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College Majors, Occupations, and the Gender Wage Gap

Carolyn M. Sloane, Erik G. Hurst, and Dan A. Black

In reckoning with the presence and evolution of gender gaps in wages and employment, scholars have identified that occupation matters. However, a person's eventual occupation is influenced by events that happen before entering the labor market: if you don't take the appropriate classes in high school and then college that qualify you for medical school, you aren't likely to become a doctor. For many workers, the specific kinds of pre-market sorting is unobservable. For college-educated workers, such sorting can be observed in one's undergraduate major. Before entering the labor market, college-educated workers are faced with a menu of potential undergraduate college majors that is nearly as varied as the opportunities to specialize in an occupation once in the market.

Although there has been convergence over time, men and women continue to cluster in different undergraduate majors. In this paper, we show that generations of college-educated US women have sorted into majors that systematically lower their potential wages relative to men. Even when men and women have sorted into the same major, women subsequently sort into occupations with lower potential wages. In terms of policy, it would be helpful to understand the extent to which gender gaps in wages and employment are pre-determined by sorting that happens before a worker enters the labor market and lands in an occupation.

■ *Carolyn M. Sloane is Assistant Professor of Economics, University of California, Riverside, Riverside, California. Erik G. Hurst is Frank P. and Marianne R. Diassi Distinguished Service Professor of Economics, University of Chicago Booth School of Business, Chicago, Illinois. Dan A. Black is Professor of Public Policy, University of Chicago, Harris School of Public Policy, Chicago, Illinois. Their email addresses are csloane@ucr.edu, erik.hurst@chicagobooth.edu, and danblack@uchicago.edu.*

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We do not attempt to unravel the underlying dynamics that lead men and women to cluster into different college majors and occupations. Instead, we document the extent to which this sorting occurs before and after entry into the market. We define a new set of summary statistics that allow the reader to consider sorting in a price space, to gain a better understanding of the linkages between major and occupation, and to assess the independent contributions of major and occupation to gender gaps in wages and employment.

In order to do this, we take advantage of a large multi-cohort data set linking detailed undergraduate major to subsequent occupations in a way that was not available until recently. We use data from the American Community Survey (ACS) that includes questions about undergraduate major for millions of college-educated individuals. Starting in 2009, these questions were asked for people of all ages, which allows us to explore how patterns of sorting into both majors and occupations have changed across cohorts ranging from those born in the 1950s through the early 1990s. The data also include information about individuals' current labor market status, allowing us to link undergraduate major to occupation and wages for multiple cohorts of men and women.

To weigh the economic implications, we introduce the concept of a "potential wage" as the earnings one would receive, largely absent the effect of market influences such as discrimination or disruptions in job tenure. In other words, the potential wage assigns everyone within a category of occupation or major the same hourly wages—that of the median middle-aged, US-born, white male within the category. In doing so, we hope to better home in on the question: How much of the gender wage gap among college graduates can be explained by sorting into different undergraduate majors which would pay differently for the median middle-aged, US-born, white male?

We find that women are systematically sorted into majors with lower potential wages relative to men. For example, Aerospace Engineering, one of the highest potential wage majors, is 88 percent male, while Early Childhood Education, one of the lowest potential wage majors, is 97 percent female. We also find that such patterns are long-standing and have been slow to converge. Overall, college-educated women born in the 1950s matriculated with majors that had potential wages 12 percent lower than men from their cohort. That gap fell to about 9 percent for the 1990 birth cohort. Even after some convergence in major sorting between men and women during the last 40 years, the youngest birth cohorts of women are still sorted into majors with lower potential wages than their male peers. Intriguingly, much of the convergence in major sorting between men and women occurred between the 1950 and 1975 birth cohorts with a modest divergence for recent cohorts.

We put this data and a set of new summary statistics to use to address the linkages between pre-market and market specialization. In other words, we answer: how has occupational sorting conditional on major evolved across generations of US college graduates? We find that while women are sorted into occupations with lower potential wages conditional on major, this gap is closing somewhat over time. For the 1950 birth cohort, for example, women on average sorted to occupations with

11 percent lower potential earnings relative to otherwise similar men with the same majors. This gap narrowed to about 9 percent for the 1990 birth cohort. Almost all of the convergence occurred within highest potential earning majors. For example, women from the 1950 cohort who majored in Engineering—a high potential earning major—sorted into occupations with potential wages that were 14 percent lower than men from the same cohort who also majored in Engineering. For the 1990 birth cohort, however, women who majored in Engineering ended up working in occupations with roughly the same potential wages as their male peers.

We close by assessing within a regression framework the separate impacts of college major and occupation on the gender wage gap among college graduates. Gender differences in major sorting explain a substantive portion of the gender wage gap among college graduates above and beyond what is explained by gender differences in occupational sorting. We also find that occupation has become a less important determinant of gender gaps in wages for US college graduates when we compare older and younger birth cohorts. In contrast, major has remained almost equally important. Overall, our results highlight the importance of understanding the social processes that lead to clustering by gender both for college major and for the occupational sorting that happens after a college major has been chosen.

Gender Differences in College Majors and Occupations

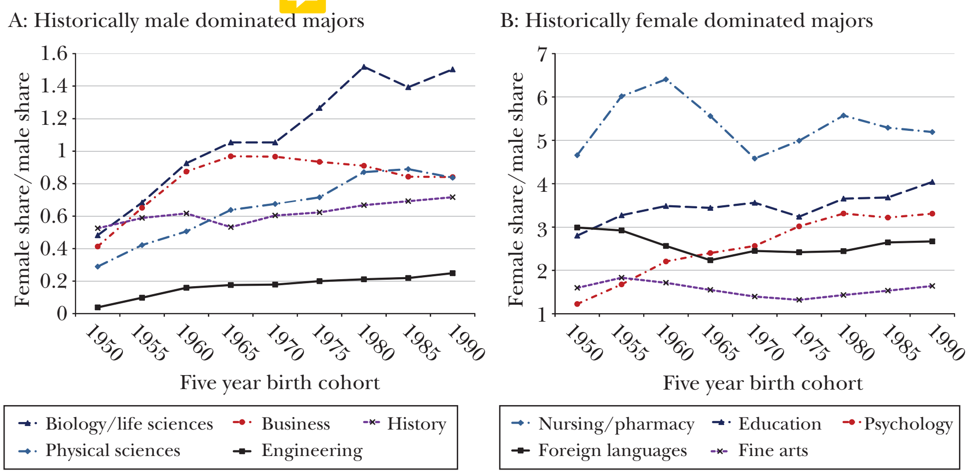
We begin by documenting the presence and evolution of gender gaps in undergraduate major sorting and how those gaps have evolved over time. For comparison, we also document trends in relative occupation for college-educated men and women. Specifically, we highlight: 1) how women from earlier birth cohorts systematically sorted into both majors and occupations that pay less than men; 2) how the gender gap in majors and occupations have narrowed for recent cohorts; and 3) how women from more recent cohorts still sort into to majors and occupations that pay less than men. To do so, we introduce a new index that measures gender differences in sorting in units of potential wage differentials.

Sorting Patterns in the Broad Categories of Majors

F1 Our sample from the 2014–2017 American Community Survey contains information on 134 detailed majors.[1] Figure 1 graphs the ratio of females to males within broad categories of majors. For example, Engineering is a broad major category, while Civil Engineering, Chemical Engineering, and Aerospace Engineering are three of the 17 detailed majors within the broad Engineering major category. In addition, for each survey year between 2014 and 2017, we begin by assigning each individual a five-year birth cohort based on current age in the survey year. We center

[1] Throughout the paper, we restrict our sample to those individuals who obtained a bachelor's degree. A detailed discussion of our sample restrictions and how we processed the data is found in the online Appendix available with this article at the *JEP* website.

