

# The Effect of Title IX on Gender Disparity in Graduate Education\*

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## Abstract

This paper examines whether Title IX of the Education Amendments of 1972, which banned sex discrimination in admissions, was successful in reducing gender disparity in graduate education. Using administrative school-level data and a national survey of college degree-holders, I find that female enrollment at graduate schools increased by an average of 18.7 percent following Title IX's passage. This phenomenon was mainly driven by schools that had greater incentive to comply with the new law. I also find evidence that Title IX reduced gender disparities across degree fields; women were 59 percent, on average, more likely to pursue a traditionally-male field after Title IX. In contrast, traditionally-female fields experienced an average decline of 9.7 percent. These results are robust to alternative explanations, such as the end of the Vietnam War draft, law changes related to fertility, and other events that occurred between the late 1960s and early 1970s that may also have affected female educational decisions.

Keywords: Title IX, gender inequality, education  
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# 1 Introduction

One of the most striking changes in American society, and indeed almost all developed nations, is convergence in labor market outcomes between men and women. In 1960, less than 4 of 10 women were participating in the labor force. In 2000, the female labor force participation rate was 60 percent.<sup>1</sup> Not only did women enter the workforce in large numbers, but they entered high-skilled, male-dominated occupations. For example, the share of female lawyers and judges increased from 4 percent to 34 percent between 1960 and 2000.<sup>2</sup> It has been a goal of public policy for decades to reduce these gender disparities. The best available research on what has contributed to this convergence, however, focuses on technological changes around fertility and demand factors, such as a rise in skill demand, rather than direct legal attempts to legislate away sex discrimination in education.<sup>3</sup>

In 1972, Congress passed Title IX of the Education Amendments, which banned the use of quotas, sex-specific rankings, and other forms of sex discrimination in admissions to graduate programs.<sup>4</sup> The law was introduced to give women “an equal chance to attend the schools of their choice, to develop the skills they want, and to apply those skills [in the labor market]”.<sup>5</sup> The goal of this paper is to empirically assess whether this policy was effective in reducing sex discrimination in education.

Using administrative school-level data and a national survey of college degree-holders, I find that female enrollment at graduate schools increased by an average of 18.7 percent following Title IX’s passage. This phenomenon was mainly driven by schools that had greater

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<sup>1</sup>These statistics are from the U.S. Bureau of Labor Statistics and were retrieved from FRED at <https://fred.stlouisfed.org/series/LNS11300002>.

<sup>2</sup>These statistics are based off the 1960 and 2000 Census IPUMS 5 percent samples for people aged 18 to 55.

<sup>3</sup>See, for example, [Heckman and Sedlacek \(1985\)](#), [Smith and Ward \(1985\)](#), [Smith and Ward \(1989\)](#), [Blau and Kahn \(1997\)](#), [Blau and Kahn \(2006\)](#), [Blau et al. \(2000\)](#), [Black and Juhn \(2000\)](#), and [Mulligan and Rubinstein \(2008\)](#) for research on demand factors. For research on the role of fertility, see [Bailey \(2006, 2010\)](#); [Goldin \(1988\)](#); [Goldin and Katz \(2002\)](#); [Myers \(2017\)](#).

<sup>4</sup>Department of Health, Education, and Welfare. “Nondiscrimination On the Basis of Sex,” *Federal Register* 40, no. 108 (June 4, 1975): 24128.

<sup>5</sup>Senator Bayh, speaking on S. 5808, on February 28, 1972, 92nd Congress, 2nd session, *Congressional Record* 118, pt. 29. Retrieved from <https://www.govinfo.gov/app/details/GPO-CRECB-1972-pt29/GPO-CRECB-1972-pt29-1/summary>.

incentive to comply with the new law. I also find evidence that Title IX reduced gender disparities across degree fields; women were 59 percent, on average, more likely to pursue a traditionally-male field after Title IX. In contrast, traditionally-female fields experienced an average decline of 9.7 percent. These results are robust to alternative explanations, such as the end of the Vietnam War draft, law changes related to fertility, and other events that occurred between the late 1960s and early 1970s that may also have affected female educational decisions.

My findings provide an indirect test for the presence of gender discrimination in graduate education. One explanation put forth for low female representation in male-dominated fields is that female preferences differ from male preferences ([Kahn and Ginther, 2017](#); [Teig and Susskind, 2008](#); [Zafar, 2013](#)).<sup>6</sup> That is, there are few females in, say, law and engineering because males differentially prefer these fields. If this were true, a removal of barriers to entry would have no effect on female share in these fields. In other words, even if admissions quotas for women at law schools were removed, we would still see few female J.D.s relative to male J.D.s because women have a distaste for law. Contrary to this theory, however, I find that traditionally-male fields experienced greater female growth after Title IX.

This paper has two major contributions. First and foremost, my findings contribute to the literature on Title IX, which is largely associated with athletics. One of the seminal papers on Title IX, for example, finds that it increased female college attendance and labor market participation by increasing female participation in high school athletic programs ([Stevenson, 2010](#)). Increased athletic opportunities through Title IX also had positive impacts on health outcomes for these women and their children ([Kaestner and Xu, 2006, 2010](#); [Schulkind, 2017](#)). In regards to educational outcomes, prior research has found positive impacts, but most are historical accounts or qualitative studies ([Buek and Orleans, 1973](#); [Department of Justice, 2012](#); [Mason and Younger, 2014](#); [Stromquist, 1993](#); [Valentin, 1997](#)). One exception is [Guldi \(2016\)](#), which uses geographic variation in teen motherhood rates and finds that Title

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<sup>6</sup>For example, [Zafar \(2013\)](#) finds that 60% of the gender gap in engineering is due to differences in preferences.

IX, which banned schools from excluding pregnant or parenting teens from the classroom, improved teen mothers' educational outcomes. My paper seeks to estimate the impact of Title IX on reducing gender disparity in graduate degree fields.

Second, I contribute to the literature on the effectiveness of anti-discrimination laws. This literature is quite extensive, covering racial discrimination laws ([Chay, 1998](#); [Donohue III and Heckman, 1991](#); [Heckman and Payner, 1989](#); [Neumark and Stock, 2006](#)), sex discrimination laws ([Beller, 1977, 1982a,b](#); [Myers, 2007](#); [Neumark and Stock, 2006](#)), disability discrimination laws ([Acemoglu and Angrist, 2001](#); [Beegle and Stock, 2003](#)), and age discrimination laws ([Neumark and Stock, 1999](#)). In examining sex discrimination laws, my paper is similar to [Beller \(1982b\)](#), which looks at the effect of equal opportunity (EO) policy on female occupational choices. The author finds that women exposed to EO laws in schooling and the labor market are more likely to be employed in traditionally-male occupations, but does not focus on schooling outcomes. In contrast, I focus on the effectiveness of a sex discrimination law on educational outcomes, which has been less studied.

I begin the remainder of the paper with background on Title IX ([Section 2](#)). [Section 3](#) describes the data and presents summary statistics on the gender disparity in graduate education. In [Section 4](#), I present motivating evidence that women began pursuing traditionally-male degrees right around the time of Title IX's passage. [Section 5](#) describes my empirical strategy, and [Section 6](#) presents results. Main alternative explanations are explored in [Section 7](#). I conclude with a discussion in [Section 8](#).

## 2 Background

### 2.1 The Status of Women in Education

The 1960s saw a colossal expansion of women's rights. President John F. Kennedy was elected into office on the promise of a New Frontier, ready to confront previously unconquered problems of social and civil injustice. As such, he signed the Equal Pay Act of 1963 into

law, banning wage disparity based on sex. One year later, the Civil Rights Act of 1964 was passed—a landmark piece of civil rights legislation that prohibited racial segregation in schools. However, it made no explicit mention of gender discrimination in educational institutions.

On May 24, 1965, U.S. News and World Report published a story on gender discrimination in university admissions policies. Reporters surveyed 1,619 co-educational U.S. colleges and found that though few have official quotas for female enrollment, the majority acknowledge an unofficial practice to maintain the level of boys to girls. The policy differs by school, but “almost always it calls for more boys than girls” ([U.S. News & World Report, 1965](#), p. 54).

The article caught the attention of Representative Edith Green, who was Chairman of the Special Subcommittee on Education in the House at the time ([Green, 1965](#)). Representative Green, seeking to pass a higher education bill that addressed gender bias in education, held Congressional Hearings on June 17, 1970.<sup>7</sup> For seven days, hearing after hearing, statement after statement revealed the dire status of a woman’s place in education. The statement of Professor Ann Sutherland Harris, Assistant Professor of Art History at Columbia University, summarized it best:

The rule is a simple one: the higher, the fewer. Although more women than men finish high school (and this has been true since 1920), fewer women than men go on to college, largely because it is harder for a woman to gain entrance to college with the necessary financial support. Fewer women than men go on to get higher degrees, again largely because graduate departments discriminate against women in admissions policies and in the distribution of fellowships. Once they qualify, the higher-the-fewer rule continues to apply: the higher in terms of rank, salary, prestige or responsibility, the fewer the number of women to be found. ([U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970](#), p. 224-245)

Two clear facts about admissions policies emerged from the 1970 Congressional Hearings. First, sex bias existed in both undergraduate and graduate admissions and was prevalent

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<sup>7</sup>The higher education bill was Section 805 of H.R. 16098 or the Omnibus Post-Secondary Education Act of 1970. The 1970 Congressional Hearings are considered to be the impetus for the development of Title IX.

across all disciplines. For example, undergraduate admission to University of North Carolina was restricted to females “who are especially well-qualified”, but no such restriction for male applicants existed (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 739). In the State of Virginia, 21,000 women were rejected for college entrance over a 3-year period while not one male student was rejected (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 739). At Cornell University, studies on the status of women found that “there were quotas on women applicants operating at all the schools” (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 1077). According to one testimony, when the Dean of Admissions at New York University Law School was approached with the idea of actively recruiting female law students, he responded that there were already too many women and that NYU did not need classes composed of 50 percent women (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 587). According to another testimony, the Dean at Harvard Law School stated that female enrollment at Harvard Law would probably stay at 5 percent of the class as “that was Yale Law School’s percentage; and...after all, there could never be a great influx of women into the school...because the policy was never to give any man’s place to a woman” (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 587).

Second, school administrators and applicants both knew that women faced barriers in pursuing graduate programs that men may not have faced. The U.S. News and World Report article publicized this fact, which was supported by testimonies from the 1970 Congressional Hearings. For example, Professor Ann Sutherland Harris recounted stories of her colleagues complaining that women undergraduates needed A or A- grades for graduate school admission while their male counterparts were admitted with B averages (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 248). A University of Chicago Report (hereafter Chicago Report) on the status of its women found

that 34 percent of graduate women had grade point averages of A or A-, while the corresponding fraction for graduate men was 27 percent (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 798). In the State School of Agriculture at Cornell, “the mean SAT scores of entering women freshmen are higher than those of men by 30-40 points” (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 1077).<sup>8</sup> A 1970 study at the University of Wisconsin found that male applicants were preferred over identical female applicants at lower levels of ability.<sup>9</sup>

Part of the problem was a widely-held belief by school administrators that women were not committed students. This was often used as an explanation by school officials when asked why women were discriminated against in admissions (U.S. Congress. House. Committee on Education and Labor. Special Subcommittee on Education, 1970, p. 248). For example, a 1970 report by the American Historical Association (AHA) on the status of women in the profession states that one prohibitive reason for women obtaining Ph.D.s is the notion that women “prefer to marry and devote themselves to domestic life”.<sup>10</sup> The AHA report’s final recommendations included objectives to “remove existing disabilities and to establish a genuine parity for women historians”, including the adoption of a formal position of disapproval of gender discrimination in graduate school admissions, grants, and awarding of degrees.

