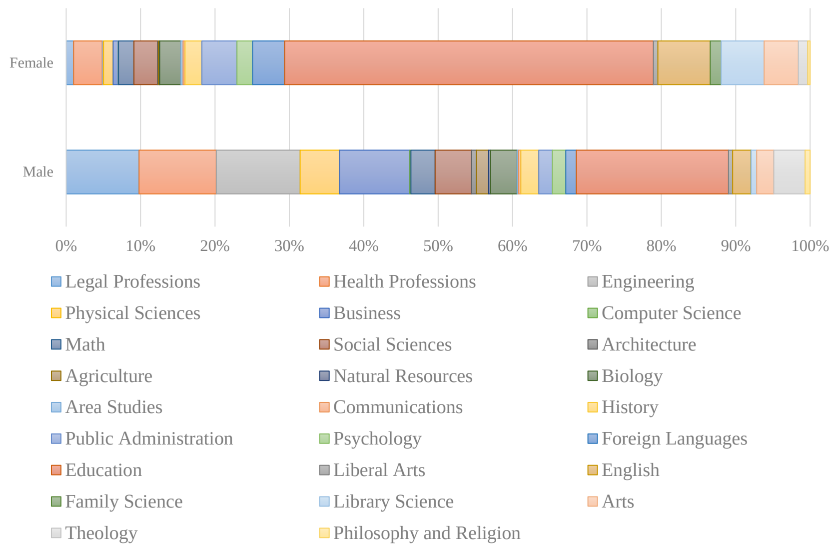
Appendix for "The Effect of Title IX on Gender Disparity in Graduate Education"

A Additional Results

Figure A1: Distribution of Graduate Fields of Study in Academic Year 1965-1966 by Sex



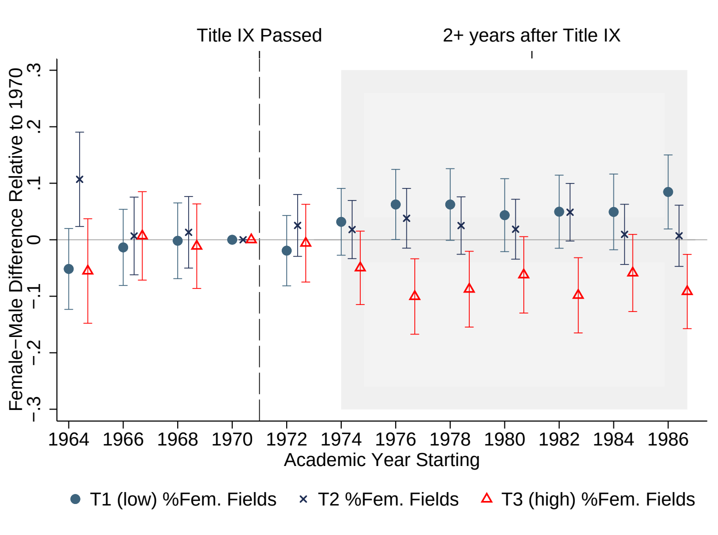
Source: HEGIS 1965 Earned Degrees data.
Notes: N = 190,507. This figure depicts the field's share of graduate degrees conferred in academic year 1965 separately by sex. Fields are listed in decreasing order of median salary.

Figure A2: Comparison of EMD using Alternative Field Rankings

(a) NSCG data (b) HEGIS data

Source: NSCG 1993 data and HEGIS 1969-1980 Earned Degrees data.
Notes: This figure plots the Earth Mover's Distance (EMD) values between female and male distributions of graduate field of study indexed to 1960, separately by alternative methods to order graduate degree fields. "Original EMD" uses a rank ordering of the graduate-degree field's expected salary. "EMD using Salary" uses the field's actual expected salary instead of a rank ordering. "EMD using 1960-69 Salary" uses the field's pre-Title salary between 1960 and 1969.

Figure A3: Gender Difference in Earned Degrees by Gender Parity

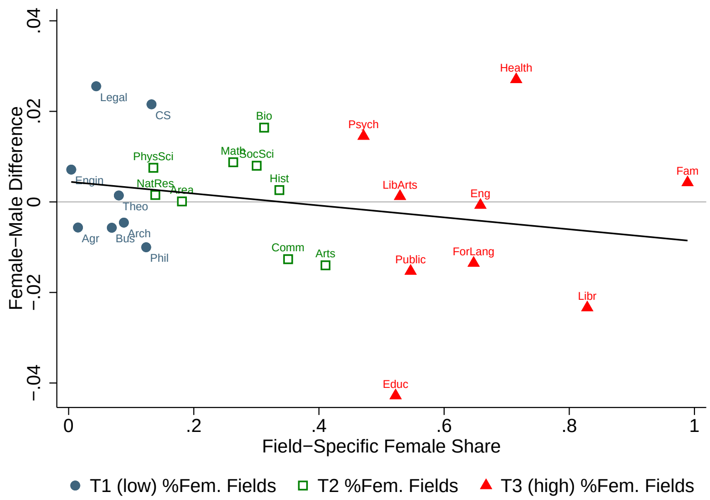


Source: NSCG 1993 data.
Notes: N = 19,514. Dots depict the annual female-male difference in degrees relative to 1970 separately for Tercile 1 (low) %female degree fields, Tercile 2 %female degree fields, and Tercile 3 (high) %female degree fields. See notes in Figure 4.

Figure A4: Gender Difference in Earned Degrees by Placebo Year

Source: NSCG 1993 data.
Notes: N = 19,514. This figure reports estimates from a placebo difference-in-differences regression. Dots depict the annual female-male difference in degrees relative to 1966 (placebo year) separately for Tercile 1 (low) %female degree fields and Tercile 3 (high) %female degree fields. See notes in Figure 4.