Figure 1
Gender Differences in Selected Majors by Birth Cohort



Source: Data from the 2014–2017 ACS and are restricted to those with at least a bachelor's degree. See text and the online Appendix for additional details.
Note: These figures plot the ratio of females to males within major category. The left panel shows trends for a set of majors where men outnumber women. The right panel shows trends for a set of majors where women outnumber men.

the five-year birth cohorts around years that are multiples of five: for example, the 1950 birth cohort includes all individuals born between 1948 and 1952. Pooling the data into five-year birth cohorts has the effect of smoothing annual fluctuations.

Panel A focuses on majors historically dominated by men. Some of these majors have shown substantial gender convergence across birth cohorts. Consider the 1950 birth cohort: Engineering majors contained 20 men for every one woman. In the youngest birth cohorts in our sample, Engineering majors are still male-dominated, but the gap has narrowed. By the 1990 birth cohort, there were five men for every one woman in Engineering majors. These patterns are shown in the solid line in panel A. Similar convergence patterns are seen for Physical Science majors (like Chemistry, Physics, and Astronomy) and for Biology/Life Sciences majors (like Biology, Molecular Biology, Genetics, and Ecology). In fact, Biology/Life Sciences switched from being a major field dominated by men (for the 1950–1970 birth cohorts) to one dominated by women (the 1980–1990 birth cohorts). Business majors display a different pattern: women converged toward men between the 1950–1965 birth cohorts, a period when the Business major itself was expanding. Thereafter, in a period that was marked by a contraction overall in Business majors, women and men once again diverged. The History major has been male-dominated and experienced little convergence or divergence over subsequent birth cohorts.

Similar heterogeneity appears in historically female-dominated majors, shown in panel B. Education majors saw little convergence or divergence between women and men over the last 50 years. The fraction of all women majoring in Education declined substantially, but the decline among males was slightly larger. Likewise, there was little gender convergence over time in Nursing/Pharmacy majors.[2] Conversely, some gender convergence was seen in both Foreign Language and Fine Arts majors. Psychology majors were more likely to be populated by women in the 1950 cohort and became even more female-dominated by the 1990 cohort.

The broad patterns presented here are not new. For example, England and Li (2006) and Blau, Ferber, and Winkler (2014, ch. 8) use nationally representative data from the National Center on Education Statistics to document how gender differences in detailed undergraduate majors have diminished over time for a nationally representative sample of undergraduates. Black et al. (2008) document these patterns using the 1993 National Survey of College Graduates. Other studies like Dickson (2010) and Zafar (2013) have looked at gender differences in major sorting using administrative data from a few universities.

A Summary Measure of Sorting Patterns across Majors

We now use an existing method to summarize overall trends in sorting patterns across all detailed major categories. We compute an inverse Duncan-Duncan index of undergraduate major sorting patterns by gender and cohort. Separately, we compute an inverse Duncan-Duncan index of occupation sorting patterns by gender and cohort.

The classic Duncan-Duncan index for majors (or occupations) is computed by: 1) calculating the absolute within-major (or within-occupation) difference between the share of the relevant male sample in a major (or occupation) and the share of the relevant female sample in a major (or occupation); 2) summing up absolute differences over all majors (or occupations); and 3) scaling by one-half to account for the comparison of two distributions. The classic Duncan-Duncan index values range from 0 to 1. If there are no differences across majors (occupations), the index would be zero. If there is complete segregation across majors (occupations), the index would be 1.[3] To gain some intuition for this index, consider a very simple example. Say there are two majors, *A* and *B*. For men, 50 percent graduated with major *A* and 50 percent of men graduated with major *B*. For women, 70 percent graduated with major *A* and 30 percent of women graduated with major *B*. In this case, the Duncan-Duncan index value would equal 0.20, which corresponds to a well-integrated distribution with respect to gender.[4]

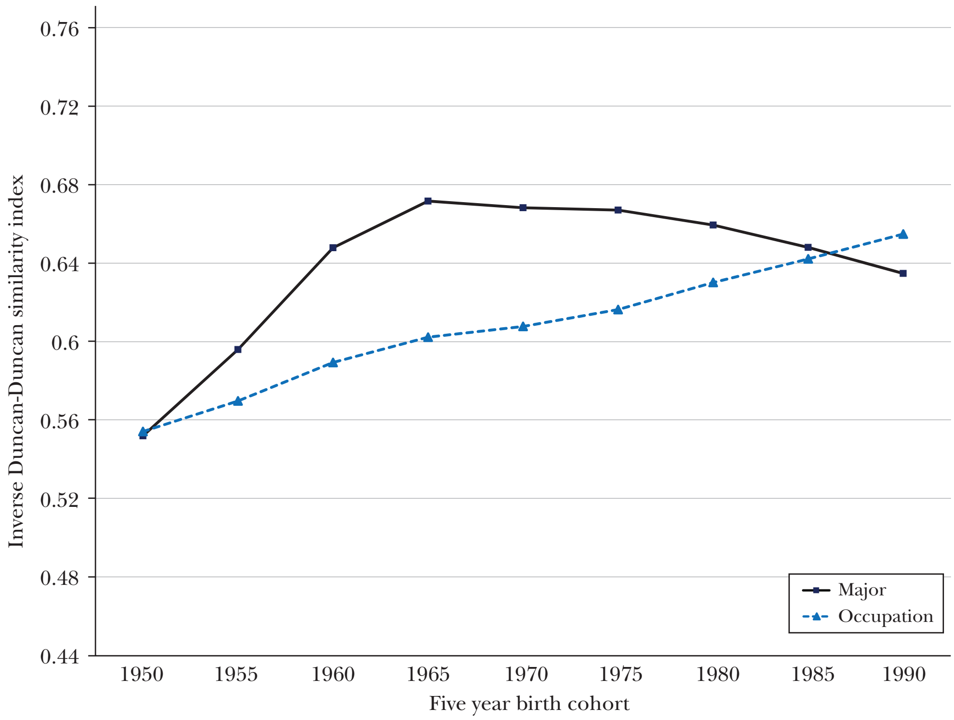
[2] The broad major field referred to as "Nursing/Pharmacy" represents a combination of health-related majors: Nursing, Pharmacy, Treatment Therapy Professions, Community and Public Health, and Miscellaneous Health Medical Professions. Nursing and Pharmacy are the two largest of the combined majors.

AQ1

[3] For more information on the classic Duncan-Duncan index, see Duncan and Duncan (1955).

[4] For further discussion of this shift, see Becker, Hubbard, and Murphy (2010), Charles and Luoh (2003), DiPrete and Buchmann (2006), Goldin, Katz, and Kuziemko (2006), and Jacob (2002).

Figure 2
Gender Similarity in Major and Occupation by Cohort



Source: Data from the 2014–2017 American Community Survey and are restricted to those with at least a bachelor's degree. See text and online Appendix for additional details.
Note: Figure plots the renormalized, inverse Duncan-Duncan indices $\left(I_c^{DD,Major}, I_c^{DD,Occ}\right)$ for different cohorts for major (solid line) and separately occupation (dashed line).

For our discussion, we renormalize these classic Duncan-Duncan indices by subtracting them from one. This step allows the reader to make easy visual comparisons with the indices introduced later in the paper: an increasing slope of any index in this paper represents a movement toward gender parity. Thus, in the simple example presented above, the inverse Duncan-Duncan index value equals 0.8 while the classic Duncan-Duncan value equals 0.2.

F2

The solid line in Figure 2 shows the trend in the inverse Duncan-Duncan index in major sorting across different birth cohorts as computed using all 134 detailed major fields in the 2014–2017 American Community Survey. The index increased from 0.55 for the 1950 birth cohort to 0.64 for the 1990 birth cohort. There is a systematic convergence in undergraduate major sorting by gender occurring between the 1950 and 1965 birth cohorts. We document a surprising new fact that there is a slight reversal in the index for recent cohorts. We also see evidence of this reversal in Figure 1 if we look at patterns among the Business and Psychology majors which experienced gender divergence in recent cohorts.

