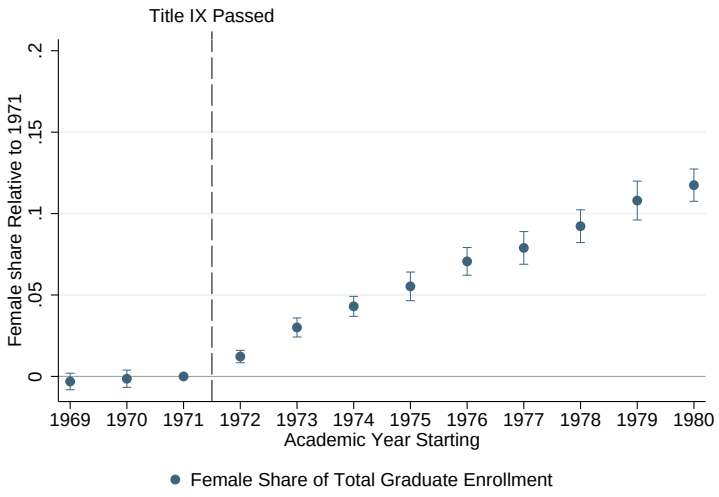
Online Appendix for
The Effect of Title IX on Gender Disparity in Graduate Education

Nayoung Rim

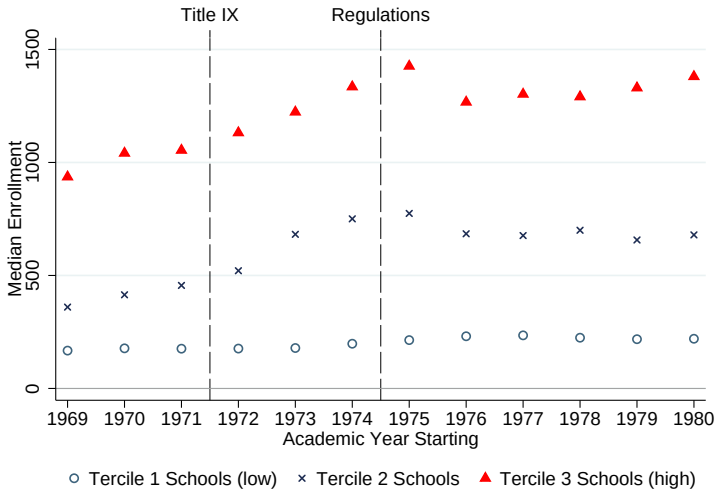
1 Additional Tables and Figures

Figure 1: Change in Female Share of Graduate Enrollment



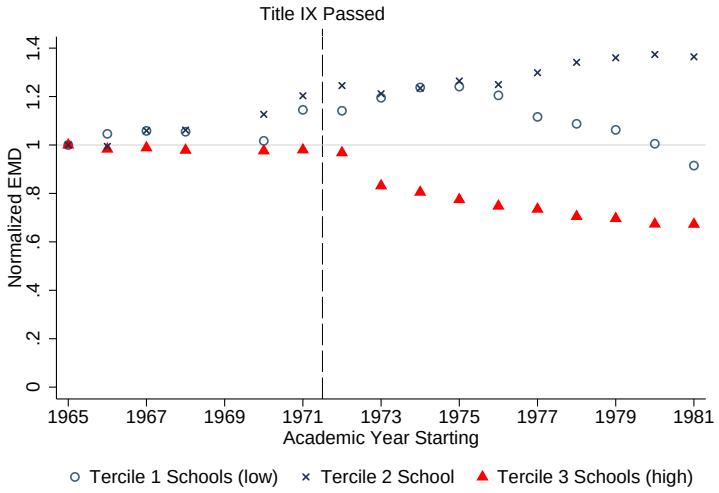
Source: HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.
Notes: N = 9,696. This figures plots each year's change in female enrollment share relative to 1971. Estimates control for school and state fixed effects and school's total enrollment by year. Vertical dashed lines indicate when Title IX and its compliance regulations were signed into law (June 1972 and May 1975, respectively). Standard errors are clustered by state, and wings are 95% confidence intervals.

