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Keys to Upward Mobility: Typewriter Adoption and Women's Economic Outcomes

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Abstract

Workplace technological changes were instrumental in creating new tasks for women over the last century. This paper studies the adoption of the typewriter into U.S. workplaces. Exploiting exogenous variation in typist demand across sectors, Rashid documents that the typewriter increased women's labor force participation, leading to lower rates of marriage and fertility. These developments stemmed from a transition of White women from households into office work and an indirect crowding-in effect drawing Black women into domestic services. Acting as a "meeting technology," the typewriter reshaped social interactions, enabling White women to marry above their socioeconomic backgrounds and achieve upward mobility.

1 Introduction

Women's labor force participation in the United States nearly doubled between 1870 and 1940 from 15 to 29 percent.[1] Concurrently, the kinds of occupations and industries accessible to women also expanded considerably, which included their greater integration into white-collar work. Existing work suggests that these developments were driven in part by factors such as increasing educational attainment, reductions in fertility, and the introduction of technologies related to the household (Goldin, 1990; Goldin and Katz, 2002; Greenwood et al., 2005). One potentially important factor that has not been carefully examined in the existing literature is the influence of new technologies introduced into the workplace.

Workplace technological changes can lead to automation of work that displaces labor or result in creation of new work that "reinstates" demand for workers (Acemoglu and Restrepo, 2018). Existing studies have examined the impact of displacing technologies, such as mechanized telephone exchanges or automatic milking machines, on female employment (Feigenbaum and Gross, 2024; Ager et al., 2023). However, the consequences of new task-creating technological changes, especially for women, and their role in explaining the rising demand for female labor are not well-understood.

This paper studies the effects of the invention and diffusion of the typewriter on women's long-term outcomes. The typewriter replaced handwritten secretarial tasks—primarily performed by men—with standardized typewriting that became dominated by women. Offices in the US adapted to the arrival of the commercial typewriter in the 1880s by shifting towards the available supply of educated women who provided cheaper labor: while women initially made-up only 12 percent of the secretarial (and typing) occupation in 1880, by 1900 they accounted for 75 percent of all typists. By 1940, the typewriter had become a large shock to women's employment, with over 1.1 million women working as typists, accounting for nearly 9 percent of all employed women at the time and a quarter of women employed in white-collar occupations. In fact, the typewriter "created an occupation calling for more women than have been employed as a result of any other invention" (U.S. Department of Labor, Women's Bureau, 1926).

This paper shows that the introduction of the typewriter into US workplaces drew women into the labor force and new sectors of the economy, a shift that, in turn, led to unintended

[1] Calculated using data from historical US population censuses. See Appendix Figure 1.

changes in their marriage and fertility patterns and intergenerational mobility. However, the effects of the technological change varied greatly by race. As White women left the household to work in clerical occupations, Black women substituted for them in the household by entering domestic service work. Joining the labor force also led to reductions in fertility and marriage rates for White women. For Black women entering domestic service work, their marriage patterns did not change but living away from their spouse and working in an occupation where kids could not accompany them to work, meant reductions in their fertility rates. The typewriter not only affected women's labor market outcomes but also served as a "meeting technology" for White women: it allowed them enter office spaces where they could be connected with and marry men of higher income, translating into upward economic mobility through the channel of marriage.

I first empirically demonstrate secondary schooling and early typing courses as key factors that helped women enter the typing occupation in response to the technological change. Using data from Goldin and Katz (2008), I show a positive association between adoption of early secondary schooling laws and the consequent supply of female typists across states. To study the role of early typing courses, I digitize and construct a new database of local women's organizations in operation before 1880, which then offered the first typing courses for women. I find that counties that already had such organizations had a greater supply of female typists and secretaries in the decades after typewriter adoption. The increasing social acceptability of and the growing demand for female clerical work then paved the way for formal secretarial schools.

I then turn to my main empirical strategy which relies on utilizing exogenous shifts in the aggregate demand for typists across industries as a result of the technological change. Specifically, I employ a shift-share instrumental variable approach that interacts local industry employment shares before the adoption of the typewriter with national shifts in the demand for typists to identify exogenous variation in the local share of typists. To identify the effect of typewriter adoption, the instrument must be uncorrelated with omitted factors that improve women's outcomes at the local level.

Using historical US complete count censuses and the main empirical strategy, I show that a 1 percentage point (pp) increase in the predicted change in the number of typists between 1880 and 1920 led to a 1.1-2.1 pp increase in women's labor force participation. Using a back-

of-the-envelope calculation, these estimates imply that without the shock of the typewriter, women's labor force participation rate in 1920 would have been 5.6 pp lower, equivalent to nearly 1.7 million fewer women in the labor force at the time. The labor market effects induced by the introduction of the typewriter further led to a 0.9-1.7 pp reduction in women's marriage rates and a 1.0-2.2 pp decrease in their likelihood of having children. These estimates imply that the share of married women and women with children would have been 3.6 pp and 5.5 pp higher in 1920, respectively, in the absence of women's entry into the labor force driven by the typewriter, accounting for 1.1 million fewer married women and 1.7 million fewer women with children out of a population of 31.7 million working age women.