In thinking about this divergence, it is important to keep in mind a macro trend with respect to college: overall college enrollments and completions in the United States have increased, and that increase was driven by women. In our sample in the 2014–2017 American Community Survey, 30 percent of women and 34 percent of men in the 1950 birth cohort had completed at least a bachelor's degree. By the 1960 birth cohort, women had overtaken men in completion. In the 1990 birth cohort, 38 percent of women and 29 percent of men had completed at least a bachelor's degree. As more women entered college, this likely broadened in a compositional sense the set of female college graduates that naturally would be reflected in their subsequent majors. Nevertheless, the recent divergence is small relative to the convergence that occurred for older cohorts.

Sorting Patterns across Occupations

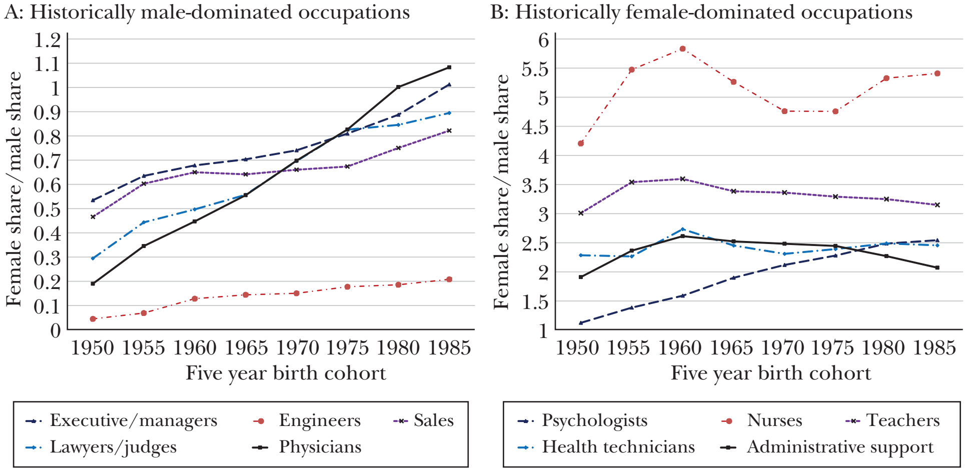
Next, we explore sorting patterns with respect to the occupations of the college graduates in our sample. In doing so, we provide a benchmark for the convergence F3 in sorting that we see in the major space. Specifically, Figure 3 replicates the exercise from Figure 1 for a selection of male-dominated broad occupations (panel A) and female-dominated broad occupations (panel B).

We begin with male-dominated occupations as shown in panel A. College educated women from the 1950 birth cohort were 20 times less likely than men to work in the Engineering occupation. College-educated women from the 1950 birth cohort were also much less likely to work in Executive/Manager, Sales, Physician, and Lawyer occupations relative to comparable men. In all of these broad occupations, the male–female gap narrowed substantively for more recent birth cohorts.[5] By the 1985 birth cohort of college graduates, the male–female gap in the Physician and Executive/Manager broad occupations was eliminated. The gender convergence in male-dominated occupations shown in panel A of Figure 3 is consistent with the gender convergence in male-dominated majors shown in panel A of Figure 1.

We see different patterns for the female-dominated occupations in panel B of Figure 3, namely, less convergence than in the male-dominated occupations. Historically, Psychologist was a slightly more prevalent occupation for college-educated women. For recent cohorts, this occupation became increasingly more female-dominated as college women became 2.5 times more likely than men to work as Psychologists. Nurses, Health Technicians, Teachers, and Administrative Support occupations have remained female-dominated during the last 50 years. Thus, we do not see gender turnover from female-to-male dominance in these occupations among college graduates.

[5] These results are consistent with the occupational sorting patterns documented in Hsieh et al. (2019).

Figure 3
Gender Differences in Selected Occupations by Birth Cohort



Source: Data from the 2014–2017 ACS and are restricted to those with at least a bachelor's degree with non-missing occupation information. See text for additional details.
Note: These figures plot the ratio of females to males within broad occupation category. The left panel shows trends for a set of occupations where men outnumber women. The right panel shows trends for a set of occupations where women outnumber men.

We return now to Figure 2, which moves us beyond a description of a select set of broad occupations as presented in Figure 3 to a summary of overall sorting patterns across all detailed occupation categories. For this exercise, we compute an inverse Duncan-Duncan index for occupations using the 251 distinct occupation codes reported in the 2014 to 2017 American Community Survey. As seen in Figure 2, the occupational segregation index (dashed line) is roughly similar in both level and overall trend to the major segregation index (solid line). Both indices start at a level of around 0.55 for the 1950 cohort and end at a level of around 0.65 for the 1990 cohort.

While there has a been a modest divergence in major sorting across genders for recent cohorts, convergence in occupation increased monotonically throughout.[6] The results in Figure 3 highlight that some of the convergence in the Duncan-Duncan occupation index among college graduates has been driven by relative entry of women into previously male-dominated occupations. We will explore the implications of this observation later in the paper.

[6]We have replicated the gender convergence in occupation using data from the historical US Censuses. This allows us to control for both cohort and age. Even conditional on age, the convergence in occupation is nearly identical to what is shown in Figure 2. See the online Appendix for additional details.

The Wage Differentials of Sorting

Segregation indices such as the Duncan-Duncan index have notable shortcomings. Importantly, the Duncan-Duncan index is invariant to the earnings rank of the major field or occupation. In other words, this index tells us to what extent college-educated men and women have sorted into similar majors or occupations, but would take on the same value if all men were Physical Education majors and all women were Fine Arts majors as it would if all men were Physical Education majors and all women were Biomedical Engineering majors. These scenarios would yield vastly different earnings implications. Thus, the units of the Duncan-Duncan index do not lend themselves easily to an economic interpretation.

As an alternative measure, we develop an index that compares the impact of undergraduate major on "potential wages" by gender. In contrast to the Duncan-Duncan index, the units of the potential-wage index allow for an economic interpretation of the impact of gender differences in sorting by major. The inputs of this index also prove useful in the ensuing empirical analysis of the college gender wage gap.

A crucial input is a potential wage based on major m that is related only to differences in sorting. Specifically, we define the potential wage $\bar{Y}^{m}_{male}$ to be the median within-major labor market log wage of a group we assume faces minimal post-educational frictions in the labor market: native-born, white men between the ages of 43 and 57 with strong attachment to the labor market. For example, for anyone (male or female) who majored in Economics, we assign as their potential wage the median log wage of older, native white men who majored in Economics. In our sample, the highest potential wage majors include the broad major categories of Engineering, Mathematics and Statistics, Computer and Information Sciences, Physical Sciences, and Biology and Life Sciences. For the 1968–1977 birth cohort, women represent 16 percent, 46 percent, 24 percent, 41 percent, and 54 percent respectively of these majors in our sample in the 2014–2018 American Community Survey. The lowest potential wage majors include the broad major categories of Philosophy and Religious Studies, Education Administration and Teaching, Cosmetology Services and Culinary Arts, Fine Arts, and Public Affairs, Policy and Social Work. For the 1968–1977 birth cohort, women represent 31 percent, 77 percent, 43 percent, 58 percent, and 82 percent respectively of these majors in our sample.

This approach is intended to answer the specific question: how much would wages by gender differ based just on sorting by major, not on other market factors related to age, race, nativity, or gender. For example, this index shuts down the direct effect of mothers or caregivers experiencing more disruptions in their job tenure. Likewise, it would shut down the direct effect of discrimination with respect to promotion opportunities and other confounding factors such as potential productivity differences by gender. However, our index will necessarily absorb the fact that men and women who choose the same major may very likely end up working in different occupations; we will return to that issue later in the paper.