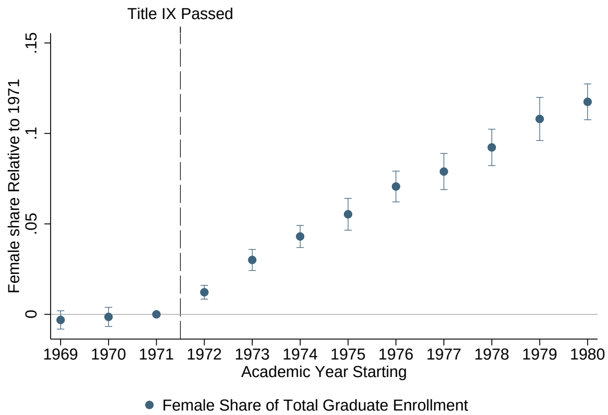
Figure A5: Gender Difference in Earned Degrees by Field of Study



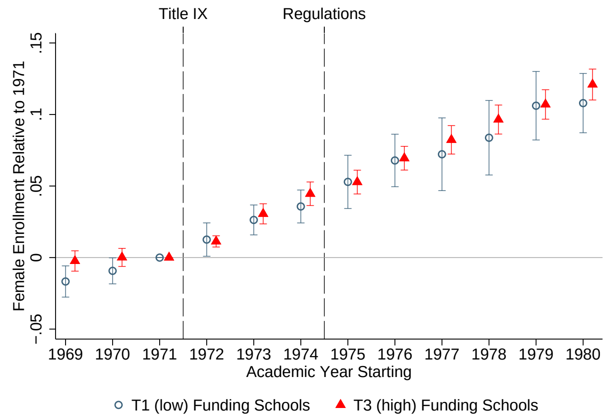
Source: NSCG 1993 data.
Notes: Dots depict the female-male difference in degrees earned in 1974 separately for each degree field. Fields of study are categorized into terciles by their mean share of females between 1960 and 1971: Tercile 1 (low) %female degree fields, Tercile 2 %female fields, and Tercile 3 (high) %female degree fields. See notes in Figure 4.

Figure A6: Change in Female Share of Graduate Enrollment

(a) All Schools

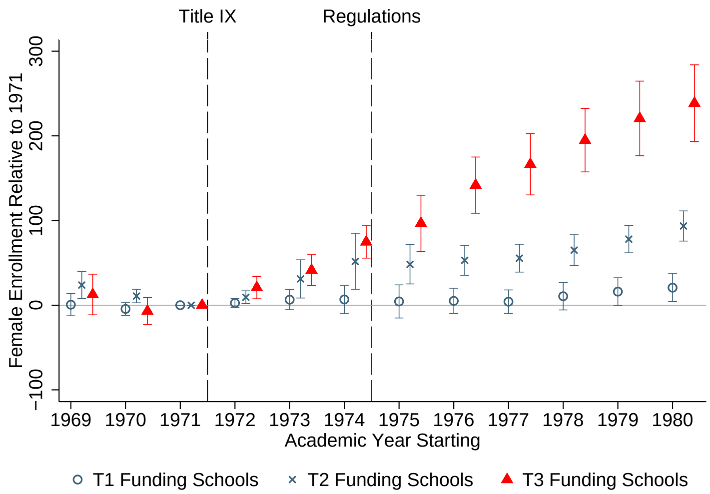


(b) By Federal-Funds Share



Source: HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.
Notes: N = 9,696. Dots depict annual changes in female share of enrollment relative to 1971 for all schools (Panel A) and by federal-funds share (Panel B). See notes in Figure 3.

Figure A7: 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 share of enrollment relative to 1971 for Tercile 1 (low) funding schools, Tercile 2 funding schools, and Tercile 3 (high) funding schools. See notes in Figure 4.

Table A1: List of Major Fields of Study by Salary Tercile

Fields in the Top Salary Tercile
Architecture and Related Services
Business, Management, Marketing, and Related Support Services
Computer and Information Sciences and Support Services
Engineering
Legal Professions and Studies
Mathematics and Statistics
Natural Resources and Conservation
Physical Sciences
Social Sciences
Fields in the Middle Salary Tercile
Agriculture, Agriculture Operations, and Related Sciences
Area, Ethnic, Cultural, Gender, and Group Studies
Biological and Biomedical Sciences
Communication, Journalism, and Related Programs
Foreign Languages, Literatures, and Linguistics
Health Professions and Related Programs
History
Liberal Arts and Sciences, General Studies and Humanities
Public Administration and Social Service Professions
Fields in the Bottom Salary Tercile
Education
English Language and Literature/Letters
Family and Consumer Sciences/Human Sciences
Library Science
Philsophy and Religious Studies
Psychology
Theology and Religious Vocations
Visual and Performing Arts

Source: NSCG 1993 data.
Notes: Ranking for non-doctorate, non-health professional graduate degrees earned between 1960 and 1990, inclusive.

Table A2: List of Major Fields of Study by Gender Parity

Tercile 1 (Low) Percent-Female Fields ("Traditionally Male")
Agriculture, Agriculture Operations, and Related Sciences
Architecture and Related Services
Business, Management, Marketing, and Related Support Services
Computer and Information Sciences and Support Services
Engineering
Legal Professions and Studies
Philsophy and Religious Studies
Physical Sciences
Theology and Religious Vocations
Tercile 2 (Medium) Percent-Female Fields
Area, Ethnic, Cultural, Gender, and Group Studies
Biological and Biomedical Sciences
Communication, Journalism, and Related Programs
History
Mathematics and Statistics
Natural Resources and Conservation
Psychology
Social Sciences
Visual and Performing Arts
Tercile 3 (High) Percent-Female Fields ("Traditionally Female")
Education
English Language and Literature/Letters
Family and Consumer Sciences/Human Sciences
Foreign Languages, Literatures, and Linguistics
Health Professions and Related Programs
Liberal Arts and Sciences, General Studies and Humanities
Library Science
Public Administration and Social Service Professions

Source: NSCG 1993 data.
Notes: Ranking for non-doctorate, non-health professional graduate degrees earned between 1960 and 1971, inclusive.

B Convergence Methods

I use two different methods to measure gender convergence. The first is the Segregation Index, also known as the Index of Dissimiliarity, developed by Duncan and Duncan (1955). 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, Brummund, and Liu, 2013). It is calculated as follows:

$$S_t = (0.5) \cdot \sum_i |m_{it} - f_{it}| \tag{5}$$

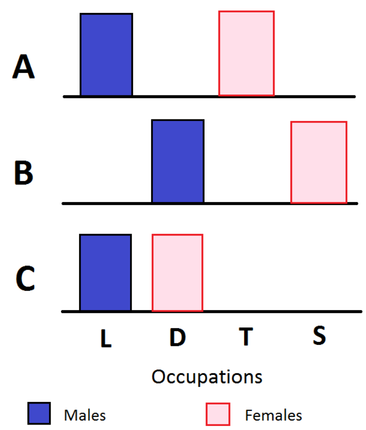
where m_{it} is the share of all male graduate students in degree-field i in year t and f_{it} is the share of all female graduate students in field i in year t. This measure indicates the share of women (or men) who would have to change graduate fields for the overall distributions of men and women to be identical. For example, if the share of women in all fields is the same as their share of total graduate degrees, then the segregation index is 0. Therefore, larger values indicate greater segregation (divergence) and smaller values indicate greater integration (convergence).