To support my main empirical approach, I show robustness of these results to using two alternative strategies: (1) constructing an alternative instrument using shifts from Canadian sectors and (2) utilizing exogenous variation in the supply of female typists. To address concerns that the national shifts in demand for typists might be endogenous to local women's outcomes, the first constructs alternative shifts using data from Canadian censuses. The second approach uses the database of local organizations providing early typing courses in a difference-in-differences framework to compare counties that had such organizations before typewriter adoption to those that did not. The intuition underlying this complementary approach is that women from counties that had such organizations before typewriter adoption would be more likely to be employed as typists and secretaries than elsewhere after the technology is introduced.

Next, I show that the changes in women's labor outcomes were not limited to White women, who were more likely to be hired as typists, but also had a *crowding-in* effect on Black women's labor participation. Specifically, I show that Black women in counties that experienced a 1 pp greater exposure to the typewriter were 1.4 pp more likely to be in the labor force. In fact, as White women left *unpaid* housework to join the labor force and work in clerical occupations in response to the technological change, Black women substituted for them by entering the labor force to work in the domestic services industry. In response to a growing demand for their labor in domestic services, many Black women also substituted out of agricultural work.

I then study the mechanisms underlying the observed changes in Black and White women's marriage and fertility choices. The decline in marriage rates among White women was driven

by both postponing marriage and, in some cases, opting out of it entirely. The reductions in fertility mainly composed of White women forgoing having children rather than only delaying childbearing. On the other hand, entering the labor force to work in the domestic services sector did not significantly change Black women's likelihood of getting married. However, working as household service workers, which often meant living away from their spouses, resulted in a drop in Black women's fertility. Historically, compared to agricultural work where Black women could bring children with to work, the nature of domestic service work also meant that women could not bring their children with them to work. Though arising from different channels, similar to the experience of White women, ultimately these reductions in fertility arose mainly from Black women remaining childless.

By allowing White women to enter offices, the typewriter also reshaped social interactions and influenced women's long-term economic mobility. Using data from Buckles et al. (2023), I am able to follow a sample of White women from the 1920 to the 1940 Census and compare the economic standing of women's fathers to that of their future spouses. Because a majority of women at the time dropped out of the labor force upon marriage, married women's historical intergenerational mobility is best measured using a comparison between their father's and husband's economic statuses (Goldin, 1983; Eriksson et al., 2023). I first descriptively illustrate that women who worked as typists in 1920 were married to higher-earning husbands in 1940 compared to women who worked in alternative non-typist occupations. To account for heterogeneity across family backgrounds, I also rely on a comparison across *sisters* to show that this result holds even when comparing typists to non-typists sisters. For women who grew up at the 25th percentile of their father's income distribution, working as a typist is associated with marrying men with an average income rank that was 18 percentiles above the average rank of husbands of non-typists. Importantly, this mobility advantage is not present in alternative white-collar occupations such as teaching.

Lastly, I use the instrument to causally show that women in locations with a 1 percentile greater predicted change in typewriter adoption were married to men with a 0.13 percentile higher expected income rank. In fact, for women growing up at the 25th percentile of the income distribution, being in a county more exposed to the shock of the typewriter resulted in marriage to a husband with an income rank that was 3.8 percentiles higher. This is consistent with a hypothesis that offices provided women a unique opportunity to work alongside and

be connected to men of higher income as opposed to their alternative work options. I provide evidence in support of this mechanism by following the spouses of women back to the 1920 Census and showing that the future husbands of typists were more likely to work in white-collar occupations in the same county as their future wives when compared to the future husbands of women who worked in alternative occupations.

These findings point towards an important factor that is overlooked in the broad literature studying the historic increase in women's labor force participation in the US: the role of workplace technological changes. This paper provides a new, long-run perspective of a workplace technological change and its effects on women's outcomes. Papers studying factors affecting the historic increase in women's labor force participation have so far considered factors such as household technological advances (Greenwood et al., 2005), expansion of educational opportunities (Goldin, 1990), innovation in contraception and reductions in fertility (Goldin and Katz, 2002; Bailey, 2006; Myers, 2017), improvements in maternal health (Albanesi and Olivetti, 2016), reduction in the cost of children (Attanasio et al., 2008) and access to electricity (Vidart, 2024).

This paper also contributes to an extensive literature studying the consequences of technological change for workers, which has largely focused on the impact of automation. In comparison, there is relatively little empirical work documenting the consequences of predominantly new task-creating technologies (Autor, 2022).[2] Recent work studies the origins of new work and tasks, tracing it to technological change, and its effect on labor demand (Autor et al., 2024; Acemoglu and Restrepo, 2019, 2018; Lin, 2011). The results of this paper not only highlight the consequences of a task creating technological change for women's labor but also their marriage and fertility choices. By showing that the adoption of the typewriter led to changes in Black women's outcomes, my findings emphasize the importance of considering indirect effects on groups of workers not directly exposed to the technological change.

Papers at the intersection of technological change and women's outcomes have considered the role of technologies that automate work done by women (Feigenbaum and Gross, 2024;

[2]Papers studying the consequences of automation include Adachi et al. (2024); Bessen et al. (2023); Acemoglu and Restrepo (2020); Chiacchio et al. (2018); Graetz and Michaels (2018); Dauth et al. (2018). In addition, this work also relates to empirical research on skill-biased technical change which often involves automating tasks performed by lower-skilled workers and an increased demand for higher-skilled workers (Boustan et al., 2022; Gray, 2013; Goldin and Katz, 2009; Acemoglu, 1998; Autor et al., 2003, 1998). Black and Spitz-Oener (2010) study the task content of occupations and the gender pay gap.