We formally define the potential wage index for major as:

$$I_c^{Major} = \frac{\sum_{m=1}^{M} s_{female,c}^{m} \bar{Y}_{male}^{m}}{\sum_{m=1}^{M} s_{male,c}^{m} \bar{Y}_{male}^{m}} - 1. \quad (1)$$

Here, I_c^{Major} is an index that measures the differential potential log wage of women of cohort c given their major m relative to the majors of men from a similar cohort. A value of $I_c^{Major} = 0$ means that the majors of women yield the same potential log wage as their male counterparts. Any deviations from zero necessarily implies that women and men sorted into different undergraduate majors. For example, a potential wage index value of –0.12 implies that women sort into majors with a potential wage that is 12 percent lower relative to males from a similar cohort.[7]

As with the inverse Duncan-Duncan index, we replicate the same exercise with respect to occupations calculating a potential wage index based on occupation, I_c^{Occ}, for college graduates. For anyone—male or female—who work in a given occupation, such as Registered Nurse, we assign as their potential wage the median log wage of older native white men who work in that occupation. Again, this index will by definition have a value of zero if men and women sort into occupations that, weighted by the numbers of men and women in each occupation, have the same potential pay. When $I_c^{Occ} < 0$, women are sorting into occupations with lower potential wages than men from a similar cohort.

In our sample, the highest potential wage occupations include the broad occupation categories of Physicians, Lawyers and Judges, Executive, Managerial and Administrative Services, Other Technicians, and Engineers. In the 1968–1977 cohort, women account for 43 percent, 43 percent, 44 percent, 28 percent, and 14 percent respectively of the college employment in these occupations. The lowest potential wage occupations include the broad occupation categories of Housekeeping, Personal Appearance, Child Care, Food Prep and Service, and Buildings, Maintenance and Keeping. Women account for 85 percent, 81 percent, 95 percent, 58 percent, and 23 percent respectively of the college employment in these occupations in our sample.[8]

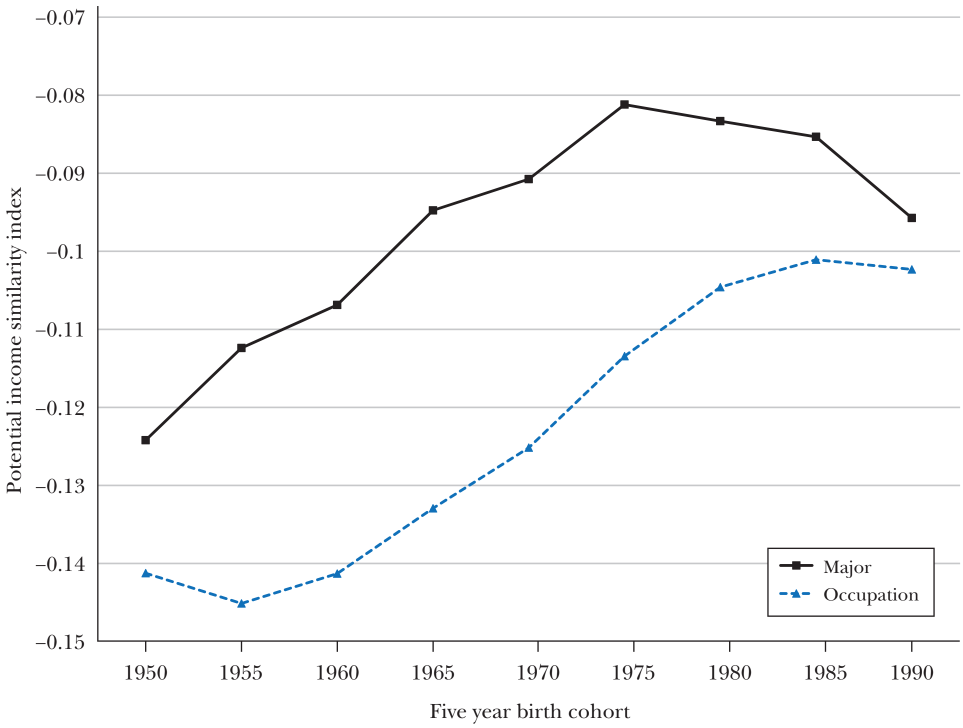
F4

The solid line in Figure 4 shows the trend in the potential wage indices across cohorts. Notice that the vertical axis of Figure 4 includes only negative values, implying that in both major and occupation space, women have systematically sorted into fields with lower potential wages than men. As with the inverse Duncan-Duncan index, a positive slope to our potential wage indices would imply convergence between men and women—and that is what we see for both majors and occupations in Figure 4. For the 1950 birth cohort, women sorted into majors that reduced their potential wage by 12.5 percent relative to their male counterparts. Notably, like the time series pattern

[7] This is similar to an index developed in Bertrand (2017). Using a similar methodology to rank undergraduate majors in the American Community Survey, Bertrand (2017) notes gender convergence at the 90th percentile, 80th percentile, and mean of log earnings across birth cohorts.

[8] We use the broad occupational categories to summarize the heterogeneity of occupations, but we calculate the index using detailed occupational codes.

Figure 4
Potential Wage Index in Major and Occupation by Cohort



Source: Data from the 2014–2017 ACS and are restricted to those with at least a bachelor's degree. See online Appendix for additional details.
Note: Figure plots the potential wage indices for major and occupation, across different cohorts of US college graduates. The solid line shows the index for major (I_c^{Major}). The dashed line shows the index for occupation (I_c^{Occ}).

in the Duncan-Duncan segregation index, this potential wage index diverges slightly for the most recent birth cohorts. Even for the 1990 cohort, women are systematically sorted into majors associated with per-hour wages that are 9.5 percent lower than men. Figure 4 shows strong convergence in occupational segregation as measured by the potential wage index for occupations—the dashed line. College women from the 1950 birth cohort were in occupations that systematically had potential wages that were 14 percent lower than the occupations of their male counterparts. The potential wage gap in occupations fell to 10 percent for the 1990 cohort.

Collectively, these results highlight four facts about gender differences in undergraduate majors and occupations. First, the gap in potential wages based on major has declined somewhat across cohorts. Second, even for the most recent set of college graduates, a large gender gap in potential wages based on major still exists. Third, the gender gap potential wages based on occupation is larger for all birth cohorts than the gender gap in potential wages based on major (the dashed line is always below the solid line). Finally, the convergence in the gap in potential wages based on major is of the same magnitude as the convergence in the gender gap in potential wages based on occupation among college graduates.

Mapping Majors to Occupations

Our discussion to this point has documented sorting patterns in majors independent of sorting patterns in occupations. There are inevitable linkages between major and occupation. For example, college-educated nurses are more likely to be drawn from a pool of undergraduate Nursing or Science majors than Humanities majors. However, the overlap is not complete and those who complete the same college major need not end up in the same occupation. In this section, we explore the connections between pre-market and market specialization by documenting gender differences in the mapping between undergraduate major and occupation. We find that, conditional on major, women systematically sort into occupations with lower potential wages relative to men from the same cohort.

Occupational Mapping Patterns within Majors

Empirically, we find motivation for the idea of forking paths from majors to occupation in Figure 4 discussed above. The potential wage index based on occupation (dashed line) is consistently lower than the potential wage index based on major (solid line). This implies that conditional on being sorted into the same major as men, women systematically work in lower-pay occupations.

T1 Table 1 shows the broad occupational distribution for men and women born between 1968 and 1977 for selected broad major categories. We summarize the occupational distribution by showing the four most common occupations associated with each major. Unlike undergraduate major, occupation may vary over an individual's lifetime. Thus, for Table 1 we measure occupations for the birth cohort from 1968 to 1977, at ages 38–47, using data from the 2014–2017 American Community Survey.

There are clearly large differences in occupational sorting between men and women who majored in the *same subject*. For example, among Education majors in the 1968–1977 birth cohort, 68 percent of all women and just 50 percent of all men who majored in Education worked as Teachers. Such patterns are robust across all birth cohorts. Again, for Education majors, 72 percent of women from the 1978–1987 birth cohort, 63 percent of women from the 1958–1967 birth cohort, and 52 percent of women from the 1948–1957 birth cohort worked as Teachers. The comparable numbers for men from the various birth cohorts were 58 percent, 43 percent, and 28 percent respectively.