Figure 2: Total Graduate Enrollment by Federal-Funds Share



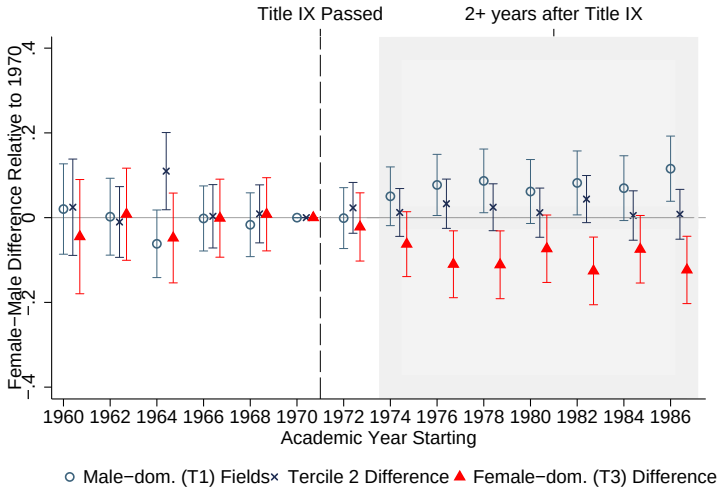
Source: HEGIS 1969-1980 Fall Enrollment data and 1968-1971 Financial Statistics data.
Notes: N = 9,696. This figures plots total graduate enrollment over time by federal-funds tercile. Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. Vertical dashed lines indicate when Title IX and its compliance regulations were signed into law (June 1972 and May 1975, respectively).

Figure 3: Distributional Change 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 between female and male distributions of graduate field of study indexed to 1960, separately for more federally dependent schools (Tercile 3), moderately dependent schools (Tercile 2), and less federally dependent schools (Tercile 1). Terciles are based on the average share between 1968 and 1971 of a school's revenue that comes from the federal government. The vertical dashed line indicates when Title IX was signed into law (June 1972).

Figure 4: Gender Difference in Non-Doctorate, Non-Health Professional Graduate Degrees



Source: NSCG 1993 data.
Notes: N = 17,107. The sample is restricted to whites who obtained a graduate degree before age 35 between 1960 and 1977. Dots depict the female-male difference in degrees in each year, separately for Tercile 1 degree fields (male-dominated fields of study), Tercile 2 fields, and Tercile 3 degree fields (female-dominated fields of study). Fields of study are categorized by their mean share of females between 1960 and 1971. Estimates control for birth year, school region, and the number of college graduates each year. Robust standard errors are reported in parentheses, and wings depict 95% confidence intervals. The vertical dashed line depicts when Title IX was passed (June 1972). The gray shaded area depits years at least two academic years after Title IX's passage.

2 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.

2.1 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.[1]

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 5 plots the share of women who took no math classes; just algebra; algebra and geometry; and algebra, geometry, and trigonometry/calculus by birth cohort.

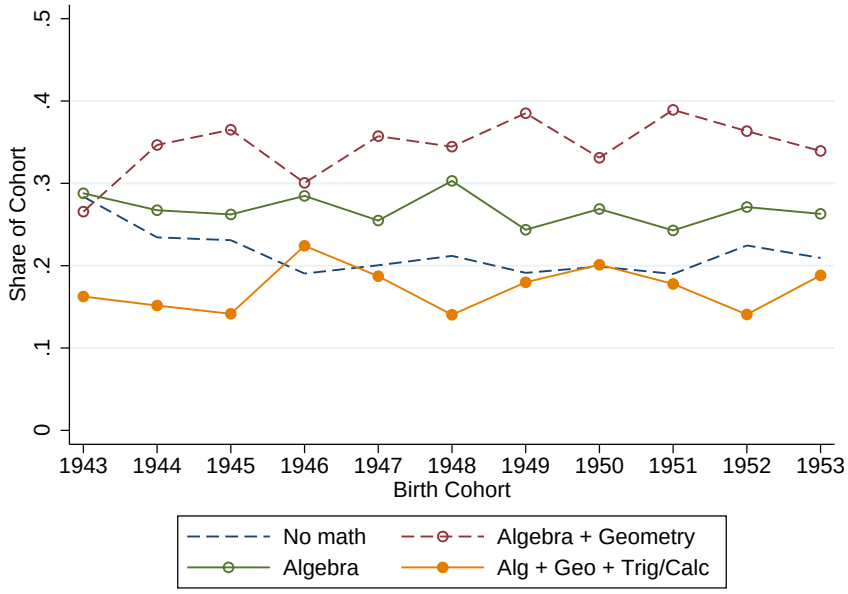
There are several things of note. First, the share of women taking algebra and geometry (2-3 years of high school math, depending on whether they took one or two years of algebra) increased by cohort. More interestingly, the rank ordering among the 1943 cohort vis-a-vis the 1953 cohort changed. In the 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.