Ager et al., 2023), technologies related to household production (Greenwood et al., 2005), and general purpose technologies such as electrification (Vidart, 2024). Relative to pre-existing work, this paper introduces task-creating workplace technological changes as a novel determinant for women's long term labor and family outcomes.

This paper makes a contribution to an extensive literature studying intergenerational mobility generally and specifically to a more recent literature studying women's historical intergenerational mobility in the US (Olivetti and Paserman, 2015; Jácome et al., 2025; Buckles et al., 2023; Althoff et al., 2023; Eriksson et al., 2023; Bailey and Lin, 2022), which has largely focused on documenting estimates of women's mobility and providing descriptive evidence of factors related to changes in women's mobility.[3] Instead, my results highlight the potential of technological changes in impacting mobility patterns. Specifically, the typewriter served as a "meeting technology" for marriage outcomes, which allowed women to gain upward mobility.[4] The availability of such opportunities is especially meaningful at a time when most married women did not participate in the labor force and women's long-term economic success was determined largely by their husband's socioeconomic standing (Goldin, 1983).

Lastly, this research adds to the literature studying the introduction of women into occupations and the rise of white-collar work for women (Bald, 2025; Greenberg et al., 2024; Miller and Segal, 2019; Goldin, 2002, 1990, 1984, 1980; Costa, 2000; England and Boyer, 2009; Rotella, 1981b).[5] This paper focuses on the creation of new white-collar work for women driven by a technological change. Compared to most examples of historical and modern white-collar work that primarily employ women, typing and secretarial work stands out as an occupation that rapidly transformed in terms of its gender composition and employed a large fraction of the female labor force across a variety of sectors.[6]

[3]The literature studying historical intergenerational mobility in the US is reviewed in Abramitzky et al. (2025). For a review of the literature studying intergenerational mobility more broadly, see Mogstad and Torsvik (2023).

[4]Papers studying the role of other "meeting opportunities" for marriage include Goldman et al. (2024); Belot and Francesconi (2013); Kalmijn and Flap (2001) and Ciscato (2024). Relatedly, these results also highlight that workplaces can serve as environments that can lead to relationship formation and changing marriage patterns. Using workplace level data, Macdonald et al. (2024) study relationship formation in the workplace.

[5]Aneja et al. (2024) study the expansion of female clerical workers in public service after WWI.

[6]The rise of typing as a predominantly female occupation is also related to a broad literature studying occupational gender segregation. See Blau and Winkler (2018) for a review of this literature.

2 Background

The first commercial typewriter was not only a major nineteenth-century innovation, but also spurred the creation of new work for women. In this section, I first outline the historical background relevant to the typewriter as a technological innovation and its adoption. Next, I describe and provide evidence for the role of this technological change in generating new work for women. Then, I empirically and historically document the role of factors such as the presence of educated women in the adoption of female labor for typing and secretarial work. Lastly, I present descriptive patterns from US census data relevant to the background of the typing and secretarial occupation in this time period.

2.1 Invention and Adoption of the Typewriter

There had been several attempts over the nineteenth century to create a "writing-machine" (Hoke, 1979). Inventors across both the US and Europe had been experimenting with many versions of such machines which were intended for use at home (Boorstin, 2010; Mokyr, 1992). However, none of these machines were commercially promising until Christopher Sholes, a Milwaukee based printer and editor, invented the "Type-Writer" in 1868 (Smith, 1922). Sholes, with the help of Carlos Glidden, improved this machine, and in 1873 convinced E. Remington & Sons to manufacture the machine.

The first commercially successful typewriter, known as the "Sholes and Glidden Machine", was sold to the public in 1874 (Hoke, 1979; Smith, 1922). Appendix Figure 2 presents an image of this early machine. The influence of Remington mechanics, who previously manufactured sewing machines, is evident in the design (Current, 1974; Smith, 1922). This early typewriter was mounted on a sewing machine base and used a foot treadle.

The early typewriter was marketed as a "literary machine" to writers. Businesses were not thought of as its target consumers (Current, 1974; Hoke, 1979) .[7] In fact, "no one in business was striving to invent the typewriter. It was clearly exogenous to the business sector" (Hoke, 1979). This is evident in the slow adoption of the typewriter by businesses depicted in annual machine sales for the Remington typewriter. Nearly a decade since its introduction, by 1882, Remington had only sold 1,200 typewriter machines, however, in 1887 this trend began to change when 14,000 machines were sold, mainly to businesses (Davies, 1974). This marked the

[7] The typewriter was even referred to as the "literary piano" for novelists and poets to "compose" at it (Hoke, 1979).

"commercial acceptance" of the typewriter and by 1900, Remington was selling over 500,000 typewriters (Hoke, 1979).[8]

The adoption of the typewriter by businesses can be attributed to both a demand for information collection and efficiency gains presented by the machine. The increasing complexity of firms after the Civil War created an increase in demand for information collected at different levels of a company's hierarchy. This included businesses adopting "scientific management", a system which relied heavily on record keeping (Rotella, 1979; Taylor, 1911). The typewriter also presented clear efficiency gains in writing speed and accuracy in comparison to handwritten memos that businesses had previously relied on. With the adoption of the typewriter, along with carbon paper and vertical filing, businesses could easily create and keep copies of different forms of communication (Yates, 1991; Boorstin, 2010).[9] And so, "once business realized all that the typewriter could do, the machine was adopted at an extremely rapid rate" (Hoke, 1979).