As is clear from the formula, the segregation index does not consider the ordering of the fields of study. 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 specifically which field these women move to or where they moved from. In some cases, however, this is an important detail. I illustrate this point with a simple example below.

Say we would like to measure gender segregation in the occupation distribution. For simplicity, assume there are four occupation categories: L, D, T, and S. Figure B1 presents three different examples of occupation distributions by gender: A, B, and C. The segregation index for all three scenarios is equal to 100 ($= 0.5 \cdot (|100 - 0| + |0 - 100|)$). According to the segregation index, these three distributions have the same level of gender segregation.

Let us add some structure and assume that L is Lawyers, D is Doctors, T is Teachers, and S is Secretaries. Lawyers and Doctors are highly-paid occupations while Teachers and Secretaries are lower-paid. Now it matters which occupations men and women are segregated into, and it is less clear that segregation is the same for these three distributions. Distributions A and B seem similar in that men are in high-paid occupations and women in low-paid occupations. In contrast distribution C is different, with both men and women in high-paid occupations (men are lawyers and women are doctors); somehow distribution C is less unequal or segregated than A or B because in C men and women are in similarly paid

Figure B1: Convergence Measure Example



occupations.

The distinction between A and B on the one hand and C on the other arises because, when assessing the level of gender segregation, we inherently assign values to occupations. The value induces an ordering and distance (metric) for the occupations, and how *far* we move matters. Figure B1 is drawn to reflect this ordering, with the occupations ordered along the x-axis according to wage: Lawyers earn more than Doctors, Doctors more than Teachers, and Teachers more than Secretaries. The ordering in Figure B1 has meaning.

Consider again distributions A and B versus C. Distribution A is a society where all women are teachers and all men are lawyers. Lawyers and teachers are far apart, as measured by wage. For distribution B, men and women are also far apart. Distribution C, however, represents a world where men and women are closer. This is the sense in which distributions A and B are more segregated or divergent than distribution C; if we want to move men and women to be in the same occupation, for distribution C we do not have to move people very far (in terms of wages). To relate this to the segregation index, for gender inequality we care about *where* we move that 30 percent of women relative to where they came from. A woman moving from a low-wage, female-dominated occupation to a high-wage, male-dominated occupation would indicate more convergence (decreasing segregation) compared to moving her to a low-wage, male-dominated occupation.

The Earth Mover's Distance (EMD) 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 move one distribution (the women) to the other distribution (the men) and keeping track of *how far* the women have to be moved. In other words, the EMD is the minimal cost that must be paid to transform one distribution into the other. Say we have a male distribution of K graduate fields, $M = [m_1, \cdots, m_i, \cdots, m_K]$, and a female distribution of K graduate fields, $W = [w_1, \cdots, w_j, \cdots, w_k]$. To transform distribution M to distribution W, the EMD is defined as follows:

$$\text{EMD}(M, W) = \frac{\sum_{i=1}^{K} \sum_{j=1}^{K} d_{ij} f_{ij}}{\sum_{i=1}^{K} \sum_{j=1}^{K} f_{ij}} \tag{6}$$

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.

EMD measures where and how far probability mass must be moved when transforming the female into the male distribution, and so the ordering of categories is non-trivial. In my application, I order graduate fields by expected salary. I define a field's expected salary as the median salary for everyone who obtained a graduate degree in that field between 1962 and 1991. 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. I use a rank ordering and define the distance between fields as one-unit of Euclidean distance.

C The Earth Mover's Distance (EMD) Algorithm

The Earth Mover's Distance is a metric that measures the difference between two distributions that considers both within-bin and cross-bin differences. In a nutshell, it is the minimal cost that must be paid to transform one distribution into the other. Computation of EMD is borne from the transportation problem. Suppose that several suppliers, each with a given amount of goods, are required to supply several consumers, each with a given limited capacity. For each supplier-consumer pair, the cost of transporting a single unit of goods is given. The transportation problem is then to find a least-expensive flow of goods from the suppliers to the consumers that satisfies the consumers' demand. The following formalization of EMD is reproduced from Rubner, Tomasi, and Guibas (2000) for the reader's convenience. The notation has been adapted to apply to the context of occupational convergence.

The computation of EMD can be formalized by the following linear programming problem:

Let

$$M = \{(m_1, s_1^m), \cdots, (m_K, s_K^m)\}$$

be the male occupation distribution with K occupation categories, where m_i is occupation i and s_i^m is the share of males in occupation i.

Analogously, let

$$W = \{(w_1, s_1^w), \cdots, (w_K, s_K^w)\}$$

be the female occupation distribution with K occupation categories; and let $\mathbf{D} = [d_{ij}]$ be the difference matrix where d_{ij} is the difference between occupations m_i and w_j, that minimizes the overall cost

$$WORK(M, W, \mathbf{F}) = \sum_{i=1}^{K} \sum_{j=1}^{K} d_{ij} f_{ij},$$

subject to the following constraints:

$$\begin{aligned} f_{ij} &\geq 0, \quad 1 \leq i \leq K, \quad 1 \leq j \leq K && (7) \\ \sum_{i=1}^{K} f_{ij} &\leq s_i^m, \quad 1 \leq i \leq K && (8) \\ \sum_{j=1}^{K} f_{ij} &\leq s_i^w, \quad 1 \leq j \leq K && (9) \\ \sum_{i=1}^{K}\sum_{j=1}^{K} f_{ij} &= \min\left(\sum_{i=1}^{K} s_i^m, \sum_{j=1}^{K} s_i^w\right) && (10) \end{aligned}$$

Constraint (7) allows moving people from M to W and not vice versa. Constraint (8) limits the number of males who can be moved in an occupation to their share (i.e., if 30 percent of males are doctors, the number of male doctors who can be moved to another occupation is limited to that 30 percent). Constraint (9) is the analog for occupation categories in F; and constraint (10) forces to move the maximum number of people possible. This maximum number is called the total flow. Once the transportation problem is solved, and the optimal flow F is found, the earth mover's distance is defined as the resulting work normalized by the total flow:

$$EMD(M, F) = \frac{\sum_{i=1}^{K}\sum_{j=1}^{K} d_{ij} f_{ij}}{\sum_{i=1}^{K}\sum_{j=1}^{K} f_{ij}}$$

The normalization factor is the total weight of the smaller distribution, because of constraint (10). Thus, the EMD naturally extends the notion of the dissimilarity between two distributions.