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<sup>8</sup>Whether any of these estimates are statistically significantly different is unknown.

<sup>9</sup>Senator Bayh, speaking on S. 5806, on February 28, 1972, 92nd Congress, 2nd session, *Congressional Record* 118, pt. 29. Retrieved from <https://www.govinfo.gov/app/details/GPO-CRECB-1972-pt29/GPO-CRECB-1972-pt29-1/summary>.

<sup>10</sup>The American Historical Association established an ad hoc committee on February 21, 1970 to study the status of women. The committee was instructed to collect statistics on women at all levels of the profession (student admissions, degrees awarded, faculty employment, salary, promotion, etc.) and to make recommendations for action by the AHA. The report was based on a survey of thirty representative institutions and a questionnaire of all Ph.D. recipients in 1970. The report can be retrieved from <https://www.historians.org/about-aha-and-membership/aha-history-and-archives/historical-archives/report-of-the-aha-committee-on-the-status-of-women>

## 2.2 Title IX Regulations and Enforcement

After an unsuccessful attempt by Representative Green to add a sex discrimination prohibition to the Education Amendments of 1971, Senator Birch Bayh of Indiana introduced an amendment that would eventually become Title IX of the Education Amendments of 1972. Current legislation, such as the Equal Pay Act, dealt mostly with sex inequities in the labor market. The senator believed that a policy that fought sex discrimination in the educational system was necessary, since labor market inequities may be linked to sex inequities in the educational system.<sup>11</sup>

The new law mandated that:

No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.

Title IX was signed into law by President Richard Nixon on June 23, 1972, four months after its introduction. The Department of Health, Education, and Welfare (HEW) began working on regulations five weeks later. The process was very much public. Between August 2-4, 1972, HEW held national hearings to discuss Title IX regulations. In June 1974, an initial draft of the regulations was published in the Federal Register. After reviewing nearly 10,000 comments, HEW edited the regulations, and they were signed into law by President Gerald Ford in May 1975.<sup>12</sup>

Title IX was broad in scope, covering many aspects of education discrimination, and generally speaking, it prohibits an institution that receives federal financial assistance from treating students differently on the basis of sex. However, there are several exemptions from its coverage.<sup>13</sup> For example, in regards to discrimination in admissions, Title IX applies only

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<sup>11</sup>Senator Bayh, speaking on S. 5803, on February 28, 1972, 92nd Congress, 2nd session, *Congressional Record* 118, pt. 29. Retrieved from <https://www.govinfo.gov/app/details/GPO-CRECB-1972-pt29/GPO-CRECB-1972-pt29-1/summary>.

<sup>12</sup>The Department of Health, Education, and Welfare published Title IX implementation guidelines on June 4, 1975, and the regulation went into effect on July 21, 1975.

<sup>13</sup>See <https://www2.ed.gov/about/offices/list/ocr/docs/t9-rel-exempt/index.html> for information on Title IX exemptions.



to “institutions of vocational education, professional education, and graduate higher education, and to public institutions of undergraduate higher education” (20 U.S.C. 1681(a)(1); 34 C.F.R. 106.15).<sup>14</sup> Therefore, the prohibition on admissions discrimination applies to all graduate institutions but not to private undergraduate colleges. All other programs and activities of private undergraduate colleges, however, are still governed by Title IX if the college receives any federal money, including student aid grants.<sup>15</sup>

The initial bill included language on enforcement, and the consequences for non-compliance were severe:

Compliance with any requirement adopted pursuant to this section may be effected (1) by the termination of or refusal to grant or to continue assistance under such program or activity to any recipient as to whom there has been an express finding on the record, after opportunity for hearing, of a failure to comply with such requirement, but such termination or refusal shall be limited to the particular political entity, or part thereof, or other recipient as to whom such a finding has been made, and shall be limited in its effect to the particular program, or part thereof, in which such noncompliance has been so found, or (2) by any other means authorized by law.

Any program, department, or school that was found to be practicing gender discrimina-

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<sup>14</sup>Although Title IX applied to both graduate institutions and public undergraduate institutions, this paper focuses on graduate education because of the direct relationship between admissions to a graduate program and the field of study. Prospective students, for example, apply to specific graduate programs such as a Master’s degree in Education or a Ph.D. in Economics. Admission to a program, therefore, directly correlates to a degree in that field of study. Admission to an undergraduate institution, in contrast, does not necessarily determine one’s choice of major. For example, a female college student may just as likely major in Education at Wellesley College or at Yale University. Therefore, I use Title IX as a plausibly exogenous reduction in barriers to entry for women applying to graduate programs and examine its impact across different degree fields.

<sup>15</sup>The regulations do not specify what constitutes as “Federal financial assistance”. This ambiguity was highlighted when Grove City College, a private college in Grove City, PA, refused to sign an Assurance of Compliance form because it received no direct federal funding and therefore believed itself exempt. However, 480 of its 2,220 students received federal grants and loans, and the Department of Education believed that qualified as Federal financial assistance. DOE entered an order terminating assistance until Grove City “correct[ed] its noncompliance with Title IX and satisfie[d] the Department that it is in compliance” (*Grove City College v. Bell*, 465 U.S. 555, 1984). In response, Grove City College filed a lawsuit, and the case eventually went before the Supreme Court. The Court held that Title IX could be applied to a private school that refuses direct federal funding if its students receive federally funded scholarships (e.g., student aid grants). However, in such instances, Title IX would apply only to the specific program or activity that was benefited by the grants; the law would not apply across the entire institution. This decision by the Supreme Court was effectively overturned when the U.S. Congress subsequently passed the Civil Rights Restoration Act of 1987, which specified that recipients of federal funds must comply with civil rights laws in *all* areas, not just in the particular program or activity that received federal funding.

tion after it was notified of the violation would no longer receive federal assistance. Title IX is mainly enforced through (1) private rights of action brought directly against schools by or on behalf of students; and (2) by federal agencies that provide funding to educational programs. This enforcement policy is similar to that for Title VI of the 1964 Civil Rights Act, which prohibits federally funded programs, activities, and institutions from discriminating based on race, color, or national origin ([University of Pennsylvania Law Review, 1976](#)). To enforce Title VI, federal funding agencies also had the power to withdraw or refuse to provide federal financial support to an institution or program seeking it.

There were several methods through which federal agencies verified Title IX compliance. First, HEW implementation regulations required schools to sign “Assurance of Compliance” forms promising the federal government to comply with the law.<sup>16</sup> Second, the Higher Education General Information Surveys that were being administered by the Department of Education were now required for “all institutions of higher education that receive, are applicants for, or expect to be applicants for Federal financial assistance.”<sup>17</sup> These reports, which asked schools about enrollment, degrees conferred, and revenue funds and expenditures, were used by the Office of Civil Rights to verify compliance with Title VI and Title IX.<sup>18</sup>

## 3 Data and Summary Statistics

### 3.1 Data

In this section, I first describe the datasets used for my analysis. I collect three types of data: earned degrees data, enrollment data, and university financial statistics data. Below, I describe the data sources, analysis datasets, and sample restrictions. Then, I present summary statistics on the gender disparity in graduate education.

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<sup>16</sup>“Nondiscrimination on the Basis of Sex”, 40 Fed. Reg. 24128 (June 4, 1975).

<sup>17</sup>See page 3 in the 1975 HEGIS Earned Degrees Survey.

<sup>18</sup>Subpart C of the HEW Regulations outlines specific prohibitions such as sex-specific rankings and the use of quotas. However, HEGIS surveys do not ask schools about admissions numbers.

*Earned Degrees data.* I use two different data sources for earned degrees. The first is from the National Survey of College Graduates (NSCG), a longitudinal, biennial survey of U.S. college graduates. I use the 1993 survey, which surveyed all non-institutionalized, U.S. individuals under the age of 73 with at least a bachelor’s degree as of 1993. The individuals who lived through Title IX would have been roughly 40-50 years old in 1993 and, therefore, are in this dataset. Most importantly, the 1993 survey asks respondents to report their fields of study and degree years, which was not asked in prior NSCG surveys. There are four types of degrees: bachelor’s, master’s (includes M.B.A.), professional (e.g., J.D., Th.D., M.D., D.D.S., etc.), and doctorate. I classify master’s, professional, and doctoral degrees as “graduate degrees”. If an individual has more than one graduate degree, I use the highest degree. These data are cross-sectional data at the individual (degree-holder) level, with reported degree years spanning from 1930 to 1993.

After cleaning, the analysis dataset has data on 20,590 individuals who earned a graduate degree by age 35 between 1965 and 1988. In this instance, graduate degrees are defined as non-doctorate and non-health professional<sup>19</sup> degrees. This dataset also contains information on birth year, birth state, parental education, BA major and degree year, and school region. I combine two-year cells to increase power and to reduce measurement error from recall bias.<sup>20</sup>

The second data source on earned degrees is the Higher Education General Information Survey (HEGIS). HEGIS is a set of surveys that began in the 1960s and is administered by the U.S. Department of Education to all public and private two-year and four-year institutions. The purpose of the survey is to provide comprehensive information on various aspects of post-secondary education, such as enrollment, earned degrees, and financial statistics of institutions. Earned degrees data span from academic year 1965-66 to academic year 1981-82. These administrative data are reported at the institution-level and are broken out by

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<sup>19</sup>Health professional degrees are master’s and professional degrees in medicine, dentistry, veterinary medicine, osteopathy, and optometry.

<sup>20</sup>A plot of reported degree-year reveals a cyclical trend from year to year. I combine degree-years into two-year cells to smooth the distribution.

sex and degree-field.

After cleaning, this analysis dataset has data on earned degrees by sex and degree-field for 608 universities. I restrict schools to non-government military schools that report: (1) earned degrees between AY1965-66 and AY1981-82; and (2) financial statistics data between AY1968-69 and AY1971-72. I use financial statistics data to classify schools as having either a low, medium, or high dependency on federal funds as a proportion of their revenue.

*Fall Enrollment data.* Fall enrollment data are from HEGIS. Graduate enrollment data span from Fall 1969 to Fall 1980.<sup>21</sup> These administrative data are reported at the institution-level and are broken out by sex but not by degree program. After cleaning, the analysis dataset has data on graduate enrollment by sex for 808 universities. Similar to the HEGIS earned degrees dataset, I restrict schools to non-government military schools that report: (1) enrollment between Fall 1969 and Fall 1980; and (2) financial statistics data between AY1968-69 and AY1971-72. I use financial statistics data to classify schools as having either a low, medium, or high dependency on federal funds as a proportion of its revenue.