2.2 Creation of New Work for Women

As businesses began to rapidly adopt the typewriter, they also shifted to hiring a predominantly female workforce of typists and secretaries. While early secretarial and clerical work was mainly performed by men, after the invention of the typewriter, female typists and secretaries were hired at an unprecedented rate. Table 1 presents the number of men and women working in the "stenographers, typists, and secretaries" occupation in each decade from 1880 to 1940.[10] In 1880, women initially made up only 12 percent of the occupation, however, in 1900 women accounted for over 74% of all typists. By 1940, over 1.1 million women were employed in this occupation, accounting for nearly 93 percent of all typists and secretaries.

[8]The increased demand for typewriter machines brought by businesses is also evident by the arrival of competing typewriter machines in the mid-1880s such as the Caligraph, the Crandall, the Hammond and the Hall (Boorstin, 2010).

[9]This advantage of the typewriter over the pen is also highlighted in early advertisements of the machine. Appendix Figure 3, Panel A shows one of the first advertisements for the typewriter which specifies that the typewriter can "write from thirty to sixty words per minute, more than twice as fast as the pen – in plain type, just like print."

[10]Both the recorded occupational information in census data (occupational strings from the *occstr* variable) and historical evidence suggest that women who were hired as typists or stenographers also performed secretarial work. Occupation titles from the occupational strings commonly combine secretary with typist or stenographer. It should also be noted that handwritten stenography and secretarial work were occupations before the invention of the typewriter.

Table 1: Men and Women Working in Typing Occupation: 1880-1940

Census Year	Total	Men	Women	Percent Women
1880	1,866	1,634	232	12.43
1900	106,857	27,066	79,791	74.67
1910	340,392	74,487	265,905	78.12
1920	668,414	83,975	584,439	87.44
1930	984,493	79,246	905,247	91.95
1940	1,206,880	87,282	1,119,598	92.77

Notes: This table presents the number of men and women working in the stenographers, typists, and secretaries occupation as well as the percent of the occupation made up by women using the *occ1950* variable in the Census.

The typewriter led to creation of new work for women and drew women into the office space (Davies, 1974). In fact, it was a predominantly new task-creating technological change because it replaced very few workers who performed secretarial work before its adoption and instead created new jobs for female labor in the office space across new sectors of the economy. Specifically, "since opportunities in the business office were generally expanding, women were not competing with men for existing jobs, nor were they pushing men out of work. Women simply filled the newly created positions" (Hoke, 1979).

Further highlighting the pivotal role of the technological change in generating new work for women, such changes are not observed in the evolution of general clerical work, which existed before the invention of the typewriter.[11] Appendix Figure 4 compares the number of men and women employed in clerical and kindred work (Panel A) over time to the typing and secretarial occupation (Panel B). While general clerical work continued to expand and employ more men than women, the growth of the typing occupation was driven predominantly by women.

Several economic historians and historians have also underscored the significance of the typewriter in generating new work for women. Rotella (1981a) emphasizes that “there was no other single technological change that transformed the office so much as did the typewriter,” and Boorstin (2010) states that "by providing a socially acceptable employment for women in the commercial world, it [the typewriter] opened new office careers ... [and] helped bring women out of the kitchen into the world of affairs." Hoke (1979) also stressed this by calling the typewriter the "the key event, the catalyst which sparked this rapid social change."

[11]General clerical jobs are classified as "Clerical and Kindred workers (not elsewhere classified)", *occ1950* code 390.

2.3 Factors Aiding Women's Entry into Typing: The Role of Education and Early Typing Schools

For women to enter this newly created work, businesses' growing demand for typists and secretaries required an available supply of qualified women. Because women in the late nineteenth century were paid close to one half the wage of men for clerical work (Goldin, 1990), and working as a typist paid more than women's other white-collar alternatives such as teaching,[12] the main constraint for women to enter typing was education and knowing how to operate the typewriter.[13]

I first document the role of education, specifically secondary school education, in shaping the supply of qualified women who could be hired as typists. Because "typists had to be able to read, write, and execute minimal mathematical skill" (Hoke, 1979), I rely on the expansion of secondary schooling in the late nineteenth century (Goldin and Katz, 2008) to document a relationship between adoption of compulsory education laws and the supply of female typists.[14] Using variation in the decade of adoption of compulsory schooling, I ask whether states that had adopted compulsory education laws by 1900 saw a greater share of female typists in the early twentieth century? Appendix Table 1, Column 1 shows that states that were early adopters of such laws had a greater supply of female typists in those states.[15] However, in comparison, such schooling laws do not seem to be related to the supply of male typists (column 2), further emphasizing the importance of secondary school expansion for *women's* entry into this newly created white-collar occupation.