D Alternative Explanations

D.1 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.[59] Given the high draft numbers during the Vietnam War, it may not be surprising to learn that the number of deferments was high.[60]

Class II-S deferments allowed a male individual pursuing undergraduate or graduate studies to defer his induction. Those pursuing undergraduate studies were allowed to defer until they graduated or until they reached their 26th birthday, whichever came first (Selective Service Report 1966). Those pursuing a master's degree were allowed to defer for one year, while those pursuing a Ph.D. or a professional degree were allowed to defer up to five years (Samuelson, 1967; Executive Order 11360). Deferments were granted as long as the student was enrolled full-time and remained in good standing.

On June 30, 1967, President Johnson signed Executive Order 11360, eliminating graduate school deferments except for those "satisfactorily pursuing a course of graduate study in medicine, dentistry, veterinary medicine, osteopathy or optometry, or in such other subjects necessary to the maintenance of the national health, safety, or interest as are identified by the Director of Selective Service upon the advice of the National Security Council." Although mathematics, engineering, and natural sciences were included in initial discussions of exempted fields of study, they are excluded from the final list of graduate fields (Samuelson, 1967; Selective Service Report 1967; "New Draft Policy to Cut Graduate School Enrollment", 1969). The July-December 1968 Semi-Annual Report of the Director of Selective Service specifies that Class II-S postgraduate deferments may be extended only to students pursuing medicine, dentistry, veterinary medicine, osteopathy, or optometry (hereafter referred to as "health professional degrees").

The amendment to the Selective Service Regulations did not affect those who were in their second or subsequent year of graduate studies as of October 1, 1967. Those students were grandfathered into the original deferment policy. However, students who were accepted or enrolled in their first year of graduate study as of October 1, 1967 were only able to defer

[59] Induction statistics are taken from the Selective Service System's online records at https://www.sss.gov/About/History-And-Records/lotter1.

[60] 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.

for one academic year.

As women were not eligible to be drafted, the Vietnam War did not affect female enrollment directly. However, the draft may have affected women indirectly through male enrollment. Although it is unknown exactly how many graduate students had enrolled on account of the draft deferment policy[61], as men comprised a majority of graduate students the new policy was expected to have a significant impact on enrollment. Therefore, the Vietnam War draft may have affected female graduate enrollment twice: first in 1968, with the end of graduate school deferments except for health professional degrees, and second in 1973, with the end of the draft.[62] The concern is that these events coincide with Title IX's passage, preventing me from disentangling the two effects.

A careful examination of the timing reveals that the Vietnam War draft presents a challenge for doctoral and health professional degrees. Due to the new draft policy, we may expect to see an impact on female doctoral degrees beginning with Fall 1969 enrollment. However, the timing of earned degrees is complicated by the fact that time-to-degree differs significantly by field. For example, Physics PhDs take, on average, six years to complete while History takes ten. Students pursuing health professional degrees were not affected by the new draft deferment policy in 1968 since those degrees were still exempt from the draft. Instead, they were affected by the end of the draft altogether in January 1973 and the close timing with Title IX's passage in June 1972 makes it difficult to disentangle the two effects.

For this reason, I restrict the analysis sample to non-doctorate, non-health professional graduate degrees, which were less affected by the draft deferment policy. 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.

D.2 Fertility-Related Law Changes

D.2.1 Minors' increased access to the birth control pill

The introduction of *Enovid* in 1960 as an oral contraceptive was 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

[61] The Selective Service reports do not distinguish between deferments for undergraduate study v. graduate study.

[62] The Selective Service announced on January 27, 1973 that there would be no more draft calls. The last draft call had occurred on December 7, 1972.

pregnancy interrupting their education or career.[63] When *Enovid* became publicly available, it was first available only to married women or to those above the age of majority. In other words, an unmarried woman above the age of majority (i.e., a woman older than 21 in most states) was legally able to obtain the pill. 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.[64]

Aside from changes in the age of majority, there were other legal ways that unmarried minors could obtain the pill. Under common law, informed consent is necessary for a physician to provide medical services (including contraception), and minors are generally considered incapable of providing informed consent. One legal way around this issue is state-specific medical consent statutes that give minors the ability to consent to medical care. Another legal way around this issue is if the state has judicial or legislative recognition of a mature minor doctrine, which allowed a minor to consent to medical care if "she is judged capable of understanding the nature and potential consequences of treatment" (Myers, 2017).

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, 2016). Therefore, the observed discontinuity in graduate-field convergence 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 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.[65] This relates to students born in 1950 or 1951, who were already at the age of majority when most of these state laws changed (see Table **??**). 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).

[63] For example, Hock (2007) finds that pill access increased college attainment for women. Goldin and Katz (2002) find that pill availability lowered the costs of long-duration professional education for women.

[64] 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).

[65] 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.

Table D1: Example Schooling Histories by Birth Cohort

		Person born in 1950		**Person born in 1951**	
Year	**Term**	**Age**	**Schooling History**	**Age**	**Schooling History**
1968	Fall	18	Start BA	17	
1969	Fall	19		18	Start BA
1970	Fall	20		19	
1971	Fall	21		20	
1972	Spr	22	Graduate BA	21	
	Fall		Apply to grad school		Apply to grad school
1973	Spr	23		22	Graduate BA
	Fall		Start MA		Start MA
1974	Spr	24		23	
	Fall				
1975	Spr	25	Graduate MA	24	Graduate MA
	Fall				

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. 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. As the 1950 and 1951 birth cohorts are the populations of interest, I restrict the NSCG data to graduate-degree holders born in states that passed laws allowing 19 year olds to obtain the pill before 1967.[66] These states are: Alaska, Arkansas, Idaho, Illinois, Kentucky, Mississippi, Montana, Nevada, North Dakota, Ohio, Oklahoma, and Utah. I estimate equation (3) in the main paper, but restrict the sample to these twelve states. This allows me to isolate the impact of teen pill

[66] To the extent that students may attend college out-of-state, this analysis does not fully control against pill access. However, the percentage of students that attend college in-state is pretty high. For example, in Fall 1992 more than 80 percent of new undergraduate students attended college in their home state. This statistic is from the National Center for Educational Statistics and retrieved from https://nces.ed.gov/programs/digest/d95/dtab197.asp.

access from Title IXs passage in 1972, which I would expect would be larger at T3 funding schools.