Importantly, Table 1 shows evidence of rank effects. In all the broad majors in Table 1, women are less likely to be Executives and Managers and more likely to work in Administrative Support occupations. Men from the 1968–1977 birth cohort who

Table 1

Gender Differences in Occupation for Selected Majors, 1968–1977 Birth Cohort

Panel A. Education majors

	Teachers	*Executive/ Manager*	*Sales*	*Administrative Support*	$HHI_{g,c}^{Major}$
Men	0.50	0.18	0.06	0.03	0.29
Women	0.68	0.09	0.03	0.07	0.48

Panel B. Nursing/Pharmacy

	Nurses/ Health	*Executive/ Manager*	*Sales*	*Health Technicians*	$HHI_{g,c}^{Major}$
Men	0.46	0.15	0.07	0.06	0.25
Women	0.63	0.09	0.03	0.05	0.41

Panel C. Social Sciences

	Executive/ Manager	*Sales*	*Lawyers/ Judges*	*Administrative Support*	$HHI_{g,c}^{Major}$
Men	0.26	0.13	0.11	0.06	0.11
Women	0.20	0.07	0.08	0.13	0.10

Panel D. Business

	Executive/ Manager	*Sales*	*Accountant/ Underwriter*	*Administrative Support*	$HHI_{g,c}^{Major}$
Men	0.31	0.18	0.12	0.07	0.16
Women	0.24	0.11	0.17	0.18	0.14

Panel E. Engineering

	Executive/ Manager	*Engineer*	*Other Technicians*	*Architects/ Civil Engin.*	$HHI_{g,c}^{Major}$
Men	0.28	0.23	0.09	0.08	0.16
Women	0.27	0.18	0.05	0.07	0.13

Panel F. Biology/Life Sciences

	Physicians	*Executive/ Manager*	*Scientists/ Actuaries*	*Sales*	$HHI_{g,c}^{Major}$
Men	0.26	0.16	0.10	0.06	0.12
Women	0.18	0.14	0.08	0.04	0.10

Panel G. Physical Sciences

	Executive/ Manager	*Scientists/ Actuaries*	*Physicians*	*Sales*	$HHI_{g,c}^{Major}$
Men	0.20	0.15	0.08	0.07	0.09
Women	0.15	0.10	0.07	0.06	0.08

Panel H. Psychology

	Executive/ Manager	*Teachers*	*Sales*	*Psychologists/ Social Workers*	$HHI_{g,c}^{Major}$
Men	0.21	0.11	0.11	0.09	0.09
Women	0.16	0.21	0.06	0.13	0.11

Note: Table 1 shows the occupational distribution of men and women born between 1968 and 1977 for different majors. We use both broad major categories and broad occupational categories for this table. Each panel shows a different undergraduate major. The cells of the panel show the fraction of men (women) who majored in that occupation who subsequently worked in different broad occupations in the 2014–2017 American Community Survey. For each major, we show the four largest occupational categories based on where men with that major in that age range worked.

majored in Education are twice as likely as women (18 percent versus 9 percent) to be Executives or Managers—including principals and superintendents. Women who majored in Education are more than twice as likely as men (7 percent versus 3 percent) to work in Administrative Support roles—including teachers' aides, administrative assistants, and office supervisors. This effect is smallest among Engineering majors, where men and women are almost equally likely (28 percent versus 27 percent) to be Executives and Managers. Even in this case, male Engineering majors are more likely than female Engineering majors to work as Engineers (23 percent versus 18 percent).

Occupational Mapping Patterns across All Majors

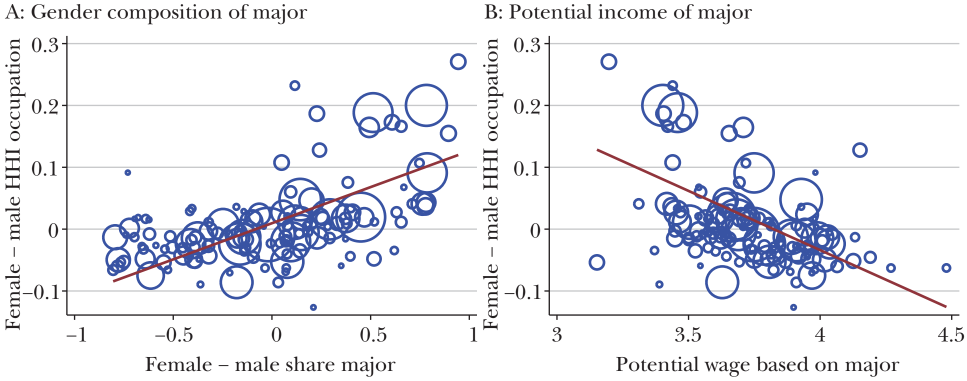
Even when men and women have completed the same college major, they systematically end up in different occupations. Here, we explore whether women subsequently sort into a broader (less concentrated) or narrower (more concentrated) set of occupations than men with the same major. We find that women sort into a narrower set of occupations when 1) the major is female-dominated and 2) the major has a lower level of potential income. Throughout, we highlight that these patterns are consistent with men systematically moving towards higher earning occupations relative to women conditional on a given undergraduate major.

To summarize these patterns, we create a cross-occupation Herfindahl-Hirschman Index for each gender *g* and cohort *c* for every major. We calculate this index by: 1) calculating the share employed in an occupation of the relevant gender-major-cohort group; 2) squaring those shares; and 3) summing up over all occupations. For example, for a given cohort of History majors, let's say that 50 percent of the male History majors work in occupation *A* and 50 percent work in occupation *B*. Let's say that 95 percent of the female History majors work in occupation *A* and 5 percent work in occupation *B*. For men, the Herfindahl-Hirschman Index would equal 0.5; for women, it would equal 0.91. Our occupational concentration index ranges from 0 to 1, and higher levels imply that occupational sorting is more concentrated.[9]

Which majors differ the most or least by gender with respect to occupational concentration? Returning to Table 1—that is, the cohort born in 1968–1977 and then evaluated by their occupation from ages 38 to 47—the broad major categories with the largest gender difference in terms of occupational concentration are: 1) Education, Administration, and Teaching, 2) Nursing, Medical, and Health Services, 3) Public Affairs, Policy, and Social Work, 4) Construction Services, and 5) Criminal Justice and Fire Protection. For the Education, Administration, and Teaching;

[9] Formally, we define the index: $HHI_{g,c}^{Major} = \sum_o^O (s_{g,c}^{o|m})^2$ where $s_{g,c}^{o|m}$ is the share of group *g* from cohort *c* working in occupation *o* conditional on having major *m*. For each gender and cohort who matriculate with a given major, $\sum_o^O s_{g,c}^{o|m} = 1$ where *O* is the total number of potential occupations. This index measures the occupational concentration for individuals in each major separately by gender.

Figure 5
Cross Major Variation in within-Major Gender Differences in Occupational Concentration, 1968–1977 Birth Cohort



Source: Data shown only for the 1968–1977 birth cohort. Both panels include a fitted regression line. The slopes of the regression lines are –0.19 (standard error = 0.027) and 0.12 (standard error = 0.011), respectively.
Note: These figures show cross-major variation in the Herndahl-Hirschman index as a function of how female-dominated is the major (panel A) and average major potential income (panel B). See text and the online Appendix for additional details. Each observation in both panels is a detailed major. We use broad occupation categories.

Nursing, Medical, and Health Services; and Public Affairs, Policy, and Social Work majors, women sort into a narrower set of occupations than their male peers. For the Construction Services and Criminal Justice and Fire Protection majors, men sort into a more concentrated set of occupations. The majors with the most similar occupational concentration between men and women are: 1) Environment and Natural Resources, 2) Business, 3) Social Sciences, and 4) Physical Sciences.