I next document the role of early typing schools in training female typists. Early typing training for women was provided by women's organizations such as the Young Women's Christian Association (YWCA). "It was only later, in response to business demand for typists, that business colleges, typewriter agencies and independent businesses began offering typing

[12] For example, a female typist in New York City in 1888 could earn an average weekly wage of up to 20 dollars (Hubert, 1888), while a female teacher earned 17.70 dollars (Annual Report of the State Superintendent, 1892)

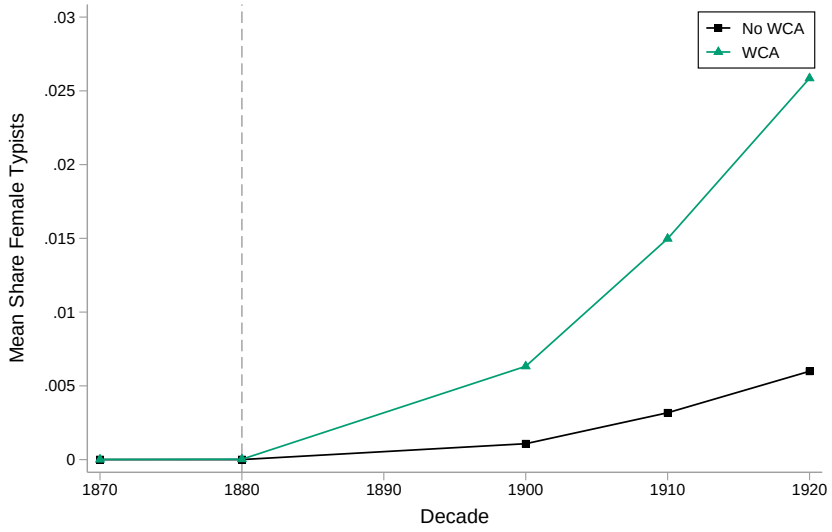
[13] Literacy rates for White women, who were more likely to be hired as typists, were already as high as 71% by 1900. Appendix Figure 5 depicts a strong positive relationship between the share of White women working as typists and the share of White literate women across US counties between 1900 and 1920.

[14] Data for this exercise is obtained from Goldin and Katz (2008). Details of this data construction can be found in Appendix Section B.3.

[15] Appendix Figure 6 plots corresponding mean share female typists for states that had compulsory schooling laws by 1900 and those that did not and shows that though both types of states trended similarly, early adopting states had a higher share of female typists. Further details of this analysis can be found in Appendix Section C.1.

courses. It was in fact the YWCA, along with Remington's agents, that offered the first typing courses" (Hoke, 1979). The New York City's YWCA was the first Women's Christian Association (WCA) chapter to offer a typing course for women in 1881. Using novel hand-collected data, Figure 1 documents the role of early WCA chapters, including YWCAs, in increasing the supply of female typists.[16] It shows that counties that had a WCA before 1880, had a greater mean share of female typists after the invention of the typewriter. I will further leverage this variation in the supply of female typists generated by local WCA organizations, which were present before typewriter adoption, in an alternative empirical specification for the main analysis of the paper.

Figure 1: Mean Share Female Typists and WCA presence



Notes: This figure plots mean female typists as a share of the female population for counties that had Women's Christian Association (WCA) chapters (including YWCAs) before 1880 (green line) and those that did not (black line) in each decade.

Together, these descriptive empirical analyses, along with the historical narrative, point to the crucial role played by secondary schooling expansion and early typing schools in training a supply of female secretaries and typists that businesses could employ after the invention of the typewriter. Other amenities provided by typing and secretarial work that could have helped women pick this occupation over alternatives included a cleaner work environment when compared to "brawn" jobs in manufacturing or domestic services (Goldin, 2002) and the accompanying "social acceptability" of working in an office environment for middle-class

[16]Section 3.2 and Appendix Section B.2 provide further details of these data.

women (Hoke, 1979).[17]

2.4 The Resulting Typing Occupation & Female Typists

The resulting typing occupation, one which primarily employed women, was different from other predominantly female white-collar occupations at the time in three ways: (1) It was driven largely by an exogenous technological change, (2) typists were needed across many different sectors, and (3) women co-existed in the same environment as men. The main alternative white-collar occupations for women included working as a teacher, bookkeeper, telephone operator, librarian, or nurse. Appendix Figure 7 summarizes the share of white-collar women employed in these comparable occupations over time. It shows that the typing occupation stands out in rapidly hiring a large share of female white-collar workers, surpassing even teaching, which was the main white-collar job that women worked in for decades before the typewriter was invented.

Among alternative white-collar occupations, telephone operation and bookkeeping also experienced technological changes.[18] However, as depicted in Appendix Figure 4 Panels C and D, the gender composition of the bookkeeping profession did not see a similar change and the number of women employed in both occupations was much smaller in magnitude when compared to the number of female typists in the economy.

Compared to other major white-collar occupations, which were concentrated within single industries, typists were employed across many different sectors.[19] Figure 2 depicts the top twelve such industries in 1920 in descending order, on the basis of the number of typists that they hired, with each hiring at least more than 10,000 typists. The y-axis depicts the representation of typists among all workers in that industry. By 1920, the Business Services industry was the largest employer of typists, employing over 90,000 female typists, and typists accounted for close to 30 percent of all employees in this sector. Other large employers of typists include the Insurance, Railroad Services, and Legal Services industries. I will utilize this variation in employment of typists across sectors for the main empirical strategy.