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 6.[2] 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.

[1] 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.

[2] 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.

Figure 5: Share of Women taking High School Math over Time



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

Last, I examine the convergence trend in undergraduate majors. This provides an indirect test of whether a sudden change in high-school or undergraduate coursework among females led to the discontinuity in graduate-degree fields. To the extent that a sudden change in pre-graduate coursework is a valid explanation, we would expect to see a coincident change for undergraduate degrees conferred in Spring 1973 (academic year starting 1972).

Using HEGIS Earned Degrees data, I plot the EMD value between the male B.A. major distribution and female B.A. major distribution between 1965 and 1981 (Figure 7). The two distributions converge over time, as indicated by the downward-sloping line, and the slope steepens between academic year 1971-1972 and academic year 1975-1976. There is a slight indication that 1972 may be an inflection point, but overall the convergence trend is smooth and does not display a large discontinuous break as we saw with graduate degree fields. Further, this result is consistent with my analysis of high-school math and science courses, which also does not find a sudden change in female course-taking but rather a gradual change over time.

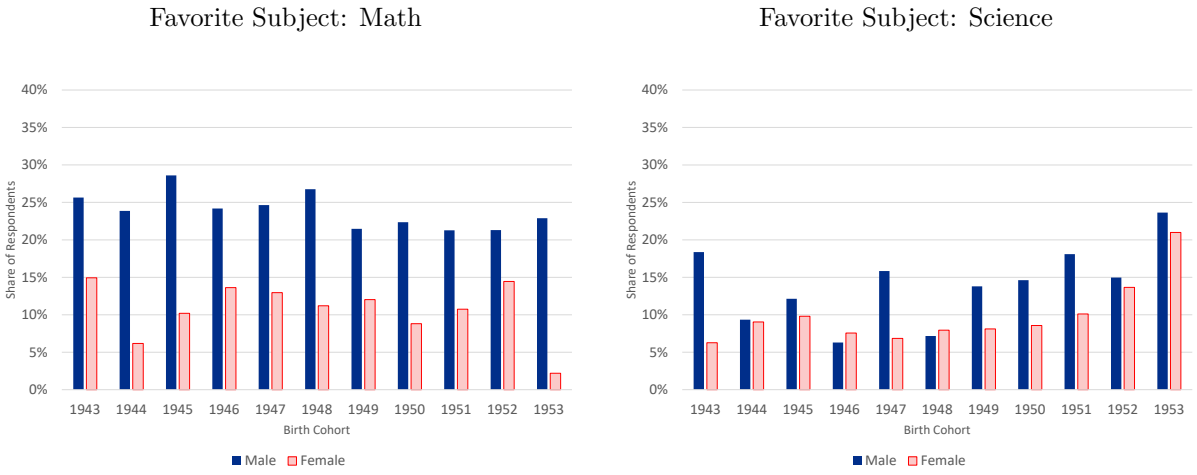
2.2 Career Aspirations

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 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.[3]

[3]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

Figure 6: Favorite High School Subject by Sex and Birth Cohort



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.

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.