*Financial Statistics data.* I use school financial statistics data from HEGIS to classify schools into terciles based on the school’s “federal-funds share”, or the share of a school’s total revenue that comes from federal funds. Financial statistics data are from academic year 1968-69, the earliest for which there are data, to academic year 1971-72. I use these baseline years before Title IX’s June 1972 passage to avoid endogeneity between enrollment and federal assistance. I then categorize schools into terciles based on their federal-funds share. To reiterate, a school’s federal-funds share is a time-invariant classification that was determined using baseline data so I am less concerned about selection into these terciles.

A school’s federal-funds share is calculated as total federal dollars as a fraction of the school’s total revenue. Total revenue is composed of educational revenue and student aid grants. Educational revenue may come from student tuition and fees, governmental appro-

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<sup>21</sup>Total and BA enrollment data begin in Fall 1968 whereas graduate enrollment data begin in Fall 1969.

priations<sup>22</sup>, endowment income, private gifts, sponsored research and programs, and recovery of indirect costs. Student aid grants may come from federal, state, or local government, private gifts and grants, endowment income, or other sources. In general, a school may receive federal funds through appropriations, for research and programs, or for student aid grants<sup>23</sup>.

There is quite some variation in federal-funds share across schools. The average federal share of total educational revenue between 1968 and 1971 is 6.8 percent with a standard deviation of 9.7 percent. The median share is 3.9 percent. The 10th and 90th percentiles are 0 percent and 17 percent, respectively. The mean shares of the three terciles are 0.7 percent (low), 4.3 percent (medium), and 15.8 percent (high).

Although T3 funding schools receive, on average, 100 times more money than T1 funding schools (\$3.3 million vs. \$33,000), not all public schools are in the top tercile. For example, 43 percent of schools in the top tercile are private schools. At the same time, public schools do tend to receive more federal money compared to private schools—about \$960,000 or 24% more. When comparing the different types of federal funds between public and private schools, the largest disparity is in appropriations (22.7% at public schools vs. 8.67% at private schools) and the smallest is in student aid grants (10.8% at public schools vs. 11.9% at private schools). For both types of schools, federal research money comprises a sizeable portion of total federal funds: around 41 percent for public schools and 60 percent for private schools.

When comparing across the three terciles, we see that federal money is used differently. For example, federal research money comprises nearly half of total federal funds for T3 funding schools, while student aid grants make up the biggest portion for T1 funding schools (36%). Federal programs comprise a similar portion of the budget across the three terciles: 24% at T1 funding schools, 35% at T2 funding schools, and 23% at T3 funding schools.

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<sup>22</sup>This pertains to federal, state, or local government money set aside for the school. As an example, the top three schools in terms of federal appropriations between 1968 and 1972 are the U.S. Air Force Academy, the U.S. Military Academy, and the U.S. Naval Academy.

<sup>23</sup>I include student aid grants as “federal funds” because of the Supreme Court case *Grove City College v. Bell*, which ruled that federally funded scholarships count as Federal financial assistance.

*Sample Restrictions.* There are three main sample restrictions. First, I focus on non-doctorate and non-health professional graduate degrees for my analysis on earned degrees.<sup>24</sup> These are all master’s and professional degrees excluding medicine, dentistry, veterinary medicine, osteopathy, and optometry. I focus on these degrees to avoid the confounding problem created by the Vietnam War draft deferment policy. Starting in 1965, when drafting for the Vietnam War began, young men rushed to enroll in graduate programs to avoid being drafted (Chiswick et al., 2015; Singer, 1989). However, draft deferments for all graduate programs, with the exception of health professional degrees, ended in 1968.<sup>25</sup> Therefore, I focus on non-doctorate and non-health professional degrees, which were less affected by the draft deferment policy, to separate the effect of Title IX from the Vietnam War draft.

Second, in NSCG data, I focus on graduate degrees obtained before age 35 and between 1965 and 1988. I choose age 35 as most graduate degrees are obtained by then. For example, the median age of new doctorate recipients in 1978 was 31.7 years old (Council of Graduate Schools, 2009). As doctoral degrees generally take longer to complete than masters degrees (which are the focus of my analysis), I use age 35 as an upper-bound limit. I also restrict NSCG data to degrees earned between 1965 and 1988 to be consistent with the HEGIS earned degrees dataset, whose earliest available data begin in academic year 1965-66.

Third, HEGIS enrollment and earned degrees data are restricted to non-government military schools that appear in all years and that have financial statistics data. This is to ensure I have a consistent sample of schools and my analysis will not be affected by schools moving in and out of the sample.

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<sup>24</sup>I make this restriction only for earned degrees data because enrollment data are not broken out by degree-fields. Reported fields of study in both the NSCG and HEGIS Earned Degrees data are first aggregated to 26 main fields, as categorized by the 2010 Classification of Instructional Programs (CIP). CIP was originally developed in 1980 by the U.S. Department of Education’s National Center for Education Statistics for the purpose of accurate tracking, assessment, and reporting of fields of study.

<sup>25</sup>Executive Order No. 11360, 32 Federal Register 9787 (July 4, 1967), <https://www.archives.gov/federal-register/executive-orders/1967.html>

## 3.2 Summary Statistics

In this section, I present summary statistics on earned degrees before Title IX. At the time the U.S. News article was written (May 1965), there were 524,008 conferred B.A. degrees of which 57.4 percent were to men.<sup>26</sup> Only 20 percent of college graduates went on to graduate school, but men were twice more likely to go than women; in academic year 1965-66, 73 percent of graduate degrees were awarded to men.<sup>27</sup> Furthermore, men and women pursued different fields of study in graduate school. Nearly half of the women in graduate school were pursuing a degree in Education in 1965, whereas men were more evenly distributed across the 26 major fields of study (see Figure A1). Moreover, if I classify fields of study by median salary, 55 percent of male graduate students were pursuing degrees in the top salary tercile, with 31 percent representing the top three: Law, Health, and Engineering.<sup>28</sup> In contrast, 12.4 percent of women were in fields in the top salary tercile.

The disparity is starker when we examine the share of female graduates in each degree field. In Figure 1, the horizontal axis lists the 26 major fields of study in rank order of median salary. For example, law degrees (e.g., J.D.s) have the highest median salary and graduate degrees in Philosophy have the lowest median salary. This ordering highlights the fact that women are disproportionately concentrated in graduate fields in the bottom salary tercile, while men are concentrated in the top salary tercile. Red, horizontal, dashed lines depict tercile averages, which are 8.7 percent (high), 27 percent (middle), and 45.4 percent (low).

The data on earned degrees reveal a large gender disparity, and one potential explanation this paper explores is discrimination. There are different channels through which discrimination may result in a gender gap. One is direct discrimination in the admissions process, by which male and female applicants are held to different standards. Discrimination may

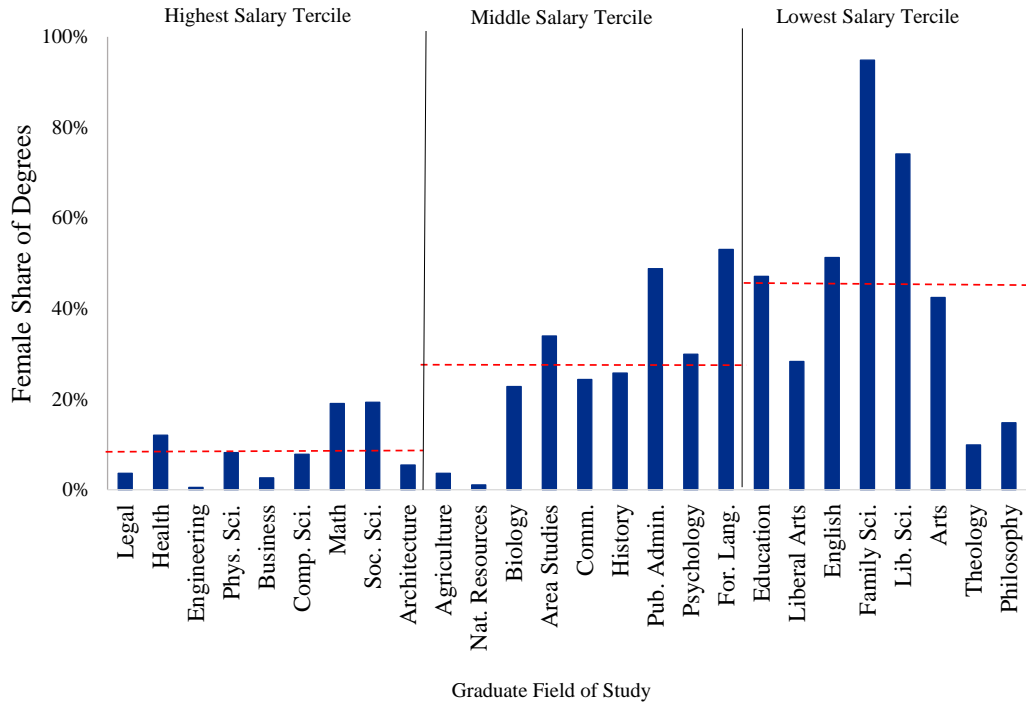
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<sup>26</sup>These statistics are for the academic year 1965-66 and are from the HEGIS 1965 Earned Degrees data.

<sup>27</sup>The number of conferred graduate degrees was 190,507. These statistics are from the 1965 Current Population Survey.

<sup>28</sup>Fields of study were categorized into terciles based on its median salary between 1962 and 1991. See Table A1 for the list of fields in each salary tercile.

Figure 1: Female Share of Graduate Degrees in 1965



Source: HEGIS 1965 Earned Degrees data.

Notes: N = 30,174. This figure depicts the female share of graduate degrees conferred in academic year 1965 separately by field of study. Fields are listed in decreasing order of median salary. Horizontal dashed lines depict tercile averages, which are 8.7% (high), 27% (middle), and 45.4% (low).

also exist in the program, either through scholarships or mentoring opportunities, which would affect women's abilities to complete their degrees. At the same time, it is difficult to ascertain whether discrimination is the main explanation for the disparity. For example, the gender disparity may also reflect differing preferences between men and women for fields of study, a lack of adequate preparation on the part of female applicants, or differing career aspirations between men and women.

To narrow down possible explanations, I exploit the passage of a new law that banned gender discrimination in education. I focus on graduate schools, where Title IX banned both discrimination in admissions and access to program benefits or scholarships. If the observed



gender disparity were due to differing tastes between men and women and not because of barriers to entry, then Title IX would have little impact on the gender disparity in graduate fields of study.<sup>29</sup> I test this hypothesis in the rest of the paper. In the next section, I present motivating evidence that Title IX may have affected women’s decisions to pursue graduate degrees in traditionally-male fields.

## 4 Motivating Evidence

This section presents descriptive evidence that women began pursuing different types of graduate degrees, specifically those in traditionally-male fields, right around the time of Title IX’s passage. To make this argument, I calculate the degree of convergence between female and male degree-field distributions between 1965 and 1987 and look for a structural break in the trendline.