Table D2: Pill and Abortion Analysis

Outcome Variable:	Female Graduate Enrollment			
States:	Teen Pill Access States		Repeal States	
Reference Group (Funding Schools):	T1 (low) (1)	T3 (high) (2)	T1 (low) (3)	T3 (high) (4)
Academic Year Starting (relative to 1971)				
1969	24.80	47.06*	-21.78*	-26.66
	(14.85)	(22.42)	(8.930)	(18.30)
1970	1.401	15.60	-18.28	-16.96
	(1.305)	(15.73)	(8.377)	(14.62)
1972	0.410	33.54	11.58*	26.64
	(1.830)	(20.06)	(4.090)	(22.00)
1973	-10.60*	21.66	21.81	80.10***
	(5.465)	(18.17)	(16.43)	(7.951)
1974	-15.35	44.52**	27.80	88.30**
	(9.951)	(19.31)	(23.30)	(26.90)
1975	-26.38**	44.15	34.70	154.5***
	(8.354)	(27.68)	(25.88)	(12.90)
1976	-17.13	108.4**	14.30	188.0**
	(14.15)	(37.42)	(19.52)	(37.04)
1977	-19.56*	142.4***	12.88	214.6***
	(9.830)	(37.44)	(17.56)	(31.47)
1978	-9.446	169.5***	20.71	234.7***
	(11.80)	(37.88)	(22.52)	(22.19)
1979	-2.643	198.2***	26.81	275.4***
	(7.026)	(45.10)	(23.02)	(36.00)
1980	10.27	209.6***	27.41	292.7***
	(11.28)	(48.89)	(25.20)	(37.12)
Observations	1,627	1,627	2,138	2,138

Source: NSCG 1993 data; HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.
Notes: This table reports annual changes in female graduate enrollment in states that granted pill access to 19-yr olds before 1967 (columns 1-2) and in repeal states that legalized abortion before *Roe v. Wade* (columns 3-4). Estimates control for school fixed effects and total graduate enrollment. The reference group in columns 1 and 3 are Tercile 1 (low) funding schools and Tercile 3 (high) funding schools in columns 2 and 4. Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. Standard errors in parentheses are clustered by state. *** $p< 0.01$, ** $p< 0.05$, * $p< 0.1$

Columns 1 and 2 in Table D2 report the annual change in female graduate enrollment relative to 1971 for T1 funding schools and T3 funding schools, respectively. I expect female graduate enrollment to be larger at T3 funding schools, which relied more heavily on federal funds. This is what the table shows. The estimates for T3 funding schools (column 2) are positive, while the estimates for T1 funding schools (column 1) are negative. Further, the estimates in column 2 become statistically significant at the 5% level starting with Fall 1974 enrollment, which is what we would expect if Title IX were driving the results.

Related to this alternative explanation is the 1972 U.S. Supreme Court ruling *Eisenstadt v. Baird*, which granted unmarried persons legal access to the pill. *Eisenstadt v. Baird* was a challenge of a specific state law (Massachusetts) that prohibited the sale of contraceptives to unmarried people (Eisenstadt v. Baird, 1972).[67] I do not believe that this Supreme Court ruling is driving my results because: (1) this court case was a challenge to one specific state's law, and many other states were already allowing unmarried women to obtain the pill legally; and (2) the ruling would not have affected my birth cohorts of interest, as discussed above.

D.2.2 Abortion Legalization with *Roe v. Wade* (1973)

To disentangle the impact of abortion legalization from Title IX, I estimate equation (2) 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. Columns 3 and 4 in Table D2 report results. Consistent with the rest of my results, I find that female graduate enrollment increased more sharply in T3 funding schools than in T1 funding schools. Again, the timing aligns with Title IX's passage, with coefficients increasing almost four-fold from Fall 1972 to Fall 1973 (26.6 to 80.1) and becoming significant at the 1% level.

D.3 Equal Employment Opportunity Act of 1972

This section explores 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[68], 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 the Equal Employment Opportunity Act of 1972, 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.

[67] After the 1965 Supreme Court ruling in *Griswold v. Connecticut* established the right of married persons to use birth control without governmental inference, many states repealed or substantially liberalized their anti-contraception laws. Massachusetts, on the other hand, amended its Comstock law to prohibit the sale of contraceptives to unmarried people (Myers, 2016). This is the law that was challenged and struck down in *Eisenstadt v. Baird*.

[68] 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.

To examine the impact of the Equal Employment Opportunity Act, I follow a similar methodology to Chay (1998), which exploits the fact that some states already had fair employment practice (FEP) laws prior to EEOA. According to Chay (1995), state FEP laws were very similar to Title VII and also established commissions that had enforcement powers. In fact, under Title VII, the EEOC was to defer the processing of discrimination charges to states with FEP laws. However, not all states had FEP laws. Most of the states with weak or no FEP laws were in the south (Chay, 1995, Appendix Table 1). For example, eight of the nine states with no FEP laws were in the South: Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina, Tennessee, and Virginia. Florida, North Carolina, and Texas had laws for public enforcement only. In contrast, "almost all of the states outside the South had FEP laws with more extensive coverage than that required by the 1972 EEOA" (Chay, 1998, p. 610). Following the classification in Appendix Table 1 in Chay (1995), I separate states into those with weak or no FEP laws ("Weak") or not ("Strong") and estimate a triple difference regression comparing the number of female degrees by gender-parity tercile. Terciles are based on the degree field's average female share of degrees between 1960 and 1971. The model is as follows:

$$\begin{aligned} Y_{ift} = {} & \beta_0 + \beta_1 Weak_i + \beta_2 Post_t + \beta_3 \big(Weak_i \times Post_t\big) + \beta_4 Mid_f + \beta_2 High_f \\ & + \beta_5 \big(Mid_f \times Weak_i\big) + \beta_6 \big(High_f \times Weak_i\big) + \beta_7 \big(Mid_f \times Post_t\big) + \beta_8 \big(High_f \times Post_t\big) \\ & + \beta_9 \big(Mid_f \times Post_t \times Weak_i\big) + \beta_{10} \big(High_f \times Post_t \times Weak_i\big) + X'\gamma + u_{ift} \end{aligned} \tag{11}$$

where Y_{ift} is the number of female graduate degrees in field tercile f conferred by school i and year t; $Weak_i$ is an indicator variable for whether school i had weak or no FEP laws prior to the 1972 EEOA; $Post_t$ is equal to 1 if the degree year is in spring 1975 or later and 0 otherwise; Mid_f and $High_f$ are indicator variables for whether degree field f is in Tercile 2 ("Mid") or in Tercile 3 ("High") according to its mean share of female degrees; and X is a vector including year fixed effects, total graduate enrollment, field fixed effects, school fixed effects, state fixed effects, and school-field fixed effects. The reference group is female degrees in fields with a female share in the lowest tercile (Tercile 1) conferred between spring 1965 and spring 1974. Standard errors are clustered by state.