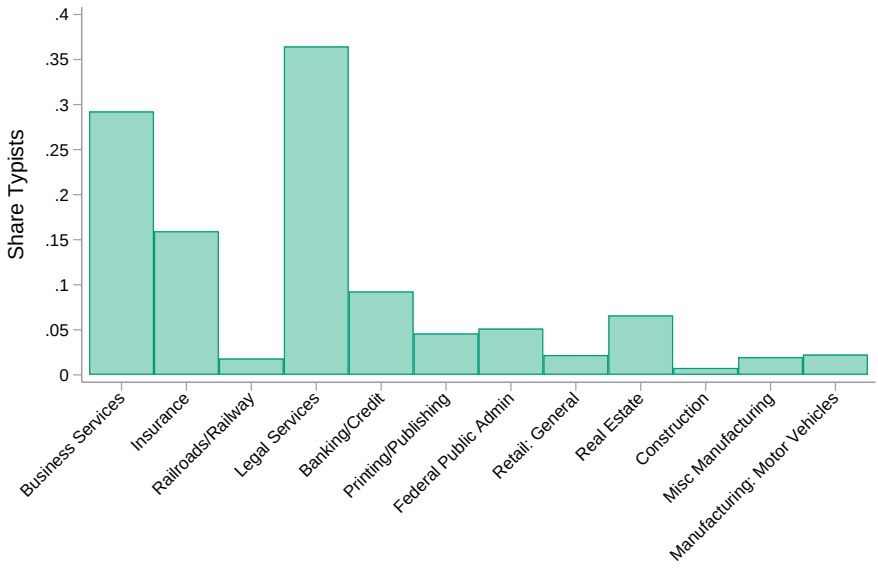
[17] The earliest typewriter being mounted on the base of a sewing machine could have provided women a comparative advantage in using the machine, although the first operators of the machine were men as depicted by the first advertisement in Appendix Figure 3.

[18] The main technological advancement relevant for creating work for women in telephone operation was the telephone switchboard, and the bookkeeping profession experienced the invention of the tabulation machine.

[19] E.g. the teaching occupation was only within the education industry, nursing within the medical sector, and telephone operation within the communication sector.

Appendix Figure 8 plots female typists as a share of female employees in these industries instead. It shows that for industries such as Legal Services, a majority of female workers in those industries were employed as typists. In fact, the entry of women into several sectors was predominantly driven by the entry of female typists. Appendix Figure 9 presents two such examples from the Legal Services (Panel A) and Banking (Panel B) industries where a majority of their female workers only enter as typists and secretaries after the invention of the typewriter.

Figure 2: Employment of Typists Across Industries, 1920



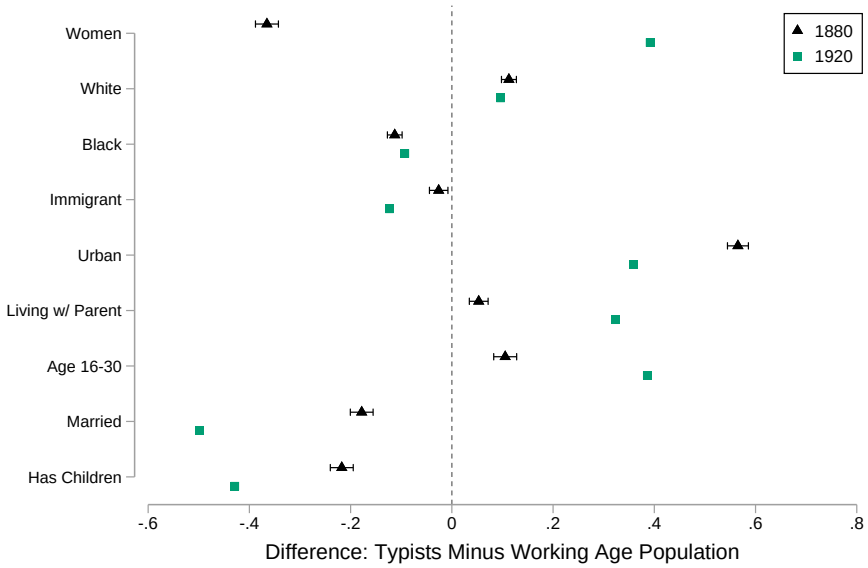
Notes: This figure plots on the x-axis, in descending order, the top 12 industries that employ the highest number of typists in 1920. Each of these industries employ at least 10,000 typists. On the y-axis, it plots typists as a share of the total industry employment. Three digit industry codes from the *ind1950* variable are used for industry classification.

The typing occupation, by allowing women to enter the office space, gave them the unique opportunity to work alongside and be connected to men in white-collar occupations, often of higher socioeconomic status. This was also referred to as an additional "amenity" of the occupation for women whereby "the educated middle-class woman who secured office employment often found that the the business office was an excellent place in which to seek a well-bred husband" (Hoke, 1979). In comparison, alternative white-collar occupations, such as teaching, did not provide such an advantage for women at the time.

As the secretarial occupation and industries that employed typists transformed over time, so did the image of secretaries and typists. Figure 3 plots differences in characteristics of secretaries from those of the working age population in two decades: 1880 (black) and 1920 (green). Compared to the working age population, typists and secretaries were more likely

to be men in 1880. By 1920, the image of a secretary completely changed and at that point women were more likely to be employed as typists. Typists in both decades are also more likely to be white, US-born, young, living in urban areas, single and without children.[20] Appendix Figure 13 uses father's occupational income score (*occscore*) to show that female typists in 1920 were drawn from across the distribution of fathers' socioeconomic status, including the bottom and with the highest share coming from the middle of the distribution. Providing additional evidence for the role of secondary school education, using information on educational attainment first collected in 1940, Appendix Figure 14 shows that nearly all female typists had completed at least some high school education.

