)	(0.288)	(0.165)
Trough_{t-2}	0.953	1.214	1.354**	1.327*	1.600***	1.228
	(0.130)	(0.163)	(0.209)	(0.192)	(0.253)	(0.166)
Trough_{t-3}	1.209	1.386**	1.629***	1.434**	1.951***	1.391**
	(0.170)	(0.193)	(0.258)	(0.215)	(0.315)	(0.194)
Trough_{t-4}	0.856	1.274*	1.289*	1.115	1.211	1.198
	(0.117)	(0.170)	(0.198)	(0.161)	(0.195)	(0.160)
Male	1.333***	2.746***	1.520***	6.135***	3.030***	0.822***
	(0.072)	(0.142)	(0.087)	(0.331)	(0.176)	(0.044)
Family Income	1.000***	1.000	1.000***	1.000***	1.000	1.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.903***	0.981	1.093**	0.898***	0.989	0.929**
	(0.032)	(0.033)	(0.040)	(0.032)	(0.038)	(0.032)
Constant	7.674***	97.803***	4.005***	1.219	1.697	13.469***
	(2.969)	(35.555)	(1.576)	(0.489)	(0.707)	(5.009)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	136,832	136,832	136,832	136,832	136,832	136,832

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.

Table A.10: Multinomial Logit Relative Risk Ratios for Black Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
Trough_t	2.125***	1.456*	2.066**	1.803***	1.550**	7.268***
	(0.395)	(0.302)	(0.613)	(0.388)	(0.277)	(1.404)
Trough_{t-1}	1.607***	0.673**	1.579*	0.922	1.267*	2.403***
	(0.238)	(0.121)	(0.402)	(0.172)	(0.178)	(0.397)
Trough_{t-2}	1.327**	0.689**	1.177	1.041	1.079	1.762***
	(0.191)	(0.118)	(0.304)	(0.183)	(0.147)	(0.289)
Trough_{t-3}	1.580***	0.836	1.698**	1.223	1.355**	1.712***
	(0.235)	(0.144)	(0.427)	(0.220)	(0.190)	(0.294)
Trough_{t-4}	1.189	1.115	1.028	0.990	1.151	1.280
	(0.172)	(0.178)	(0.271)	(0.174)	(0.155)	(0.214)
Male	1.713***	1.518***	2.119***	2.338***	0.937	3.331***
	(0.095)	(0.095)	(0.176)	(0.151)	(0.051)	(0.183)
Family Income	1.000	1.000	1.000***	1.000***	1.000***	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.960	0.969	0.850***	0.907**	1.034	0.931**
	(0.035)	(0.041)	(0.052)	(0.041)	(0.036)	(0.034)
Constant	2.287**	1.853	0.196**	0.566	7.290***	1.838
	(0.935)	(0.828)	(0.135)	(0.282)	(2.718)	(0.729)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	136,832	136,832	136,832	136,832	136,832	136,832

Notes: * p <0.10, ** p <0.05 level, *** p <0.01 level.
Standard errors in parentheses.
Using English as the reference major.