The parameters of interest are β_3 and the coefficient on the triple difference, β_{10}. β_3 depicts how female degrees in traditionally male fields (T1 %-female fields) after 1975 from schools in "weak states", where the EEOA definitively strengthened current labor laws, changed relative to the reference group. β_{10} depicts how female degrees in traditionally female fields (T3 %-female fields) after 1975 from schools in weak states relative to the reference group. I would expect β_3 to be positive and β_{10} to be negative if the EEOA rather than Title IX were driving my results.

Table D3 reports estimates for β_1 through β_{10}. Columns 1-5 are different model specifications as I include additional controls. Columns 6 and 7 show how estimates vary if I cluster the standard errors at different levels. I find that women were more likely to pursue traditionally *female* degrees fields in states where the EEOA strengthened labor laws. This is the opposite of what I would expect if EEOA were driving my results. This estimate is largely robust to additional controls and how the standard errors are clustered. For example, under the baseline specification in column 1, T3 %-female fields in weak-state schools see an average increase of about 6 female students after 1975. This estimate is statistically significant at the 1% level and remains positive as I include school fixed effects, the number of graduates, and field fixed effects. In my preferred specification in columns 5-7, the inclusion of school-field fixed effects reduces the initial estimate by about half to 2.5. However, this estimate remains positive and, if the standard errors are clustered by field or school-field, statistically significant at the 5% level.

Perhaps a more fitting interpretation is that states with weak anti-discrimination labor laws were predominantly in the south, which has strong gender norms. Therefore, Title IX, potentially combined with EEOA, may have had a larger impact on increasing women's educational attainment overall as opposed to increasing female representation in traditionally male degrees.

Table D3: Effect of Equal Employment Opportunity Act of 1972

Outcome Variable: Number of Female Graduate Degrees	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Weak State	1.356						
	(1.170)						
Post-1975	11.79***	12.66***	4.312***	4.362***	1.417	1.417	1.417
	(0.959)	(1.122)	(1.134)	(1.157)	(0.968)	(2.692)	(0.930)
Post-1975 x Weak State	-1.708	-2.074	-1.815	-2.202	-1.374	-1.374	-1.374
	(1.387)	(1.456)	(1.456)	(1.455)	(1.318)	(0.850)	(0.972)
Tercile 2 %Female Field (medium)	1.068***	3.299***	11.63***	7.240***			
	(0.268)	(0.417)	(1.432)	(1.153)			
Tercile 3 %Female Field (high)	18.68***	20.11***	17.01***	-0.156			
	(2.450)	(2.478)	(2.127)	(1.622)			
Post-1975 x T2 %Female Field	-8.027***	-8.506***	-2.215**	-2.245**	0.181	0.181	0.181
	(0.800)	(0.860)	(1.053)	(1.023)	(0.773)	(2.507)	(0.783)
Post-1975 x T3 %Female Field	-2.972***	-3.254***	-0.120	0.815	2.848***	2.848	2.848***
	(1.007)	(1.030)	(1.128)	(1.053)	(0.785)	(4.336)	(0.822)
Weak State x T2 %Female Field	-0.0528	-1.210**	-2.765	-3.984*			
	(0.325)	(0.520)	(2.109)	(2.148)			
Weak State x T3 %Female Field	-3.448	-3.877	-3.846	-5.337*			
	(2.814)	(2.845)	(2.839)	(3.080)			
Post-1975 x Weak State x T2 %Female Field	1.842	2.177*	1.478	1.870	0.993	0.993	0.993
	(1.263)	(1.296)	(1.346)	(1.332)	(1.174)	(0.868)	(0.980)
Post-1975 x Weak State x T3 %Female Field	5.796***	5.826***	3.204*	3.632**	2.504	2.504**	2.504**
	(1.872)	(1.869)	(1.660)	(1.631)	(1.532)	(0.950)	(1.177)
Observations	116,096	116,096	116,096	116,096	116,096	116,096	116,096
Standard Errors Clustered by:	State	State	State	State	State	Field	School x Field
Controls for:							
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School FE		Yes	Yes	Yes			
Number of graduates			Yes	Yes	Yes	Yes	Yes
Field FE				Yes			
School x Field FE					Yes	Yes	Yes

Source: HEGIS 1968-1975 Earned Degrees data; Chay (1995), Appendix Table 1.
Notes: Sample is at the school-field-year level and includes all non-doctorate, non-health professional graduate degrees earned by women between 1965 and 1981. Reference group is "Strong States", which are non-south states that had FEP laws prior to EEOA (between 1966 and 1974). "Weak States" are Alabama, Arkansas, D.C., Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. Standard errors in parentheses are clustered by state. *** $p< 0.01$, ** $p< 0.05$, * $p< 0.1$

D.4 Cohort-Specific Changes

This section examines the possibility of a cohort-specific change in preferences as an alternative explanation. The two changes I examine are a change in high-school course taking among females and a change in career aspirations.

D.4.1 High School Courses

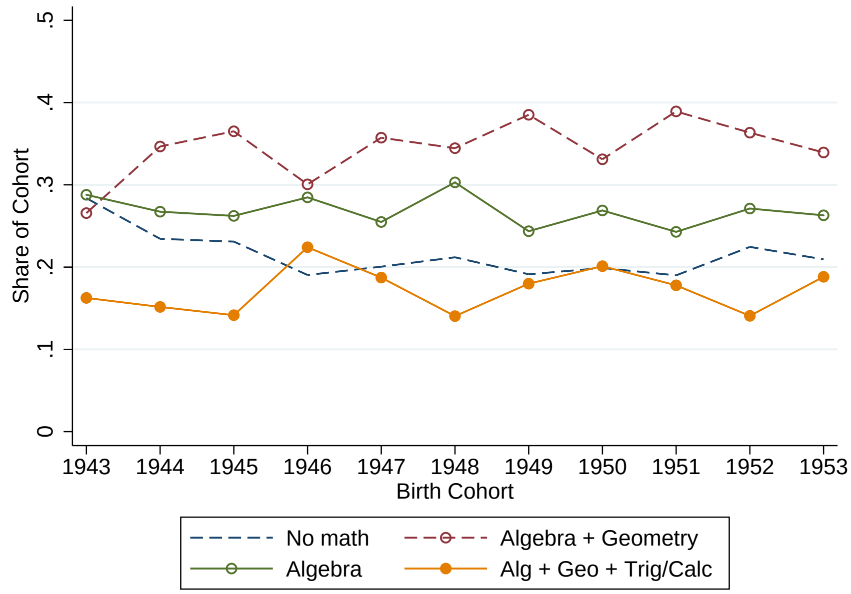
This section examines whether a change in high-school course taking among women led to the observed discontinuity in graduate fields. This alternative explanation stems from the fact that advance preparation and training is necessary to pursue a graduate degree. To answer this question, I take several approaches. First, I examine the number of math courses taken in high school by women. Next, I compare male and female preferences for high-school math and science courses. Last, I examine how undergraduate majors between men and women converged over time. Put together, the results indicate that high-school course preferences and math courses changed gradually over time. However—and this is the main counterargument—there is no sudden change in math course taking or in course preferences that can explain the sudden change in graduate-field distributions.