Figure 3: Characteristics of Secretaries Compared to Working Age Population, 1880 & 1920



Notes: This figure plots the differences in means of typists and working age population for each of the characteristics listed in 1880 (black triangles) and 1920 (green squares). The coefficients represent how much more or less likely a typist is than the working age non-typist in that decade to satisfy the particular characteristic. A value of 0 on the x-axis represents no difference.

Having descriptively established how the typewriter led to the creation of new work for women and changed the nature of secretarial work, the main empirical analysis of this paper is dedicated to documenting and understanding the direct and indirect consequences of the typewriter as a predominantly task-creating technological change for women.

[20] Female typists, when compared to other working age women, were more likely to be white, US-born, living in urban areas, young, unmarried and without children (Appendix Figure 10). These differences still hold, though smaller in magnitude, when female typists are compared to women working in other white-collar occupations (Appendix Figure 11). Compared to male typists, female typists were more likely to be younger and unmarried (Appendix Figure 12).

3 Data

In this section, I describe the main sources of data used in the analysis of the paper: historical US census data, a novel hand-collected dataset of organizations offering early typing courses for women, and genealogical linked data following women across changes in marital status in historical censuses.

3.1 Historical US Census Data, 1870-1940

To conduct the main analysis of the paper, I employ digitized US population decennial censuses from 1870 to 1940 (Ruggles et al., 2021). The analysis focuses on working-age individuals between the ages of 16 and 64. I use these data both at the individual level and aggregated to the county level. For parts of the data construction that require a panel of counties, to address changes in county boundaries over time, I use population-based weights from Ferrara et al. (2022) to harmonize county boundaries.[21] Using these data, I construct three main outcome variables: women's labor force participation which is defined using the sample of women employed in occupations for pay, whether or not they are married using the recorded marital status variable, and if they have children using the number of *own* children recorded as living with them.[22]

3.2 Women' Christian Association (WCA) Data, 1875-1880

I hand-collected and constructed a database of the Women's Christian Association (WCA) local chapters across the US to study the role of early typing schools and to exploit exogenous variation in the supply of female typists. These data also include a number of local Young Women's Christian Association (YWCA) chapters that were in operation and associated with the larger organization.[23] These local organizations were the first to offer typing courses for

[21] Complementary methods for historical county boundary harmonization include Hornbeck (2010), Eckert et al. (2020), and Berkes et al. (2023).

[22] The main variable used to define labor force participation is *labforce*. Results are robust to constructing this variable using occupations reported from the *occ1950* variable or using employment status from the *empstat* variable. For the 1880 population Census, newer versions of the historical census data at the time of the analysis of this paper contained an error that miscoded approximately 1 million unemployed women into occupations for pay. I account for this by using variables related to individual occupation, industry and labor force participation from older versions of the census free of this error. Appendix Section B.1 provides details of the error and the correction. For the marriage outcome, I rely on the *marst* variable. Because the 1870 Census did not record marital status, for time series that include the 1870 variable, I rely on the *sploc* variable instead which specifies whether a spouse is present in the household. The *nchild* variable which records the number of *own* children residing with the individual will include biological children as well as step-children and adopted children.

[23] The two later merged and are today known as the YWCA.

women and were consequently associated with a higher supply of female typists in those locations (Section 2.3). These data are collected from published biennial conference proceedings of the national association which recorded information on all associated local chapters. Mapping locations of chapters to counties, there were a total of 49 counties that had at least one chapter that existed before 1880 and could offer typing courses after the adoption of the typewriter. Appendix Figure 15 plots these counties on a map and Appendix Section B.2 provides further details of these data.

3.3 Linked Sample of Women

To study women's intergenerational mobility through marriage, I rely on a sample of White women linked from the 1920 to the 1940 Census using links from the Census Tree (Buckles et al., 2023). Specifically, I follow single young White women, aged 16-30, who can be observed in the labor force and living with their fathers in the 1920 Census, to their married selves in the 1940 Census when they can be observed living with their spouse. Because historical census data do not contain personal identifiers and women, who commonly changed their last names upon marriage, are especially difficult to link across the marriage decision, using genealogical data from FamilySearch Family Trees is one of the few ways to link such women across census decades.[24] The resulting main sample for the intergenerational mobility analysis consists of 903,150 White women.[25]

Linked samples can often be unrepresentative of the underlying population. Appendix Figure 16 depicts observable differences between the women in the linked sample and the 1920 population of White single women aged 16-30. Women from farming households are overrepresented and women from urban areas and daughters of immigrants are underrepresented in the linked sample. To account for these differences, I show robustness of results to the use inverse probability weights to reweight my sample to match the observable characteristics of the underlying population following Abramitzky et al. (2021); Bailey et al. (2020); Zimran (2019) and Pérez (2017).[26]

[24]These data are widely used in recent economics publications and working papers (for a list of papers see the Census Tree webpage). Other methods to link women across the marriage decision include using marriage certificates (Eriksson et al., 2023), vital records (Bailey et al., 2022), and administrative data sources (Althoff et al., 2023). For a review of historical record linking methods see Abramitzky et al. (2021).