I use two different methods to measure gender convergence. The first is the Segregation Index, also known as the Index of Dissimilarity, developed by [Duncan and Duncan \(1955\)](#).<sup>30</sup> The segregation index is used to measure change in the distribution of an unordered, categorical variable and has been used in a variety of applications, from measuring racial segregation in neighborhoods ([Massey and Denton, 1988](#)) to gender segregation in occupations ([Blau et al., 2013](#)). This measure indicates the share of women (or men) who would have to change graduate fields for the overall distributions of men and women to be identical. For example, if the share of women in all fields is the same as the female share of total graduate degrees, then the segregation index is zero. Thus, larger values indicate greater segregation (divergence) and smaller values indicate greater integration (convergence).

One limitation of the segregation index for my study is that it does not consider the

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<sup>29</sup>A key assumption is that any changes in female preferences for high-school subjects or college majors or in female career aspirations were gradual changes and did not change suddenly between 1972 and 1973. An examination of the data confirms this assumption. Results are in the Online Appendix at <https://goo.gl/h4MEaw>.

<sup>30</sup>It is calculated as  $S_t = (0.5) \cdot \sum_i |m_{it} - f_{it}|$ , where  $m_{it}$  is the share of all male graduate students in degree-field  $i$  in year  $t$  and  $f_{it}$  is the share of all female graduate students in field  $i$  in year  $t$ .

ordering of degree fields. For example, a segregation index of 30 means that 30 percent of women need to change their degree-field but there is little constraint on which specific fields these women move to or where they moved from. But, as my goal is to test whether women entered traditionally-male fields after Title IX, it is important for me to account for the fields women are moving into and out of. In other words, we care whether women are switching from a female-dominated field to another female-dominated field or to a male-dominated field.<sup>31</sup>

The Earth Mover’s Distance is a metric that incorporates the idea that we care about the distance moved. It measures the difference between two distributions by asking how we transform one distribution (women) into the other distribution (men) and keeping track of *how far* the women have to be moved.<sup>32</sup> Importantly, because EMD measures how far probability mass must be moved when transforming the female distribution into the male distribution, the ordering of categories is non-trivial. In my application, I order graduate fields by expected salary.<sup>33</sup> I define a field’s expected salary as the median salary for everyone who obtained a graduate degree in that field between 1960 and 1990. Because EMD considers categories that are further away from each other to have a higher “moving cost”, the ordering by expected salary is a logical one. As EMD is the minimal cost that must be paid to transform one distribution into the other, larger values indicate greater dissimilarity (divergence) and smaller values indicate less dissimilarity (convergence).

Using the two dissimilarity measures, I estimate the following regression model to test

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<sup>31</sup>See Appendix B for a discussion on the difference between the Segregation Index and the Earth Mover’s Distance.

<sup>32</sup>For example, say we have a male distribution of  $K$  graduate fields,  $M = [m_1, \dots, m_i, \dots, m_K]$ , and a female distribution of  $K$  graduate fields,  $W = [w_1, \dots, w_j, \dots, w_K]$ . To transform distribution  $M$  to distribution  $W$ , the EMD is defined as follows:  $EMD(M, W) = \frac{\sum_{i=1}^K \sum_{j=1}^K d_{ij} f_{ij}}{\sum_{i=1}^K \sum_{j=1}^K f_{ij}}$ , where  $i, j$  denote graduate-field category for distributions  $M$  and  $W$ , respectively,  $d_{ij}$  is the distance between graduate-field categories  $m_i$  and  $w_j$ , and  $f_{ij}$  is the total number of people who are being moved between  $m_i$  and  $w_j$ . Appendix C describes EMD in more detail.

<sup>33</sup>In Appendix Figure A2, I conduct robustness checks using alternative methods to order graduate degree fields. Specifically, I use the field’s expected salary instead of a rank ordering by expected, and the field’s pre-Title IX salary between 1960 and 1969. The results are very similar.

for a structural break in the data:

$$y_t = \beta_0 + \beta_1 Trend_t + \beta_2 \mathbb{1}\{t > t^*\} + \beta_3 (Trend \times \mathbb{1}\{t > t^*\}) + u_t \quad (1)$$

where  $y_t$  is the dissimilarity measure using either the Segregation Index or EMD. I include a linear trend,  $Trend_t$ , with 1 indicating the start-year in the data. I also allow for a discontinuous break in the trend,  $\mathbb{1}\{t > t^*\}$ , where  $t^*$  denotes the break-year. Last, I allow the linear trend after the break-year to vary from the initial linear trend,  $Trend \times \mathbb{1}\{t > t^*\}$ .

To identify the break-year, I estimate equation (1) separately for each potential value of  $t^*$ , which ranges across the entire period except for the start- and end-years. For example, the NSCG data contain degrees earned between academic year 1964 and academic year 1986, with two-year cells. Potential break-year values, therefore, start with 1966 and end with 1984. The HEGIS earned degrees data range from academic year 1965 to academic year 1981. Therefore, potential break-year values start with 1966 and end with 1980. Then, I compare the  $R^2$  of all regressions to see which break-year best fits the data. Table 1 reports coefficient estimates from equation (1) for the break-year with the highest  $R^2$ .

Columns 1 and 2 in Table 1 report estimates using the Segregation Index, and columns 3 and 4 report estimates using EMD. In three of the four regressions, the break-year that best fits the data follows Title IX's passage. We would expect the break-year to occur at least one year after Title IX's passage to account for time to complete the degree. The break-year that best fits the NSCG data is AY1974 or degrees earned in spring 1975 and spring 1976. For HEGIS data, the break-year is AY1973 or degrees earned in spring 1974 when using the Segregation Index, and AY1971 or degrees earned in spring 1972 when using EMD. Additionally, the discontinuity is statistically significant at the 1% level for the break-years that are post-Title IX. Last, the magnitude of the discontinuity is larger when using EMD, indicating that it measures greater convergence compared to the Segregation Index. This suggests that female-male convergence after Title IX is due to women moving into

Table 1: Female-Male Convergence in Graduate Degree Fields

Convergence Measure:	Segregation Index		EMD	
	(1)	(2)	(3)	(4)
Trend ( $\hat{\beta}_1$ )	-0.01299* (0.005713)	-0.001997*** (0.0005369)	-4.615** (1.782)	-0.5556* (0.2604)
Discontinuity ( $\hat{\beta}_2$ )	-0.1631*** (0.03214)	-0.03392*** (0.0034515)	-51.72*** (10.02)	0.1605 (1.102)
Post-trend ( $\hat{\beta}_3$ )	-0.002166 (0.003414)	-0.005366*** (0.0004476)	-1.508 (1.065)	-2.169*** (0.09551)
N	12	16	12	16
Sample	NSCG	HEGIS	NSCG	HEGIS
Academic Year range	1964-1986	1965-1981	1964-1986	1965-1981
Break-year	AY1974	AY1973	AY1974	AY1971
$R^2$	0.9282	0.9863	0.9321	0.9851

Source: NSCG 1993 data; HEGIS 1965-1981 Earned Degrees data.

Notes: This table tests whether a structural break exists in the female-male convergence of graduate-field distributions. Estimates are reported for the break-year with the highest  $R^2$ . HEGIS data have one-year cells, while NSCG data have two-year cells. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

male-dominated, more lucrative fields.

In column 4, the break-year is in AY1971 and the discontinuity is positive. However the discontinuity is not statistically significant. Further, though the break-year with the highest  $R^2$  is AY1971 at 0.9851, the second highest  $R^2$  is break-year AY1973 at 0.9814—which is in line with the other estimates. The post-trend is also significantly more negative than the pre-trend<sup>34</sup>, indicating that female-male convergence was greater in later years. Most importantly, all four specifications are broadly in line with each other, which is that female-male convergence sped up around the time of Title IX’s passage.

It is important to note that there are limitations to both datasets. The NSCG, being survey data, is weighted to be nationally representative of the entire U.S. population that has a B.A. as of 1993. But because it was administered in 1993, if older people or those with particular degrees were less likely to respond to the survey, then the data would be truncated. On the other hand, the HEGIS dataset is administrative data, but it only uses data from

<sup>34</sup>These are statistically significantly different at the 5% level.

universities that voluntarily reported earned degrees and financial statistics. Because of these limitations, I do not expect the NSCG and HEGIS estimates to line up exactly. But the important takeaway is that both datasets point to the fact that something appears to have occurred around 1972 that sped up female-male convergence in graduate degree fields.

One consideration is how increased supply of women pursuing graduate degrees affects the dissimilarity measure. This is important as women were more likely to attend graduate school during this time due to gradually changing forces other than Title IX. For example, the introduction of the birth control pill in 1965 changed female opportunity costs of pursuing higher education and entering the labor force (Goldin and Katz, 2002).

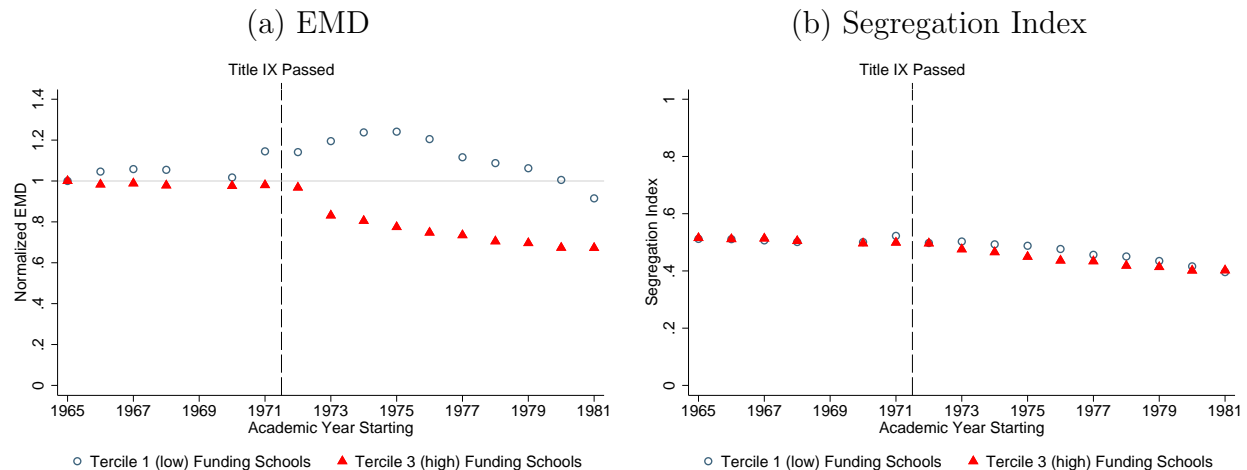
To answer this question, I borrow from Blau et al. (2013) and decompose the segregation index to see whether distributional convergence occurred because of a change in sex composition within degree fields (“sex-composition effect”) or because of a change in relative sizes of segregated and integrated fields (“graduate field mix effect”). An example of a sex-composition effect is when women predominantly enter male-dominated fields or vice versa. An example of a field mix effect is a secular increase in female-dominated graduate fields of study. This would result in greater divergence even if the sex composition within fields remained unchanged. I find that nearly 74 percent of the -6.1 percentage-point change between 1972 and 1974 is due to changes in sex composition within occupations with the remaining 26 percent due to changes in the field mix.