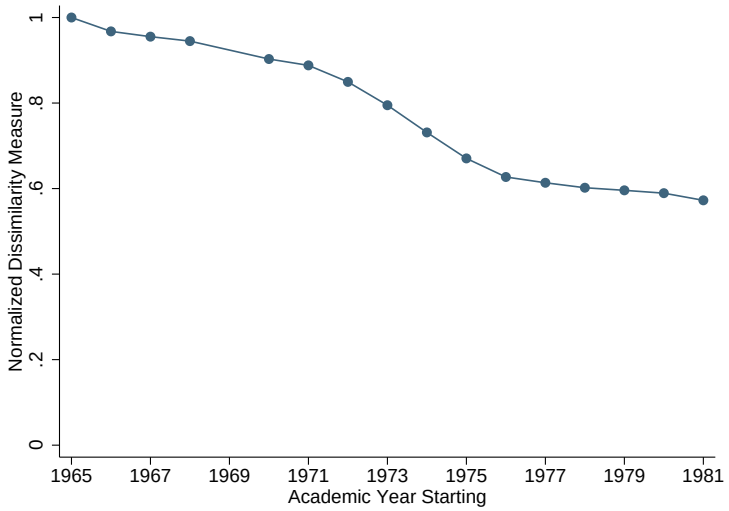
Because this question is not asked in consecutive survey years, I am unable to compare how the 1950 birth cohort responded to this question at age 18 to how other cohorts responded to this question at age 18.[4] Instead, I am only able to compare cohort responses in 1968. This means that I will be comparing 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

"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.

[4]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.

Figure 7: Female-Male Convergence in Undergraduate Majors



Source: HEGIS Earned Degrees data, 1965-1981.
Notes: This figure plots the dissimilarity between female and male distributions of B.A. majors using the Earth Mover's Distance algorithm as a measure of dissimilarity. Majors are ordered in the distribution by expected salary. Expected salary for B.A. major is calculated using everyone who majored in that field as an undergraduate, even if the student subsequently attended graduate school.

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 significant, I estimate the following regression model:

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

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 1. 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

Table 1: 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)
Mean in reference cohort	0.914	0.448	0.678	0.282
Observations	5,109	5,109	5,108	5,108

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

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.

References

Beller, A. (1982). Occupational Segregation by Sex: Determinants and Change. *Journal of Human Resources*, *17*(3), 371.

Chay, K. (1998). The Impact of Federal Civil Rights Policy on Black Economic Progress: Evidence from the Equal Employment Opportunity Act of 1972. *Industrial and Labor Relations Review*, *51*(4), 608.

Equal Employment Opportunity Act of 1972. Public Law 92-261. 86 Stat. 103-111. (24 March 1972). Retrieved from `https://www.gpo.gov/fdsys/pkg/STATUTE-86/pdf/STATUTE-86-Pg103.pdf`

Flood, S., King, M., Ruggles, S., & Warren, J. R. (2017). *Integrated Public Use Microdata Series, Current Population Survey: Version 5.0 [dataset].* Minneapolis, MN: University of Minnesota. Retrieved from `https://doi.org/10.18128/D030.V5.0`

Salomone, R. C. (1980). Title IX and Employment Discrimination: A Wrong in Search of a Remedy. *Journal of Law and Education*, *9*, 433.

Steven Ruggles, R. G. J. G., Katie Genadek, & Sobek, M. (2017). *Integrated Public Use Microdata Series: Version 7.0 [dataset].* Minneapolis, MN: University of Minnesota. Retrieved from `https://doi.org/10.18128/D010.V7.0`

United States. Congress. House. Committee on Education and Labor. Subcommittee on Equal Opportunities. (EEOC Hearings). (1975). *Equal Employment Opportunity Commission: Hearings before the Subcommittee on Equal Opportunities of the Committee on Education and Labor, House of Representatives, 93rd Congress, 2nd Session, on H.R. 15826.* Washington, DC: Government Printing Office. Retrieved from `https://babel.hathitrust.org/cgi/pt?id=umn.31951d008189461;view=2up;seq=6`

United States. Equal Employment Opportunity Commissions. (1973). *8th Annual Report.* Washington, DC: The Commission.

U.S. Department of Education, National Center for Education Statistics. (n.d.-a). *Higher Education General Information Survey (HEGIS): Earned Degrees 1972-1973 [Computer file]. ICPSR version.* Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].

U.S. Department of Education, National Center for Education Statistics. (n.d.-b). *Higher Education General Information Survey (HEGIS): Fall Enrollment 1968-1969 [Computer file]. ICPSR version.* Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].