F5 In Figure 5, we compute a Herfindahl-Hirschman index using the 134 detailed major categories focusing again on the 1968–1977 birth cohort.[10] Figure 5 highlights two notable patterns pertaining to gender differences in occupational concentration using the detailed major categories. Panel A plots the relationship between the extent to which the major is female-dominated (*x*-axis) and gender differences in occupational concentration for graduates with that major. In female-dominated majors, women systematically sort into a narrower set of occupations than men. Likewise, in male-dominated majors, men sort into a narrower set of occupations than women. Thus, panel A suggests strong relationship between the extent to which a major is dominated by one gender and the extent to which that gender sorts into a narrower set of occupations.

[10]When computing the concentration measures for detailed majors, we still measure occupational sorting using our broad occupation categories.

For example, consider the Elementary Education major that occupies the upper right quadrant of Figure 5. Women outnumber men in the major by 77 percentage points. The wedge in the Herfindahl-Hirschman index between women and men who major in Elementary Education is 0.15, which means that women with this major are much more likely to matriculate into a narrower set of occupations than comparable men. Consistent with the patterns for broad major categories in Table 1, almost all women who major in Elementary Education become teachers while more of the men become executives/managers (such as school principals). As an alternative example, consider the Theology major that occupies the lower left quadrant of Figure 5, Panel A. Male Theology majors outnumber women by 53 percentage points. The female-to-male difference in the Herfindahl-Hirschman Index is equal to –0.10 for Theology majors, which means that men who major in Theology are much more likely to matriculate into a narrower set of occupations than comparable women.

The anecdotal patterns underlying the results in Table 1 and panel A of Figure 5 suggest that women tend to sort into lower paying occupations conditional on major. Panel B of Figure 5 provides additional evidence of this pattern. In particular, the figure highlights a strong and significant negative relationship between the potential income of a major, as we defined it above, and the female-to-male difference in occupational concentration for individuals graduating with that major. When the potential returns to a major are low, men disperse into a wider set of occupations than women, presumably to avoid the wage penalty of a low-return major. When the potential returns to a major are high, however, men sort into a *narrower* set of occupations than women. This is consistent with women migrating to lower income occupations (relative to men) when the potential income of a major is high.

For example, consider the Health and Medical Preparatory Programs that is the detailed major with the highest potential wage in the lower right quadrant of panel B. The female-to-male difference in occupational concentration is equal to –0.09, which means that men in this major are more likely to matriculate into a narrower set of occupations than comparable women. Many more men in this major end up being doctors relative to women in this major. The results in this section so far: 1) document that conditional on major men and women sort into different occupations; and 2) provide suggestive evidence that women systematically sort into lower earning occupations. In the next sub-section, we provide more specific evidence for the second result.

Cross-Cohort Patterns in Occupational Mapping

A shortcoming of our above occupational concentration index is that, like the Duncan-Duncan index, it does not take the earnings rank of occupations into account. Yet rank effects are quite evident in the descriptive exercise in Table 1. Consider two scenarios: in one, all male and female Finance majors sort into the same high-paying occupation: Executive or Manager. In the other scenario, all male Finance majors sort into the Executive or Manager occupation and all female Finance Majors sort into the Administrative Support occupation. In both scenarios, men and women will have the same value of occupational concentration ($HHI_{g,c}^{Major}$). In other words, the concentration index is not in a price space and therefore does not account for men and women with the same major sorting into occupations with different potential wages.

In order to account for the true economic significance of differential major-to-occupation sorting patterns by gender, we introduce a summary statistic, $I_c^{Occ|m}$, that measures the gender gap in *potential occupational wages* for men and women graduating with the same major.[11] Consistent with this exercise throughout this paper, a potential wage refers to the log wages of native-born, white men, age 43 to 57 with strong attachment to the labor market. In the case of the potential occupational wage ($I_c^{Occ|m}$), we calculate the potential wage within an occupation conditional on matriculating with a given major. Each birth cohort, major, and gender in our sample has its own value of this index. Within a cohort and major, if these values differ by gender, it means that conditional on major, men and women have sorted into occupations with a different earnings ordering (rank). A negative value of the index implies that women with a certain major are systematically working in occupations with lower potential wages relative to men from the same major and cohort.

To build intuition, consider an example with a single major: Let's assume 70 percent of male Zoology majors work in occupation *A* and 30 percent work in occupation *B* while 30 percent of female Zoology majors work in occupation *A* and 70 percent work in occupation *B*. Recall, these distributions would yield the same concentration index for occupation. However, let's say the potential wage for occupation *A* (in logs) is 4.79 (the potential wage for the highest paid broad occupation in our sample–Physicians) and the potential wage for occupation *B* (in logs) is 2.71 (the potential wage for the lowest paid broad occupation in our sample—Housekeeping). In this example, the index would have a value of –0.83. This implies women Zoology majors choose occupations that are associated with 83 percent lower earnings on average relative to male Zoology majors.

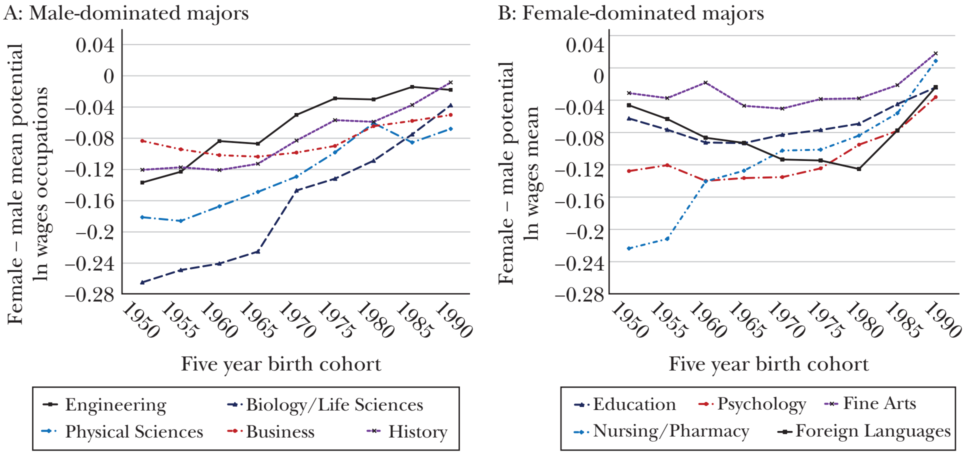
F6 Conditional on graduating with the same major, do women systematically sort into occupations with lower potential wages? Figure 6 provides an initial answer to this question by examining the index value for the same broad categories of majors and cohorts shown earlier in Figure 1. The *y*-axis—the female-male difference in potential wages as determined by occupation conditional on major—contains mostly negative values, implying that for both male-dominated majors (panel A) and

[11] As in the previous indices, we subtract the weighted sum for men of the potential wage as determined by occupation from the weighted sum for women of the potential wage as determined by occupation. The weights are the shares of men and women, respectively, who work in each occupation conditional on having majored in the same subject. Formally, we define our index as:

$$I_c^{Occ|m} = \sum_{m=1}^{M} \left(s_{female,c}^{Occ} \,|\, m\right) \bar{Y}_{male}^{Occ} - \sum_{m=1}^{M} \left(s_{male,c}^{Occ} \,|\, m\right) \bar{Y}_{male}^{Occ} \qquad (2)$$

where $s_{g,c}^{Occ}|m$ is the share of gender *g* choosing occupation *Occ* conditional on major m from cohort *c*.

Figure 6
Within-Major Gender Differences in Potential Wage by Occupation, by Gender and Cohort



AQ2 *Source:*

Note: These figures show the trends in the occupational sorting based on the occupation's potential log wage conditional on having graduated with a given major ($I_c^{Occ|m}$). Panel A are male-dominated majors. Panel B are female-dominated majors. As with Figure 4, occupational potential log wage is computed in the 2014–2017 American Community Survey using the log wages of native-born, white men 43–57 with strong attachment to the labor market who work in a given occupation.

female-dominated majors (Panel B), women in each birth cohort are sorted into lower pay occupations conditional on major. There is evidence of convergence across cohorts. Take, for example, the Engineering major (solid line, panel A). For the 1950 birth cohort, the gender gap in potential wages based on occupation was large—female Engineering majors sorted into occupations that, on average, had potential wages that were 14 percent lower than their male peers. For the 1990 birth cohort, this difference fell to a 2 percent difference. Business majors saw this gap reduced by almost one-half although they experienced less convergence than Engineering majors.