As an additional check that Title IX affected female degrees, I test the predictions that arise from Title IX’s enforcement clause. The consequence for non-compliance is termination of federal assistance. If schools were indeed responding to Title IX, then we would expect to see a greater response among federally-dependent schools relative to less federally-dependent schools. That is, we predict that schools with more to lose from non-compliance may be more likely to comply with Title IX, which may result in more female degrees relative to female degrees from schools that are less federally-dependent.

I empirically test this prediction by examining whether fields of study between men and

women converged more among schools with a federal-funds share in the highest tercile (T3) relative to schools with a federal-funds share in the lowest tercile (T1). I calculate EMD separately for the two groups and plot normalized values in Panel A of Figure 2.

Figure 2: Gender Convergence by Federal Funds Share



Source: HEGIS 1965-1981 Earned Degrees data and 1968-1971 Financial Statistics data.

Notes:  $N = 116,294$ . Dots depict EMD values or Segregation Index between female and male distributions of graduate field of study indexed to 1965, separately for more federally dependent schools (T3 funding schools) and less federally dependent schools (T1 funding schools). Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. Vertical dashed line indicate when Title IX was signed into law (June 1972).

Before Title IX, the degree-field distributions of men and women pursuing non-doctorate, non-health professional graduate degrees do not vary much from year to year. Then starting with degrees earned in spring 1974, there is an increase in convergence by 13.7 percentage-points for students at more federally dependent schools (T3 funding schools). This trend continues as female and male distributions become more similar over time. In contrast, distributions in T1 funding schools diverged between 1971 and 1975 before converging again.

The reason we see a divergence among T1 funding schools is because the women entering T1 schools pursued traditionally-female fields, whereas women entering T3 schools pursued traditionally-male fields. This is made clearer when we use the Segregation Index instead of EMD. Recall that EMD measures convergence while taking into account which fields women are moving into, whereas the Segregation Index simply measures convergence. In

Panel B of Figure 2, we see a slightly negative slope post-Title IX, indicating there are slight changes between the female and male distributions. In contrast, Panel A depicts much starker convergence (and divergence) trends. This implies that women were much more likely to pursue male-dominated fields at T3 funding schools than at T1 funding schools. Indeed, the share of females in male-dominated fields was similar at T1 funding schools and T3 funding schools in 1970, at 12.2% and 12.3%, respectively. In 1975, these percentages were 14.9% and 21.7%, respectively.

Why were women more likely to pursue male-dominated fields at T3 funding schools than at T1 funding schools? One potential explanation is that T3 funding schools are more likely to be public universities. The majority of T3 funding schools are public (57%) compared to 19% of T1 funding schools. Therefore, T3 funding schools may be more likely to comply with Title IX regulations because they may rely more on federal funding. Another potential explanation is that T3 funding schools were generally larger: the median annual graduate enrollment is 1,219 at T3 funding schools vs. 197 at T1 funding schools. This may have impacts on the demand side; students may be more likely to apply to larger, public universities because of their visibility or lower tuition rates compared to smaller, private colleges. It may also be the case that larger universities have better infrastructure in place to accommodate women. For example, they may be more able to quickly build or convert existing dormitories for women.

In summary, I presented motivating evidence of a change in earned degree-fields following Title IX's passage. I found that women were more likely to pursue traditionally-male graduate degrees after Title IX, and this mainly occurred in more federally dependent schools. These results are consistent with the theory that Title IX reduced barriers to entry, rather than convergence being the result of a change in female preferences.

## 5 Empirical Strategy

This section describes the empirical strategy, which has two parts. First, I examine female graduate enrollment, which should have grown as a result of Title IX’s ban on admissions quotas for women. Then, I check whether there are larger changes among more federally dependent schools. Due to the penalty for non-compliance, I would expect a larger response by schools that receive more federal funds. Second, I use a difference-in-differences strategy to analyze whether women were more likely than men to enter traditionally-male fields after Title IX. This analysis focuses on earned degrees.

### 5.1 Graduate Enrollment

The first analysis uses HEGIS fall enrollment data to examine whether female graduate enrollment changed discontinuously after Title IX’s passage. I estimate the following regression model:

$$F_{it} = \beta_0 + \sum_{\substack{s=1969, \\ s \neq 1971}}^{1980} \mathbb{1}\{t = s\} \cdot \tau_s + X' \gamma + \varepsilon_{it} \quad (2)$$

where  $F_{it}$  is school  $i$ ’s female graduate enrollment in academic year starting  $t$ .  $X$  is a vector of school fixed effects, school’s total graduate enrollment, and state fixed effects. Standard errors are clustered by state.<sup>35</sup>

The parameters of interest are  $\tau_s$ , which tell us the average annual increase in female enrollment relative to 1971. My hypothesis is that female enrollment increased after Title IX’s passage. Since Title IX was passed in June 1972, the earliest I would expect to see any effects in fall enrollment is in AY1973.

Next, I test whether schools with a larger federal-funds share are also more likely to experience greater female enrollment. The argument is that these schools face harsher penalties for non-compliance relative to schools that rely less on federal funds, and so have a greater incentive to reduce barriers to entry for women. The regression model is as follows:

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<sup>35</sup>I estimate an alternative specification with regular standard errors, and the results are largely unchanged.



$$\begin{aligned}
F_{it} = & \beta_0 + X'\gamma + \sum_{\substack{s=1969, \\ s \neq 1971}}^{1980} \mathbb{1}\{t = s\} \cdot \tau_s^L + \sum_{\substack{s=1969, \\ s \neq 1971}}^{1980} (\mathbb{1}\{t = s\} \times MidFunds_i) \cdot \tau_s^M \\
& + \sum_{\substack{s=1969, \\ s \neq 1971}}^{1980} (\mathbb{1}\{t = s\} \times HighFunds_i) \cdot \tau_s^H + \varepsilon_{it}
\end{aligned} \tag{3}$$

where  $F_{it}$  is school  $i$ 's female graduate enrollment in academic year starting  $t$ .  $X$  is a vector of school fixed effects, school's total graduate enrollment, and state fixed effects.  $MidFunds_i$  and  $HighFunds_i$  are indicator variables for whether school  $i$  is a Tercile 2 funding school ("*MidFunds*") or a Tercile 3 funding school ("*HighFunds*"). The reference group is Tercile 1 funding schools ("*LowFunds*") in 1971. Terciles are based on the school's average federal-funds share between 1968 and 1971. Standard errors are clustered by state.<sup>36</sup>

The parameters of interest are  $\tau_s^H$ , the coefficients on the year dummies for schools that are more federally dependent. These depict how female enrollment at an average T3 funding school changed annually relative to an average T1 funding school's female enrollment in 1971.

## 5.2 Earned Degrees

The second analysis examines whether Title IX reduced gender disparity in graduate education. I focus on non-doctorate, non-health professional<sup>37</sup> degrees. This is for two reasons. First, as I am examining earned degrees instead of enrollment, this streamlines the analysis by considering programs of similar length (i.e., two years of study). Second, this sample restriction avoids problems raised by the Vietnam War draft, which allowed men pursuing health professional degrees to defer the draft.<sup>38</sup>

<sup>36</sup>The estimates are, for the most part, unchanged when I estimate regular standard errors.

<sup>37</sup>Health professional degrees are graduate degrees in medicine, dentistry, veterinary medicine, osteopathy, and optometry.

<sup>38</sup>See Section 7 for more information.

I conduct a difference-in-differences analysis to estimate how the likelihood of pursuing a traditionally-male graduate degree changed for women relative to men after Title IX’s passage. I classify “traditionally-male degrees” by the share of females in the degree field between 1960 and 1971. Degrees are then categorized into terciles based on their female share: Tercile 1 percent-female (low female share or “traditionally-male”), Tercile 2 percent-female (medium female share), and Tercile 3 percent-female (high female share or “traditionally-female”). Appendix Table A2 lists the fields that are in these three groups. The following regression model is estimated separately for each tercile:

$$Y_{it}^c = \beta_0^c + \beta_1^c \cdot F_i + \sum_{\substack{s=1964, \\ \neq 1970}}^{1986} \tau_s^c \cdot \mathbb{1}\{t = s\} + \sum_{\substack{s=1964, \\ \neq 1970}}^{1986} \delta_s^c \cdot (F_i \times \mathbb{1}\{t = s\}) + X' \gamma^c + \varepsilon_{it}^c \quad (4)$$

where  $Y_{it}^c = 1$  if individual  $i$  obtained a graduate degree in tercile  $c$  in academic year  $t$  and 0 otherwise,  $F_i$  is a female dummy, and  $X$  is a vector of controls including birth year, birth region, school region, parental education, a linear time trend, the percent-female tercile of the individual’s BA major, and the number of college graduates in the year individual  $i$  graduated from college. I estimate robust standard errors to correct heteroskedasticity that is introduced by having a binary outcome variable.<sup>39</sup> Degree year is aggregated into two-year cells to reduce measurement error from recall bias.

The parameters  $\tau_s^c$  tell us how male tercile  $c$  degree-fields changed relative to 1970 (the reference group). The parameters of interest are  $\delta_s^c$ , which tell us how female graduate degrees in tercile  $c$  changed annually relative to males degrees. My hypothesis is that women were more likely to pursue traditionally-male degrees after Title IX’s passage. Therefore, I expect to see positive effects for T1 percent-female degrees earned in academic year 1974 or later, and negative effects for T3 percent-female degrees earned in academic year 1974 or later. For degrees earned prior to 1974, I expect to see null effects. The reason I expect positive coefficients starting in AY1974 is because that is the structural break-year identified

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<sup>39</sup>The results are robust when I cluster the standard errors by respondent’s region.

in Table 1.

I use NSCG data for this analysis because the micro-data allows for individual-level controls, which is important when trying to model people’s decisions to pursue a particular degree-field. The NSCG data, being cross-sectional, are not perfect, but it does contain important background information such as birth year, undergraduate major, birth region, and parental education, which are not available in HEGIS data.

## 6 Results

In this section, I report my findings on whether female graduate enrollment increased after Title IX, whether enrollment increased differentially more at federally dependent schools, and whether women were more likely to pursue traditionally-male degree fields after Title IX.

### 6.1 Graduate Enrollment

In this section, I present evidence that female graduate enrollment increased after Title IX and that it increased disproportionately more at federally dependent schools. Panel A of Figure 3 graphs the values of  $\tau_s$  from equation (2) between Fall 1969 and Fall 1980.<sup>40</sup> The vertical dashed line depicts when Title IX was signed into law (June 1972). At the earliest, Title IX’s passage would affect Fall 1972 applicants looking to enroll in Fall 1973.