I first examine the number of math courses women took in high school. Although it does provides a limited look at high-school course taking among women, it does shed light on whether a change in high-school courses occurred among females during this time.[69]

For this analysis, I use the National Longitudinal Survey of Young Women (NLSYW), which interviewed 5,159 women who were ages 14-24 when first interviewed in 1968. The survey asked all respondents which, if any, of the three math classes they took in high school: algebra, geometry, and trigonometry or calculus. Figure D1 plots the share of women who took no math classes; just algebra; algebra and geometry; and algebra, geometry, and trigonometry/calculus by birth cohort.

[69]Ideally, I would like to examine their complete course-load. Unfortunately, the NLS Young Women's survey only asked about the number of math courses taken. Further, a similar question was not asked in the NLS Young Men's survey so a comparison is not possible.

Figure D1: Share of Women taking High School Math over Time



Source: NLSYW 1968 data.
Notes: N = 3,363.

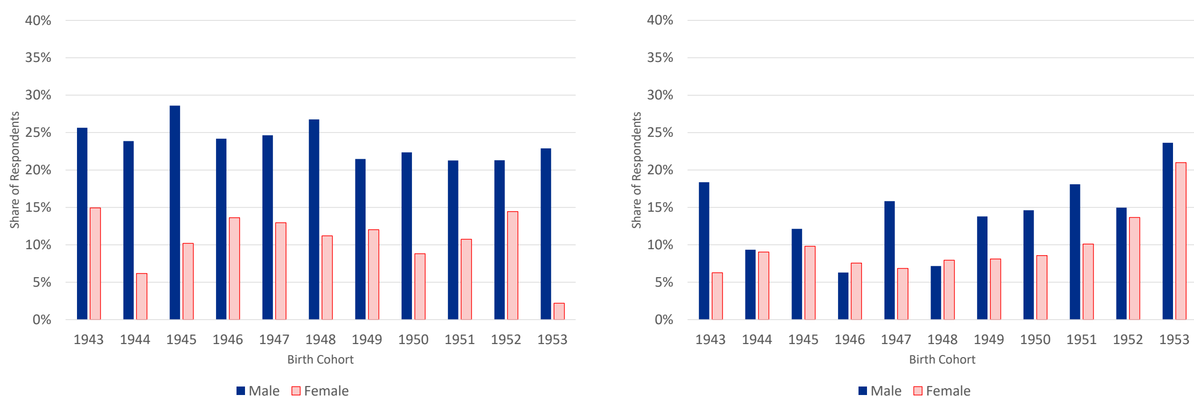
There are several things of note. First, the share of women taking algebra and geometry (2-3 years of high school math, depending on whether they took one or two years of algebra) increased by cohort. More interestingly, the rank ordering among the 1943 cohort vis-a-vis the 1953 cohort changed. In the 1943 cohort, the plurality of women is either taking no math or taking only algebra (around 28% for both percentages). Close behind is the share of women who took both algebra and geometry. Last is the share of women taking four years of high school math. In the 1953 cohort, however, the rank ordering changes. Nearly 34% of women took both algebra and geometry. Next largest is the share of women with algebra (26%), then the share of women with no math (20.9%), and last is the share of women with four years of high school math (18.8%). This figure highlights that there was indeed a change in high-school course taking between the 1943 cohort and the 1953 cohort. However, there does not appear to be a marked break for the 1950 and 1951 birth cohorts, our cohorts of interest.

This finding is consistent with Garrison (1979), who surveyed around 60,000 seniors in Virginia public high schools about their career aspirations in 1970, 1973, and 1976. He found that high school males and females became more similar across these three cohorts, particularly in regards to their aspirations involving high-status professional occupations. As high-status professional occupations typically require graduate degrees (e.g., law, medicine, business), it may not be surprising to see this manifest in female-male convergence in graduate school degree-fields.

I also examine how favorite subjects change over time. NLSYW also asks which high school subject was the respondent's favorite, and I compare the female and male answers by birth cohort in Figure D2.[70] Recall we are looking for a distinct change starting with the 1950-1951 cohort in order for this mechanism to explain the sudden change in gender convergence in graduate degree fields. We do not see such a change. There appears to be a change with the 1953 cohort, but this birth cohort is too young to explain my main results.

Figure D2: Favorite High School Subject by Sex and Birth Cohort

Favorite Subject: Math | Favorite Subject: Science



Sources: NLSYW 1968 data; NLSYM 1966 data.
Notes: N = 6,890. This figure depicts male and female responses given at the same age, and listed by female birth year.

D.4.2 Career Aspirations

Next, I consider whether female work preferences changed across birth cohorts. Specifically, I examine whether the sudden change in graduate-degree fields between men and women can be explained by an underlying change in career aspirations of the young women who were pursuing these graduate degrees.

To answer this question, I use the NLSYW, which surveyed 14-24 year old women in 1968. This survey is ideal for this analysis because it surveyed young women born between 1944

[70] For male responses, I use the National Longitudinal Survey of Young Men (NLSYM), which interviewed 5,225 young men aged 14-24 starting in 1966. Although the survey population of NLSYW and NLSYM are from different birth cohorts, my analysis matches up male and female responses by the same age. In other words, I compare a 16 year old's male response to a 16 year old female's response. These two 16 year olds, however, are born in different years.

and 1954, thereby including the cohorts of interest. Further, it asks about women's attitude towards working full-time in two scenarios: (1) if it is absolutely necessary to make ends meet, and (2) if she wants to work and her husband agrees.[71] The exact question wording is as follows:

> Now I'd like you to think about a family where there is a mother, a father who works full time, and several children under school age. A trusted relative who can care for the children lives nearby. In this family situation, how do you feel about the mother taking a full-time job outside the house?
>
> 1. If it is absolutely necessary to make ends meet.
> 2. If she wants to work and her husband agrees.