The gender convergence in occupation within majors is seen in many but not all of the occupations in Figure 6. Many of the historically female-dominated majors like Education, Foreign Languages, and Fine Arts (panel B) saw more modest convergence across cohorts in the occupations taken by women relative to men (as measured by potential wages) conditional on major. Collectively, the patterns in Figure 6 highlight that for many broad majors, women sort into occupations with lower potential earnings relative to men, conditional on major, and that the extent of such differential sorting has diminished somewhat for recent cohorts.

The cross-cohort trends in Figure 6 are somewhat limited in that they describe just a few broad major categories in a taxonomic fashion by name and gender endowment (panel A versus panel B). In the online Appendix, we discuss in detail an exercise to both show these patterns for all majors in our sample and to provide a meaningful economic ordering of majors. In particular, we show the mapping to occupations, conditional on major, for two cohorts of college graduates who are likely to be settled into their careers: the 1955 birth cohort and the 1975 birth cohort. We know from earlier in the paper that compared to the 1955 cohort, women in the 1975 cohort have sorted into majors that were more similar to men. In this exercise, we show that compared to the 1955 birth cohort, women in the 1975 birth cohort also work in occupations that are more similar to their male peers *conditional on major*.

This convergence is non-trivial. For example, conditional on major, women from the 1955 birth cohort sorted into occupations that had potential earnings roughly 11 percent less than otherwise similar men. By the 1975 cohort, women sorted into occupations—conditional on major—that earned roughly 9 percent less than otherwise similar men. The convergence is driven by cross-cohort changes in occupation among those majoring in the highest paid majors. This change in the mapping of majors to occupations is one of the key findings of the paper.[12]

It is important here to note that our data from the 2014–2017 American Community Survey observes birth cohorts at different points in the life cycle. Recall that major in our study refers to undergraduate major of college graduates, not current college students. As such, major is fixed and will not change over time for an individual. In contrast, occupation is likely to change over one's life cycle. Because occupation is dynamic over the life cycle and increasingly dynamic across generations, this will complicate the interpretation of cross-cohort differences in occupation-based results. This limitation is particularly salient when considering the evolution of occupational sorting across cohorts. For this reason, the discussion in this section focused on birth cohorts who are likely settled in their occupations.

Analyzing the Wage Gap among College Workers

How much of the gender gap in college-graduate wages can be explained by controlling for both undergraduate major and for current occupational sorting? How have these relationships evolved over time? Previous scholarly work has grappled with these questions. In a classic reference, Brown and Corcoran (1997) use data from the 1984 Survey of Income and Program Participation (SIPP) and the National Longitudinal Study of High School Class of 1972 (NLS72) to document how coursework differences between men and women are associated with gender wages gaps. For older cohorts born prior to 1960 (and thus, prior to the female

[12] In the online Appendix, we discuss a mapping result in an hours-worked space. In doing so, we show systematic sorting of women into occupations with lower potential hours worked than their male peers who graduated with the same major. In particular, over all majors and across all cohorts, conditional on major, women are in occupations that have a work requirement (based on male hours) that is about 3 percent less than comparable men. There is little trend in this gap across cohorts.

overtaking in college completion), they find that undergraduate major accounts for 8 or 9 percentage points of the 20 percentage point college gender wage gap (where majors are divided into 20 broad categories). In related work, Loury (1997) uses data from the National Longitudinal Study of 1972 and the High School and Beyond Senior Cohort (Class of 1980) to document that controlling for grade point average and four broad major categories reduces the gender wage gap. Black et al. (2008) use data from the 1993 National Survey of College Graduates to examine the extent to which pre-labor market factors—including broad undergraduate major—explains differences in wages across various race-gender groups of college graduates. Within a broader analysis of factors contributing to the gender wage gap such as psychological attributes and demands for flexibility, Bertrand (2017) uses data from the 2012–2015 American Community Survey to document cross-cohort convergence in potential wages based on degree attainment and major.

Returning to our sample from the 2014—2017 American Community Survey, we explore these issues, both for all cohorts pooled together and also separately by 10-year birth cohorts. The latter analysis lends itself to a decomposition exercise to assess how much of the change in gender wage gaps can be explained by changes in the distribution of undergraduate majors and occupations. Specifically, we estimate regressions of the following form:

$$\ln(Wage)_i = \alpha + \beta Female_i + \delta_m Major_i + \delta_o Occ_i + \Gamma X_i + \epsilon_i \quad (3)$$

where $\ln(Wage)_i$ is a measure of individual *i*'s log wage and $Female_i$ is a dummy variable equal to 1 if the individual is female. Our estimated variable of interest is β that measures the gender gap in log wages. The variables $Major_i$ and Occ_i are summary measures of the individual's chosen undergraduate major and observed occupation. We summarize an individual's major and occupation with the potential log wage variables $\bar{Y}_i^m$ and $\bar{Y}_i^o$. In all specifications, we include a vector of demographic controls summarized in the vector X_i. Specifically, we control for five-year birth cohort, race, state of residence, educational attainment beyond a bachelor's degree, survey year, and marital status. Standard errors are clustered by state of residence.[13]

T2

Table 2 summarizes the basic results. In the top panel we show results pooling together individuals from all the birth cohorts in our sample. In column 1, we use only demographic controls for highest degree completed, age, race, and state of residence to estimate the gender gap in wages for all college-educated cohorts. The gap is estimated at 23 percent, meaning college women in our sample earn about 77 cents on a dollar compared to college men.

[13] In the online Appendix, we report results from an alternate specification where we do not include demographic controls. We also report results from two alternate specifications where we aggregate majors and occupations to broader categories and instead include dummies for each broad major and occupation category. These exercises yield results that are very similar to those in Table 2.

Table 2
Majors, Occupations, and Gender Gaps in Wages

Panel A. log wage regressions, pooled cohorts

	log wages			
Variable	*(1)*	*(2)*	*(3)*	*(4)*
$Female_i$	−0.233 (0.006)	−0.158 (0.004)	−0.143 (0.004)	−0.114 (0.003)
$\bar{Y}_i^m$		0.807 (0.015)		0.408 (0.012)
$\bar{Y}_i^o$			0.757 (0.011)	0.677 (0.009)
Controls	Yes	Yes	Yes	Yes
R^2	0.22	0.27	0.36	0.37

Panel B. log wage regressions, separately by cohort

	1958–1967 birth cohorts			*1978–1987 birth cohorts*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$Female_i$	−0.322 (0.008)	−0.198 (0.005)	−0.168 (0.004)	−0.155 (0.005)	−0.093 (0.004)	−0.065 (0.004)
$\bar{Y}_i^m$			0.411 (0.016)			0.443 (0.010)
$\bar{Y}_i^o$		0.909 (0.015)	0.823 (0.012)		0.599 (0.008)	0.513 (0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.32	0.33	0.13	0.25	0.27

Note: Table 2 shows estimates from regression (3). See text and online Appendix for additional details. Sample size for panel A columns 1–4 is 2,270,392. Sample size for panel B columns 1–3 is 533,348. Sample size for panel B columns 4–6 is 614,106.

In the rest of the analysis, we consider the effects of specialization on the gender wage gap. Column 3 shows reports the gender wage gap from a regression that controls only for demographics and occupation. This gap is estimated at 14.3 percent or about 86 cents on a dollar. Consistent with the existing literature on the gender wage gap, this estimate tells us that market specialization (occupation) matters.

How much predictive power does major have above and beyond controlling for just occupation? In column 4, we report results from a regression that fully controls for demographics, occupation, and college major. Adding undergraduate major further reduces the gender wage gap to 11 percent—a reduction of about one-half from our model with no specialization controls in column 1. Adding major to our model accounts for an additional 3 percent of the college gender wage gap above and beyond a model that only accounts for market specialization. In this calculation, major independently accounts for one-quarter of the reduction in the college gender wage gap. In other words, college women earn 89 cents on a dollar earned by college men who have sorted into similar majors and occupations.