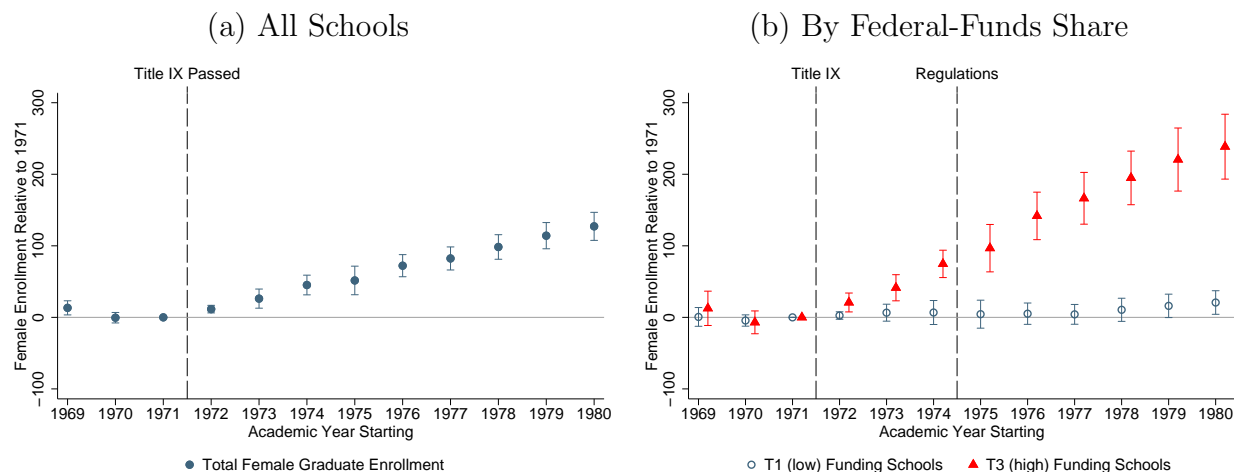
Average graduate female enrollment at a university increased by 26 students in the fall of 1973, relative to Fall 1971 enrollment. Female graduate enrollment at an average university in AY1971 is 415 so this estimate represents an increase of 6 percent. Importantly, female enrollment continued to increase steadily throughout the 1970s. As a robustness check, I look for a structural break in the data. I estimate equation (1) but with female graduate enrollment as the outcome variable and also include controls for total enrollment, school fixed effects, and state fixed effects. The discontinuity is statistically significant beginning

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<sup>40</sup>Accompanying regression results are reported in Table 2.

with Fall 1973 enrollment and grows larger each additional year.

Figure 3: Change in Female Graduate Enrollment



Source: HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.

Notes:  $N = 9,696$ . Dots depict annual changes in female graduate enrollment relative to 1971 for all schools (Panel A) and by federal-funds share (Panel B). Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. Estimates control for school fixed effects, total enrollment, and state fixed effects. Standard errors are clustered by state, and wings are 95% confidence intervals. Vertical dashed lines indicate when Title IX and its compliance regulations were signed into law (June 1972 and May 1975, respectively).

Panel B of Figure 3 illustrates how female enrollment changed relative to Fall 1971, separately for T1 (low) funding schools and T3 (high) funding schools. Vertical dashed lines indicate when Title IX and its compliance regulations were signed into law (July 1972 and May 1975, respectively). Prior to Title IX, changes in female graduate enrollment in T3 funding schools and T1 funding schools were small and not statistically significant. In Fall 1973, female enrollment at T3 funding schools increased by an average of 41 students or 6%. In Fall 1976, after compliance regulations went into effect, enrollment increased by 142 students or 22%. In contrast, female enrollment at an average T1 funding school is relatively stable throughout this time period and not statistically significant until Fall 1979.<sup>41</sup>

The observed increase in female graduate enrollment in AY1973 and AY1974 is consistent with testimony from the May 1975 Congressional Hearings on Title IX regulations. For ex-

<sup>41</sup>Female graduate enrollment at T2 funding schools is also relatively stable but statistically significant until Fall 1978 (see Appendix Figure A7).

ample, Nellie M. Varner, spokesperson for the National Association of State Universities and Land-Grant Colleges, the American Council on Education, and the Association of American Universities, testified that “many institutions [had] already begun to respond to the spirit of Title IX” (U.S. Congress. House. Committee on Education and Labor. Subcommittee on Postsecondary Education., 1975, p. 416).<sup>42</sup> As an example, the University of Michigan, a T3 funding school, had asked its schools and colleges to review their recruitment, admissions, and financial aid policies “in light of the proposed Title IX regulations” (U.S. Congress. House. Committee on Education and Labor. Subcommittee on Postsecondary Education., 1975, p. 416).

There are several reasons that schools may have begun compliance before regulations went into effect. First, the language and enforcement policy were very similar to the Civil Rights Act, which was passed eight years ago. Second, the initial bill in 1972 clearly stated that the penalty for non-compliance would be termination of federal funds. Therefore, schools were likely aware of the consequences from the start. Indeed, this pre-emptive behavior exists *only among T3 funding schools*, the schools who were relatively most federally dependent.

An interesting note is that female enrollment also increased slightly in Fall 1972, which seems too early to see an effect from Title IX. This is likely capturing an increase in female demand for graduate school that began in the late 1960s; Goldin and Katz (2002) find that the diffusion of the birth control pill lowered the costs of pursuing professional education for women. However, I do not believe this invalidates my results. First, the change is a small one. Average female graduate enrollment at a T3 funding school is 642 in AY1971, so an increase of 21 students is about a 3% increase. Second, when checking for a structural break among T3 funding schools, the discontinuity is statistically significant starting with *Fall 1973 enrollment* and more than triples for Fall 1976 enrollment. I do not find evidence

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<sup>42</sup>This statement was made by Nellie M. Varner at the June 1975 Congressional Hearings before the Subcommittee on Postsecondary Education. The purpose of these Hearings was to review Title IX regulations and hear any contestations. The main opposition was on Title IX’s coverage of athletic programs (U.S. Congress. House. Committee on Education and Labor. Subcommittee on Postsecondary Education., 1975, p. 69, 285, 385).

of a break in female enrollment at T1 funding schools.

In Appendix Figure A6, I present estimates for the change in female share of graduate enrollment rather than in levels. When pooling all schools, I find very similar patterns. The change in female share is flat at zero prior to AY1971, and starting with Fall 1972 enrollment, there is a statistically significant increase that continues on through the end of the sample. When I analyze the data by school funding tercile, I find that estimates for T1 funding schools and T3 funding schools are pretty similar, which seems contradictory to my results that found larger increases in female graduate enrollment at T3 funding schools than at T1 funding schools. However, this is because both types of schools also increased *total* enrollment during this time, masking the rise in female enrollment (see Table 2). For example, T1 funding schools increased female enrollment by an average of 7 people in Fall 1974 and T3 funding schools increased by 75 people on average. At the same time, total graduate enrollment increased by 92 and 454 people, respectively. A more informative way of interpreting these numbers is to estimate the female share of *new* enrollments. If measured this way, women represented 7.6% ( $= 7/92$ ) and 16.5% ( $= 75/454$ ) of new graduate enrollments at T1 funding schools and T3 funding schools in Fall 1974, respectively, which is consistent with the rest of my findings. Therefore, simply looking at the change in female share masks important dynamics and does not provide the full picture.

## 6.2 Earned Degrees

Next, I present difference-in-difference results for whether women were more likely than men to earn traditionally-male graduate degrees following Title IX. Figure 4 illustrates that the female-male difference in graduate degrees is not statistically significantly different from zero before Title IX's passage.<sup>43</sup> This is true for both traditionally-male and traditionally-female degree fields. Starting in spring AY1974, however, women are 3.2 percentage-points

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<sup>43</sup>Accompanying regression results are presented in Table 3.

more likely than men to earn a graduate degree in a traditionally-male field.<sup>44</sup> This is an effect size of about 41 percent as 7.8 percent of women earned a non-doctorate, non-health professional graduate degree in a traditionally-male field in AY1970. This timing is consistent with what one would expect for two-year master’s degrees. Further, it appears to be persistent, with coefficients ranging from 4.4 to 8.5 percentage-points between AY1976 and AY1986. However, only the point estimates for AY1976 and AY1978 are statistically significant.<sup>45</sup>

In contrast, women are less likely than men to earn a traditionally-female degree by almost 5 percentage-points (6.2%) in AY1974, and by 10 percentage-points (12.4%) in AY1976. Afterwards, the estimates remain consistently negative, ranging from -6.2 to 9.8 percentage-points, and are statistically significant.

I also estimate alternative specifications wherein I use a continuous outcome measure rather than the discretized terciles measuring the extent of historic male representation in the field. The results, reported in Table 3, are largely consistent across the different specifications.

In column 1 of Table 3, the outcome variable is the share of males in the field between 1960 and 1971. Prior to Title IX, the female-male difference is very close to zero and not statistically significant. Starting with degrees earned in AY1974, the average female earned a graduate degree in a field that historically had 2.5 percentage-points more men than the average graduate field in AY1970. This increases to 4.2 percentage-points in AY1976, meaning that the average female graduate student is pursuing a field that is even more historically male-dominated. Importantly, these estimates remain positive (ranging from 2.9 to 4.8) and statistically significant through AY1986.

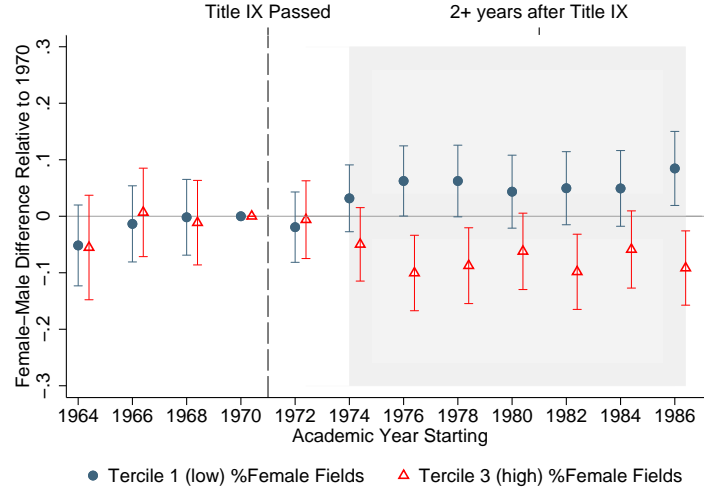
Column 4 of Table 3 uses the field’s median salary, and, again, the estimates are consistent

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<sup>44</sup>Appendix Figure A3 plots estimates for Tercile 2 percent-female fields, which show modest positive increases in the years following Title IX’s passage but are not statistically significant.

<sup>45</sup>It is possible that mean reversion may be generating this result. However, I am somewhat reassured by the fact that the point estimates remain positive and similar, even if they are not always statistically significant. Additionally, when using continuous outcome measures, the coefficient estimates are positive and remain statistically significant.

Figure 4: Female-Male Difference in Earned Degrees by Gender Parity



Source: NSCG 1993 data.