For each scenario, the respondent chose a ranking from 1 to 5 with the following definitions: 1. Definitely all right; 2. Probably all right; 3. No opinion: Undecided; 4. Probably not all right; 5. Definitely not all right.

Because this question is not asked in consecutive survey years, I am unable to compare how the 1950 birth cohort responded to this question at age 18 to how other cohorts responded to this question at age 18.[72] Instead, I am only able to compare cohort responses in 1968. This means that I will be comparing 18 year olds (the 1950 cohort) to 19 year olds (the 1949 cohort). A key assumption is that preferences do not change over time within the same cohort. That is, the 1950 cohort holds the same preferences at age 18 as they will at age 20 or 22.

The proportion of each birth cohort that responded favorably towards working full-time ("Probably all right" or "Definitely all right") is pretty stable across birth cohorts; it remains around 90 percent. Favorable responses to the second scenario fluctuate more, ranging between 60 and 70 percent. Under the second scenario, the proportion of those responding "Definitely all right" also remains relatively stable, but interestingly decreases for younger cohorts under the first scenario. To examine whether any of these differences are statistically

[71]The survey also asks about a third scenario: if she wants to work and her husband disagrees. I exclude this question from my analysis because this question captures more attitudes than a women's attitude towards work. For example, a response of "Probably not all right" or "Undecided" to this question does not necessarily imply that the woman does not desire to work. Rather, her response may merely reflect her acknowledgment that such a decision, especially if she and her husband do not agree, should be a joint decision and may require a lengthier conversation with her partner to determine the best action for their family.

[72]This three-part question series is asked again in 1972, which unfortunately is the year that Title IX was passed. Ideally, I would like to capture young women's attitudes towards work before Title IX's passage, in case its passage altered their career aspirations. Because these survey questions are asked only once before Title IX's passage, I am unable to compare responses given at the same age across different cohorts.

Table D4: Women's Attitude Towards Work by Birth Cohort

Scenario:	If necessary to make ends meet		If want to work and husband agrees	
Outcome = 1 if:	Prob/Def okay	Definitely okay	Prob/Def okay	Definitely okay
	(1)	(2)	(3)	(4)
Birth cohort (relative to 1950-1951)				
1944	-0.00320	0.140***	0.0300	0.0461
	(0.0189)	(0.0324)	(0.0304)	(0.0302)
1945	-0.0120	0.128***	-0.0499	0.0530*
	(0.0203)	(0.0335)	(0.0327)	(0.0312)
1946	-0.00448	0.0902***	0.00170	0.0266
	(0.0193)	(0.0332)	(0.0313)	(0.0303)
1947	0.00861	0.140***	-0.0368	0.0270
	(0.0173)	(0.0306)	(0.0299)	(0.0278)
1948	-0.000999	0.0919***	-0.0318	0.00482
	(0.0170)	(0.0298)	(0.0288)	(0.0265)
1949	-0.00966	0.0616**	0.00798	0.0193
	(0.0190)	(0.0310)	(0.0294)	(0.0279)
1952	-0.0268	-0.0257	0.0367	0.000867
	(0.0178)	(0.0291)	(0.0270)	(0.0262)
1953	-0.0187	-0.0898***	0.0249	0.0422
	(0.0177)	(0.0288)	(0.0277)	(0.0273)
1954	-0.0721***	-0.0704**	0.0463	0.0201
	(0.0232)	(0.0323)	(0.0305)	(0.0298)
Constant	0.914***	0.448***	0.678***	0.282***
	(0.00974)	(0.0172)	(0.0164)	(0.0152)
Observations	5,109	5,109	5,108	5,108
Mean in reference cohort	0.914	0.448	0.678	0.282

Source: NLSYW 1968 data.
Notes: Robust standard errors are in parentheses. *** p< 0.01, ** p< 0.05, * p< 0.1

significant, I estimate the following regression model:

$$y_i = \beta_0 + \sum_{c=1944, c\neq 1950,1951}^{1954} \mu_c \cdot \mathbb{1}\{c = t\} + \varepsilon_i, \tag{12}$$

where y_i is a binary outcome variable indicating 1 if woman i responded favorably towards working and 0 otherwise, and $\mathbb{1}\{c = t\}$ are indicator variables for birth cohort (reference group is 1950 and 1951). The parameters of interest are μ_c, the coefficients on the cohort fixed effects relative to the 1950-1951 cohorts. Specifically, we are looking at the coefficients on the cohorts that were born *before* 1950 to see if they are statistically significantly negative. That is, we want to see if earlier cohorts were *less* likely to have favorable attitudes about working full-time. If we see a sudden change in female attitude towards work starting with the 1950 or 1951 birth cohort, then this provides some evidence that young women's aspirations may explain the sudden change in graduate-field distributions instead of (or in addition to) Title IX's passage.

The results are reported in Table D4. Columns (1) and (3) compare the proportion of each cohort that responded either "Definitely all right" or "Probably all right", relative to 1950-1951 cohort's response. For example, the 1949 cohort is 0.97 percentage-points less likely to respond favorably to survey question scenario (1) and 0.80 percentage-points more likely to respond favorably to survey question scenario (2). Not only are these estimates small in magnitude, they are also not statistically significant. In fact, none of the earlier cohorts responded statistically significantly differently from the 1950-1951 cohorts (as measured by a favorable response or not).

Columns (2) and (4) narrow the definition of a "favorable" outcome and compare the proportions of those who responded "Definitely all right". Again, we do not see *negative* coefficients between the earlier cohorts and the 1950-1951 cohorts. The coefficients for the 1944-1949 cohorts are statistically significant, but they are positive, indicating that older cohorts are *more* likely to want to work. These results suggest that a sudden change in work attitudes did not occur with the 1950 or 1951 cohort, indicating that it cannot explain the sudden change in graduate-field distributions observed in 1975.

It is important to remember that these results assume that preferences did not change over time within cohorts. Therefore, to the extent that this assumption is not valid, I am unable to definitively rule out changing preferences as an alternative explanation. This assumption may be a strong one to make between 18 year olds (1950 cohort in the regression analysis) and 24 year olds (1944 cohort in the regression analysis). However, it may not be so outlandish when comparing 18 year olds to 19 year olds (1949 cohort in the regression analysis). And between these two age groups, we do not see any significant differences.