How has the gender gap evolved across generations of US college graduates? In the bottom panel of Table 2, we compare recent (1978–1987) birth cohorts to older cohorts (1958–1967). In the most basic models that control only for demographics, we see a reduction in the gender wage gap among college graduates from 32.2 percent for the older cohort to 15.5 percent for the younger birth cohort. These results can be found in columns 1 and 4. We find that in our fully controlled models, there is a further reduction in the gender wage gap between the older cohort (column 3) and the younger cohort (column 6). Controlling for demographics, occupation, and major, the 1958–1967 birth cohort had a 16.8 percent gap, or about 83 cents on a dollar. By the 1978–1987 birth cohort, this gap fell to 6.5 percent or about 94 cents on a dollar. The role of college major in these cohorts increased modestly, but there was a sharp reduction in the importance of occupation. Overall, we find that controlling jointly for major and occupation explains roughly 40 percent of the cross-birth cohort decline in the wage gap.

In the 1950 birth cohort, men completed bachelor's degrees at a higher rate than women, but for all subsequent birth cohorts, women surpassed men in bachelor's completion. In a counterfactual exercise, we equalize the male and female distributions. Upon doing this, we can bound the above estimates of the college gender wage gap. If the number of male and female college graduates in each five-year cohort was the same, the gender wage gap in wages after controlling for simple demographics was between 21 and 27 log points. Once we control for demographics, occupation, major and equalize the distributions, the college gender wage gap was between 11 and 12 log points.

In additional work, we conducted a wage decomposition exercise to better understand the power of our explanatory variables within cohort. A detailed discussion including a table of results can be found in the online Appendix. We find occupational specialization explains the largest share of the gender wage gap for college graduates. For example, occupation explains 36.9 percent of the gender wage gap in the youngest cohort (1978–1987). Sorting by major is also important and explains 27.9 percent of the gender wage gap in that same cohort. Notably, human capital attainment above and beyond a bachelor's degree (such as a graduate degree) explains considerably less of the college gender wage gap. These results suggest that properly accounting for human capital decisions above and beyond schooling attainment and occupational specialization is centrally important in understanding the causes of the gender wage gap among the highly skilled.

Separately, we document that undergraduate major does not have any effect on extensive margin labor market participation for college graduates. While undergraduate major is informative about gender wage differentials, it is not informative with respect to explaining extensive margin gender differences in labor supply. However, we document heterogeneous effects by gender on intensive margin participation.

Specifically, we find that conditional on undergraduate major, women sort into occupations with lower annual hours worked than men.[14]

Discussion

A gendered specialization of human capital and labor has primitive roots. A division of labor in the early home-based economy was largely influenced by biological differences between the sexes, particularly with respect to manual tasks. As workers wandered beyond the home and field to factory employment, many tasks remained manual, and biological differences continued to dictate a division of labor. We see historical evidence of this in US manufacturing at the end of the 19th century: women worked in mostly precision manufacturing occupations such as tobacco, textile, apparel, paper, and rubber, with men dominating most other manufacturing occupations including heavy machinery manufacturing used in the production and fabrication of metal.[15] Modern US history has seen improved knowledge of and access to family planning, a subsequent decline in fertility, and a sustained growth in occupations that require relatively less manual tasks and relatively more cognitive tasks (Bailey 2006; Blau, Ferber, and Winkler 2014; Autor and Dorn 2009). Such factors would erode a physicality-based male comparative advantage in the labor market.

Further, as technology was altering the occupational landscape with respect to task demands, changes were afoot with respect to college education. For the US birth cohorts from 1870 to 1910, the male and female college graduation rates were close and paralleled in trend. For the birth cohorts from the mid-1910s to the mid-1950s, the male series pulled away from the female series creating a sustained period of male comparative advantage on average with respect to tasks requiring a college degree. The late 1950s birth cohorts saw a male–female convergence in college completion with women eventually surpassing men, giving cohorts of younger women both in the United States and globally a comparative advantage on average in a global labor market that was experiencing upskilling—a trend that has not reversed (Becker, Hubbard, and Murphy 2010; Charles and Luoh 2003; DiPrete and Buchmann 2006; Goldin, Katz, and Kuziemko 2006; Jacob 2002).

The shifting comparative advantage also seems to have affected women's investments while at university. Using the 1993 National Survey of College Graduates, Black et al. (2008) report that among women with a bachelor's degree born in the 1930s, 38.3 percent majored in Education and 12 percent majored in the Humanities. For women born between 1960 and 1965, only 14.8 percent majored in Education and only 6.8 percent majored in the Humanities. As we documented

[14] A full discussion of these results can be found in the online Appendix.

[15] According to the 1890 US Manufacturing Census, tobacco, textile, apparel, paper, and rubber were 31.9 percent, 40.8 percent, 60.2 percent, 39.9 percent, and 48.8 percent female respectively (Goldin 1990, p. 80).

in Figure 4, women's majors converged in terms of potential wages until about the 1975 birth cohort and then experience a puzzling reversal. Since then, the gap in potential wages between women and men has increased, although it is important to keep in mind that in this era relatively more women graduated from college. During this time, overall college enrollments grew with much of that growth coming from increased female enrollments. Thus, as college enrollments ballooned, we may expect marginal students to select less challenging majors, which may be associated with lower potential wages.

For college graduates, success in the labor market is not determined by pre-market specialization (college major) alone, but is also influenced by specialization that happens in the market (occupation). Unlike field of study, occupational specialization requires workers and firms to match on the assignment. Using a potential wage index for occupation constructed in the same way as the one for major, we document strong male–female convergence in potential wages. Importantly, we see a flattening but do not see a reversal in the trend as we do in the major series.[16]

Despite the convergence in potential wages based on both occupation and major, the gender wage gap among college graduates remains substantial. Controlling for major and occupation sorting explains roughly 60 percent of this gap. These patterns are a highly salient topic for future research. The sustained importance of major in explaining the gender wage gap—a specialization outcome set in motion before workers even enter the market and face market frictions such as tenure disruptions due to family demands or employer discrimination—highlights the need to better understand the mechanisms driving pre-market investments. Whether women choose a major in anticipation of future family demands, based on individual preferences, under the burden of restrictive social norms, or for any other reason may be best explored in an experimental setting or with access to data where preferences and not solely outcomes are observed.

In closing, our thoughts return to the home sector. As work outside the home has evolved to involve fewer manual tasks, there should be a subsequent narrowing of female comparative advantage in home production. If this comparative advantage does not completely disappear, we may expect sustained gender differences with respect to specialization before and in the market, which will result in disparities in labor market outcomes. In a model in which men and women are equally productive in the market but women have a comparative advantage at home, Lazear and Rosen (1990) predict tougher promotion standards for women than men. If there is any investment feedback effect, we may anticipate different educational and specialization decisions by workers who have a smaller probability of promotion—in this case, female workers. Recent empirical evidence, summarized in Cortés and Pan

[16] For those who wish to explore the literature documenting both changes in occupational sorting by gender over time and the contribution of occupation to gender labor market disparities, useful starting points include Blau, Ferber, and Winkler (2014); Cortés and Pan (2018); Hsieh et al. (2019), and the references cited therein.

(2020), points to sustained gender wage gaps among all workers. With respect to the influence of home production, particularly child-rearing, the paper reports a long-term earnings loss of 39 percent for working mothers relative to the birth year of their first child. Understanding the relationship between anticipated demands at home and specialization decisions that occur both before and in the market would appear central to understanding gender disparities in outcomes.

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1.	In footnote 3, should Duncan and Duncan be 1995 per reference list?	
2.	Do you have a source for this figure?	
3.	Is this it https://www.nber.org/papers/w27980? If so, I will reformat to being an NBER working paper.	
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