Notes:  $N = 19,514$ . Dots depict the annual female-male difference in degrees relative to 1970 separately for T1 (low) %female degree fields and T3 (high) %female degree fields. Fields of study are categorized by their mean share of females between 1960 and 1971. Estimates control for birth year, birth region, school region, parental education, a linear time trend, the %female tercile of the person's BA major, and the number of college graduates each year. Wings depict 95% confidence intervals constructed from robust standard errors. Vertical dashed line depicts when Title IX was passed (June 1972). Gray shaded area depicts years at least two academic years after Title IX's passage.

with my other results. For graduate degrees earned before AY1972, women were pursuing degree-fields that earned relatively similarly to the fields that men were pursuing in AY1970. The estimates grow as years pass, implying that women are gradually pursuing more lucrative fields. Starting with degrees earned in AY1974, the first degrees we would expect Title IX to have an impact, we see a large increase in the expected salary of the degree-fields that women were pursuing. For example, Title IX is associated with women pursuing fields that paid \$1,663 more, on average, than the average field that men were pursuing in AY1970. As the average female earned a degree with an expected median salary of \$40,881, this represents an effect size of 4 percent and is statistically significant at the 5% level.

To provide a sense of the fields that are driving my results, I estimate equation (4) separately by degree field. The estimates for  $\tau_{1974}^F$  are graphed in Appendix Figure A5. Amongst



traditionally-male fields, women disproportionately entered Legal, Computer Science, and Engineering fields relative to men. Biology, Math, Physical and Social Sciences, which are Tercile 2 percent-female fields, also saw larger increases in female degrees relative to men. For traditionally-female fields, Education and Library Science saw the largest declines in female degrees, while Health<sup>46</sup> experienced an increase, relative to men.

The identifying assumption for DID is that the treatment group (women) and the comparison group (men) were exhibiting similar trends in the outcome variable (traditionally-male field or traditionally-female field) prior to the treatment (Title IX’s passage in 1972). This parallel trends assumption allows me to obtain counterfactual estimates of the treatment group’s outcome in the absence of treatment. For the purposes of this study, this means that the female share of graduate degrees should be on a similar trend as male graduate degrees before Title IX’s passage. Pre-treatment leads in Figure 4 indicate that female-male differences are zero or very close to zero and not statistically significant, which supports this assumption.

In Appendix Figure A4, I conduct a robustness check where I estimate equation (4) relative to a placebo year. If I set the reference years to AY1966-AY1967—well before Title IX’s passage—I still see increased female entry into traditionally-male degree fields starting with degrees earned in AY1974.

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<sup>46</sup>These degrees are graduate degrees in health outside of health-professional degrees (medicine, dentistry, veterinary medicine, osteopathy, or optometry). Examples are Nursing, Occupational and Physical Therapy, Dental Hygiene, and Public Health.

Table 2: Change in Graduate Enrollment Levels

Outcome:	Female Graduate Enrollment			Total Graduate Enrollment			Female Share of Graduate Enrollment		
Reference Group (Funding Schools):	All	T1 (low)	T3 (high)	All	T1 (low)	T3 (high)	All	T1 (low)	T3 (high)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Academic Year Starting (Rel. to 1971)									
1969	13.29*** (4.911)	0.614 (6.517)	12.63 (11.93)	-116.4*** (26.03)	-73.21*** (19.29)	-139.4*** (50.49)	-0.00310 (0.00253)	-0.0167*** (0.00543)	-0.00238 (0.00354)
1970	-0.487 (3.638)	-4.413 (3.931)	-6.971 (7.945)	-23.35 (19.04)	-18.98* (10.84)	-22.17 (33.68)	-0.00140 (0.00263)	-0.00927** (0.00452)	0.000136 (0.00315)
1972	11.52*** (2.628)	2.550 (2.587)	20.80*** (6.576)	45.73*** (10.24)	12.35*** (3.846)	61.39*** (17.74)	0.0122*** (0.00190)	0.0126** (0.00581)	0.0113*** (0.00195)
1973	26.20*** (6.648)	6.529 (5.906)	41.36*** (9.090)	249.2*** (41.92)	68.08*** (13.89)	354.0*** (73.99)	0.0301*** (0.00291)	0.0263*** (0.00520)	0.0306*** (0.00350)
1974	45.21*** (6.851)	6.774 (8.336)	74.73*** (9.522)	330.8*** (47.45)	91.76*** (16.56)	453.8*** (80.04)	0.0430*** (0.00305)	0.0357*** (0.00572)	0.0446*** (0.00410)
1975	51.58*** (9.937)	4.433 (9.730)	96.70*** (16.49)	400.4*** (62.59)	129.5*** (19.58)	594.8*** (106.5)	0.0553*** (0.00438)	0.0529*** (0.00926)	0.0528*** (0.00414)
1976	72.21*** (7.688)	5.136 (7.415)	141.8*** (16.53)	195.8*** (44.77)	64.90 (46.33)	314.2*** (44.05)	0.0707*** (0.00423)	0.0679*** (0.00913)	0.0695*** (0.00413)
1977	82.33*** (8.014)	4.210 (6.882)	166.4*** (18.01)	192.2*** (49.59)	71.24 (47.07)	316.5*** (52.09)	0.0789*** (0.00499)	0.0722*** (0.0127)	0.0823*** (0.00495)
1978	98.36*** (8.538)	10.56 (8.036)	194.9*** (18.65)	180.7*** (44.45)	75.83 (45.37)	293.2*** (59.93)	0.0923*** (0.00501)	0.0838*** (0.0130)	0.0965*** (0.00505)
1979	114.2*** (9.116)	16.06* (8.141)	220.6*** (21.93)	167.1*** (50.62)	67.90 (47.52)	278.8*** (61.11)	0.108*** (0.00594)	0.106*** (0.0119)	0.107*** (0.00512)
1980	127.2*** (9.755)	20.75** (8.198)	238.6*** (22.56)	205.7*** (45.99)	76.88* (44.63)	340.2*** (59.28)	0.117*** (0.00493)	0.108*** (0.0103)	0.121*** (0.00537)
Observations	9,696	9,696	9,696	9,696	9,696	9,696	9,696	9,696	9,696
Female Mean in 1970	413	144	642	1,257	421	2,154	0.319	0.247	0.304

Source: HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.

Notes: This table reports annual changes in female graduate enrollment (columns 1-4), total graduate enrollment (columns 5-8), and female share of graduate enrollment (columns 9-12), relative to 1971. Each column reports estimates for a different reference group: all schools, Tercile 1 (low) funding schools, Tercile 2 (medium) funding schools, and Tercile 3 (high) funding schools. Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. Estimates control for school fixed effects and state fixed effects. Columns 1-4 and 9-12 also control for total graduate enrollment. Standard errors are clustered by state. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 3: Female-Male Difference in Earned Degrees

Outcome Variable:	%Male in Field (1)	T1 (low) %Fem. Share (2)	T3 (high) %Fem. Share (3)	Median Salary (4)
Academic Year Starting (relative to 1970)				
1964	-0.0269 (0.0207)	-0.0516 (0.0365)	-0.0553 (0.0472)	-372.5 (978.9)
1966	-0.00971 (0.0184)	-0.0135 (0.0344)	0.00681 (0.0399)	177.1 (901.0)
1968	-0.00763 (0.0180)	-0.00181 (0.0342)	-0.0113 (0.0382)	112.3 (883.0)
1972	0.00541 (0.0167)	-0.0193 (0.0318)	-0.00607 (0.0351)	594.6 (863.9)
1974	0.0251 (0.0156)	0.0317 (0.0302)	-0.0498 (0.0332)	1,663** (816.4)
1976	0.0419** (0.0165)	0.0624** (0.0317)	-0.100*** (0.0341)	2,120** (858.5)
1978	0.0452*** (0.0166)	0.0624* (0.0323)	-0.0875** (0.0342)	2,670*** (860.2)
1980	0.0345** (0.0168)	0.0435 (0.0329)	-0.0621* (0.0345)	2,913*** (898.6)
1982	0.0433** (0.0170)	0.0496 (0.0330)	-0.0983*** (0.0339)	2,683*** (915.0)
1984	0.0286* (0.0173)	0.0493 (0.0342)	-0.0588* (0.0349)	2,003** (922.9)
1986	0.0483*** (0.0166)	0.0846** (0.0334)	-0.0916*** (0.0335)	3,626*** (898.5)
Observations	19,514	19,514	19,514	19,514
Female Mean in 1970	0.492	0.078	0.805	\$40,881
Controls for:				
Birth year	Yes	Yes	Yes	Yes
Birth region	Yes	Yes	Yes	Yes
School region	Yes	Yes	Yes	Yes
Parental education	Yes	Yes	Yes	Yes
Linear time trend	Yes	Yes	Yes	Yes
BA major %female tercile	Yes	Yes	Yes	Yes
Number of BA degrees	Yes	Yes	Yes	Yes

Source: NSCG 1993 data.

Notes: Each column is a separate regression reporting the female-male difference in each year relative to 1970 for the field's share of males (column 1), T1 %female degree fields (column 2), T2 %female degree fields (column 3), T3 %female degree fields (column 4), and the field's expected salary (column 5). Fields of study are categorized by their mean share of females between 1960 and 1971. Standard errors are reported in parentheses. Columns 2 and 3 estimate robust standard errors. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

## 7 Alternative Explanations

This section examines other events occurring between the late 1960s and early 1970s that may also have affected women’s educational decisions. The main alternative explanations I consider are the end of the Vietnam War draft and law changes related to fertility. Substantial discussions of alternative explanations, including the Equal Employment Opportunity Act of 1972 and cohort-specific changes in high-school course-taking and career aspirations, can be found in the Appendix.

### Vietnam War and the End of Draft Deferments for Graduate School

U.S. military involvement in the Vietnam War began to escalate in the early 1960s under President Kennedy, and escalated even further between 1963 and 1969 under President Johnson. There were 112,386 inductions in 1964, more than doubling to 230,991 the following year.<sup>47</sup> Given the high draft numbers during the Vietnam War, it may not be surprising to learn that the number of deferments was also high.<sup>48</sup> Indeed, research has found that young men rushed to enroll in undergraduate and graduate programs in an effort to defer the draft (Chiswick et al., 2015; Singer, 1989). Then, on June 30, 1967, President Johnson signed Executive Order 11360, eliminating graduate school deferments. The exceptions were degrees in medicine, dentistry, veterinary medicine, osteopathy, or optometry (“health professional degrees”) (United States Selective Service System (Selective Service Report 1968), 1969). For this reason, I restrict the analysis sample to non-doctorate and non-health professional degrees, which were less affected by the draft deferment policy, to separate the effect of Title IX from the Vietnam War draft.

A careful examination of the timing reveals that the Vietnam War draft does not contaminate my analysis of non-doctorate, non-health professional graduate degrees. For example,

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<sup>47</sup>Induction statistics are taken from the Selective Service System’s online records at <https://www.sss.gov/About/History-And-Records/lottery1>.

<sup>48</sup>According to Selective Service System records, 1,857,304 men entered military service through the draft between August 1964 and February 1973. Statistics are taken from <https://www.sss.gov/About/History-And-Records/Induction-Statistics>.

deferments for graduate study ended in 1968 (with the exception of health professional degrees) so we may expect to see an impact on two-year graduate degrees in spring 1970 at the earliest. This is before Title IX’s passage.

## Fertility-Related Law Changes

Technological advances in and access to contraception were an important milestone in advancing female rights and civil liberties. It not only gave women sexual freedom, but it also lowered the cost of making long-term career investments. With greater certainty over the pregnancy consequences of sex, women no longer needed to worry about an unintended pregnancy interrupting their education or career.<sup>49</sup> In this section, I discuss two fertility-related law changes that may have affected women’s educational choices: the birth control pill and abortion.

When the birth control pill, *Enovid*, became publicly available in 1960, it was first available only to married women or to those above the age of majority. During the late 1960s, several states lowered their age of majority thereby granting a large set of single college-aged women access to the pill.<sup>50</sup> One concern is that changes in state laws, doctrines, and medical consent statutes resulted in sudden increased legal access to the pill for college-aged women, which may have influenced their educational decisions. Although states changed their laws in different years, in half of all U.S. states, 18 year olds gained legal access to the pill between 1971 and 1972 (Myers, 2017). Therefore, my findings may have been driven by increased access to the pill due to state-law changes rather than Title IX.

There are two reasons that I do not believe increased pill access among 18-20 year old women is driving my results. The first is that these state-law changes did not affect the cohorts of interest. Considering that the law was signed in June 1972, the earliest we would

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<sup>49</sup>For example, Hock (2007) finds that pill access increased college attainment for women. Goldin and Katz (2002) find evidence that pill availability lowered the costs of long-duration professional education for women.

<sup>50</sup>These legal changes came about mainly in response to the discrepancy in minor’s rights highlighted by the ongoing Vietnam War. In particular, 18-year old men were being drafted but were not allowed to vote until they were 21 (Paul et al., 1974).

expect to see an impact is on Fall 1972 applications. The youngest applicants would either be a rising senior in college or a recent college graduate.<sup>51</sup> This relates to students born in 1950 or 1951, who were already at the age of majority when most of these state laws changed. This means they already had access to the pill. In fact, female students were able to obtain the pill on campus prior to these law changes: a 1970 study that surveyed prescription and dispensing practices of contraception on college campuses found that 63 percent of college physicians prescribed hormonal contraceptive medications and 77 percent of colleges that did so prescribed them to unmarried women (Barbato, 1970).

The second reason I do not think increased pill access is a major confounder is that I find differential effects by the field’s gender parity (see Figure 4). As the pill lowered the cost of making long-term career investments, pill access may have influenced a young woman’s decision to pursue a doctoral degree or a medical degree, both of which require a long training period. But conditional on the type of degree, it is hard to imagine how pill access would have a differential effect by field-of-study. For example, after Title IX, female M.A. degrees in engineering grew at a faster rate than female M.A. degrees in education. It is unclear why pill access would affect a woman’s decision to pursue an engineering degree rather than an education degree. This result would not necessarily be predicted by a “pill access” story, but is consistent with a “barriers-to-entry” story.

As a robustness check, I attempt to disentangle the impact of pill access from Title IX by focusing on individuals who had pill access when they began college (see Appendix Table D2). I estimate equation (3), but restrict the sample to states that passed laws allowing 19 year olds to obtain the pill before 1967. These states are: Alaska, Arkansas, Idaho, Illinois, Kentucky, Mississippi, Montana, Nevada, North Dakota, Ohio, Oklahoma, and Utah. This allows me to isolate the impact of teen pill access from Title IXs passage in 1972, which I would expect would be larger at T3 funding schools. Consistent with my previous results, I

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<sup>51</sup>Although it is certainly possible for women to take time off in-between graduate and undergraduate studies, highlighting the age of the youngest possible applicants is helpful when examining this alternative explanation.

find that female graduate enrollment increased in T3 funding schools and fell in T1 funding schools.

To disentangle the impact of abortion legalization from Title IX, I again estimate equation (3), but restrict the sample to states that legalized abortion before *Roe v. Wade* (“repeal states”). These states are Alaska, California, Hawaii, New York, and Washington. Again, I find that female graduate enrollment increased more sharply in T3 funding schools than in T1 funding schools (see Appendix Table D2).

## Other Alternative Explanations

I also consider the possibility that the Equal Employment Opportunity Act of 1972 (EEOA) affected women’s educational choices. Although anti-discrimination laws in the labor market existed since the early 1960s<sup>52</sup>, enforcement powers were relatively weak. For example, the Civil Rights Act of 1964 created the U.S. Equal Employment Opportunity Commission (EEOC) but it “possessed no authority to force recalcitrant employers and unions to comply with the law” (U.S. Equal Employment Opportunity Commission, 1972, p. 1). This changed with EEOA, which gave the EEOC the power to bring civil actions against private employers. The Act also expanded the jurisdictional coverage of Title VII to employers with 15 or more employees, as well as to local and state governments and educational institutions. In the Appendix, I examine whether women were more likely than men to pursue traditionally-male degree fields in states where EEOA strengthened labor laws. These states were predominantly in the south. I find that women were more likely to pursue traditionally-*female* degrees in these states. One interpretation of this finding is that Title IX, potentially combined with EEOA, may have had a larger impact on increasing female educational attainment overall, particularly as these states in the south also prescribed

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<sup>52</sup>For example, the Equal Pay Act, which prohibited wage discrimination in sex, passed in 1963. Title VII of the Civil Rights Act of 1964 prohibited job discrimination because of sex in addition to race, color, religion, and national origin. In 1965, President Johnson signed Executive Order 11246, banning federal contractors from discrimination in employment based on sex as well as race, color, religion, and national origin.

more strongly to traditional gender norms.

Last, I consider the possibility of a cohort-specific change in preferences as an alternative explanation. As graduate degrees are positively correlated with undergraduate majors, if young female high-school students are suddenly more interested in traditionally-male subjects vis-a-vis their predecessors, that may explain the increase in female graduate degrees in these fields. The two changes I examine are a change in high-school course taking among females and a change in career aspirations. Using the National Longitudinal Survey of Young Women, I examine how high-school math courses and career aspirations evolved across birth cohorts. I do not find evidence of a sudden change in course-taking or career aspirations.

## 8 Discussion

During the 1960s, nearly 16 percent of working women were secretaries, administrative assistants, and office clerks.<sup>53</sup> By 2000, the occupational distribution for women looked very different. Thirty-six percent of U.S. lawyers and judges and 32 percent of U.S. physicians and surgeons were female.<sup>54</sup> The female-male occupational convergence has important implications; the reallocation of female talent between 1960 and 2000 is estimated to explain 25 percent of the growth in U.S. GDP per capita (Hsieh et al., 2019). Hsieh et al. (2019) also find that declining obstacles to accumulating human capital were more important than declining labor market discrimination in explaining the convergence. A contribution of my paper is the examination of the removal of a specific human capital barrier, Title IX, and its resulting impact.

I find that female graduate enrollment increased by an average of 18.7 percent following Title IX's passage. Further, women entered male-dominated fields suggesting that barriers to entry were the reason for pre-existing sex disparities in graduate education rather than differing preferences between men and women. This is further supported when I compare

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<sup>53</sup>This number is based off women aged 35 to 45 in the 1960 Census IPUMS 5 percent sample and the 1965-1969 Current Population Survey.

<sup>54</sup>These statistics are based off the 2000 Census IPUMS 5 percent samples for people aged 35 to 45.



schools that are more federally dependent to schools that are less federally dependent. That I find stronger effects among more federally dependent schools would not necessarily be predicted by gender-specific preferences, but is consistent with a barriers-to-entry story.

Although Title IX may be considered an exogenous reduction in barriers to entry for women, other events may have occurred around the same time that prevent me from making a causal claim. For example, the draft ended in 1973, meaning the rush of young men enrolling in graduate programs to avoid the Vietnam War also ended. The sudden ebb of male enrollment may have allowed women to fill the void, thereby resulting in a sudden increase in the number of women with graduate degrees. To bypass this problem, I focus my analysis on non-doctorate, non-health professional graduate degrees, which constitute 86 percent of graduate degrees.<sup>55</sup> Draft deferments to these graduate programs ended in 1968, thereby allowing me to separate the effect of Title IX from the Vietnam War draft. Second, I consider law changes regarding fertility control. A literature finds that technological changes in fertility control affected female educational and occupational decisions (Bailey, 2006, 2010; Goldin, 1988; Goldin and Katz, 2002; Myers, 2017). Consistent with my main results, I find that female graduate enrollment increased more at schools with a greater incentive to comply with the law.

One interesting question is why Title IX was successful in reducing inequality in schools while past laws were not. A possible reason is the existence of an enforcement mechanism. For example, *Brown v. Board of Education* ruled that segregated schools are unconstitutional, but it offered no guidelines on how to comply with the ruling.<sup>56</sup> In contrast, compliance regulations for Title IX were clearly stated and communicated to schools. The HEGIS Fall Enrollment Survey, for example, which has been administered to all U.S. post-secondary institutions since 1968, included a page post-Title IX that clearly states that completion of

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<sup>55</sup>This statistic is calculated using earned degrees data from the Higher Education General Information Survey between 1965 and 1981. Health professional degrees are graduate degrees in medicine, dentistry, veterinary medicine, osteopathy, or optometry.

<sup>56</sup>Reardon and Owens (2014) document that schools did little to reduce racial segregation immediately following the *Brown v. Board of Education* in 1954. Rather, most of the segregation decline occurred after 1968.

the survey is mandatory for “all institutions of higher education which receive, are applicants for, or expect to be applicants for Federal financial assistance” (Codebook for HEGIS 1976 Fall Enrollment Survey). The data also support this explanation; institutions that relied more on federal funding experienced larger female enrollment and saw greater gender convergence in the distribution of fields of study. In terms of policy geared towards reducing gender disparity in education, this paper provides optimistic evidence for the role of legislation.

It is also important to recognize the limits of legislation. Title IX, for example, has been in place for almost 50 years, and yet gender gaps still exist in education, occupation, and earnings.<sup>57</sup> Although legislation, such as Title IX, the Equal Pay Act, and the Civil Rights Act, was effective in closing gender and racial gaps, it did not close them completely. The first generation of women had to demonstrate the need for access into all-male institutions, and Title IX and similar laws served to legitimize this need by banning direct and overt forms of discrimination. However, these laws have been less effective in addressing more subtle and complex forms of discrimination. These “second-generation” forms of bias arise from social practices and patterns of interaction, networking, and mentoring.<sup>58</sup> Although current anti-discrimination laws may have teeth in disparate treatment cases, where there is intentional differential treatment by sex, their effectiveness in disparate impact cases, where differential treatment is unintentional, is less clear. However, not all is lost. [Sturm \(2001\)](#), for example, describes how the law can legitimize the pursuit of fair and equal practices even if it lacks short-term economic payoffs.

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<sup>57</sup>For example, according to the 2019 Survey collected by the Committee on the Status of Women in the Economics Profession, women comprised 37 percent of undergraduate economics majors in 2019 and 32 percent of Economics Ph.D. students.

<sup>58</sup>For example, workplace policies that allows employees to negotiate their salary, allows senior colleagues to assign tasks, or extends parental leave to both men and women may unknowingly contribute to gender disparities in pay or promotion because women are worse negotiators ([Card et al., 2016](#)), more likely to accept less desirable tasks ([Babcock et al., 2017](#)), and less likely to devote time to work while on parental leave ([Antecol et al., 2018](#)).

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