[25]Though the Census Tree data provide additional links using machine learning methods for women who changed their marital status, I mainly rely on the provided genealogical links. These additional links account for 384,884 additional women. Results are robust to the inclusion of these additional links.

[26]Specifically, the reweighting variables include age, father's occupation score, farming household status,

Measuring the intergenerational mobility of women through marriage requires observing both the woman's father's income in 1920 and her husband's income in 1940. While the 1940 Census recorded income, the 1920 Census did not. Thus, to obtain a measure for father's socioeconomic status I rely on a constructed occupation based income-score measure based on father's characteristics from Abramitzky et al. (2021).[27]

4 Empirical Specifications

To study the effect of the adoption of the typewriter on women's outcomes, I take two approaches. The first, and main specification, uses a shift share instrumental variable which relies on exogenous shifts in the demand for typists across industries after the invention of the typewriter. The second approach complements the main specification by relying instead on exogenous variation in the supply of female typists across counties.

Measure for Typewriter Adoption.— I first define an endogenous measure of typewriter adoption for each county. This measure captures the 1880 to 1920 change in the number of people working as typists and secretaries in a county as a share of the initial working population and is defined as follows:

$$\Delta typ_c^{1880-1920} = \frac{typ_c^{1920} - typ_c^{1880}}{emp_c^{1880}} \tag{1}$$

Based on the historical evidence, I choose 1880 as the pre-period before mass adoption of the typewriter. Then, between 1880 and 1920 industries experience different patterns of adoption of the technology with many starting adoption in 1900. Appendix Figure 17 plots the variation in this measure across counties.

However, ordinary least square estimates of the relationship between typewriter adoption and women's outcomes in a county can be biased. One obvious downward bias can arise from increased demand for female labor in the local economy in other industries crowding out the demand for female typists. On the other hand, these estimates can also be biased upwards if counties with the greatest change in typists also have more progressive norms for women. To

urban status, literacy, and nativity of women and their fathers.

[27] These characteristics include birthplace, age, occupation and state of residence. I also show robustness of main results to using an alternative occupational score measure, *occscore*, provided by Ruggles et al. (2021).

address these challenges, I utilize a "shift-share" approach described below.

4.1 Shift Share Instrumental Variable

The intuition behind this empirical strategy lies in the fact that due to the nature of their production processes, different industries had more or less use for typists and consequently adopted the typewriter and employed typists at different rates, especially early on. Additionally, counties had a varying composition of the workforce employed across industries before the invention of the typewriter, making typewriter adoption rates in one county different from another. To depict this intuition, consider two neighboring counties in New York state: Kings and Nassau. While both counties had similar population densities and a similar set of industries in 1880, the share of the workforce employed in the Printing and Publishing sector in Kings was higher than in Nassau (Appendix Figure 18, Panel A). At the same time, a higher share of the workforce in Nassau county was dedicated to construction than in Kings. After the invention of the typewriter, due to the nature of its production process, the Printing and Publishing industry adopted the typewriter at higher rates than did the Construction industry. This is reflected in the Printing and Publishing industry experiencing a greater *national* change in the number of typists hired between 1880 and 1920 as compared to Construction (Appendix Figure 18, Panel B). Consequently, by 1920, Kings county experienced a greater change in the number of typists that it employed than did Nassau county (Appendix Figure 18, Panel C, gray bar).

As such, the primary empirical strategy generalizes this intuition and combines the varying industrial composition of counties before the invention of the typewriter with several exogenous *shifts* to industries captured by national changes in their demand for typists in order to obtain the *predicted* change in the number of typists for each county (Borusyak et al., 2025, 2022).[28] Formally, I construct the shift share instrumental variable, the 1880 to 1920 predicted change in typists, as follows:

$$\Delta\widehat{typ}_c^{1880-1920} = \sum_{k=1}^{K} s_{kc}^{1880} \; g_k \tag{2}$$

where, $(g_1, ..., g_K)$ represent a set of shifts to industries k (common to all counties c) and are

[28] Examples of similar shift share approaches that rely on exogenous shifts can be found in Borusyak et al. (2025). A key example includes Derenoncourt (2022) who employs a similar shifts-based approach to obtain predicted Black population changes for localities from the Great Migration.

captured as the *national* 1880 to 1920 change in the number of typists relative to initial industry employment:[29]

$$g_k = \frac{typ_k^{1920} - typ_k^{1880}}{emp_k^{1880}} \tag{3}$$

and, $(s_{c1}^{1880}, ...s_{cK}^{1880})$ represent the set of pre-period *shares* that vary across counties and are defined as the share of workers in a county that are employed in each industry:[30]

$$s_{kc} = \frac{emp_{kc}^{1880}}{emp_c^{1880}} \tag{4}$$

Then, interacting local industry level employment shares before the introduction of the typewriter with the national growth in the typist occupation allows me to identify exogenous variation in the local share of typists, represented by the predicted 1880 to 1920 change in typists ($\Delta\widehat{typ}_c^{1880-1920}$). Building on the example of Kings and Nassau county, Appendix Figure 18 Panel C (blue bars) plots the resulting predicted changes in typists across these two neighboring counties and in line with the intuition, this predicted change is higher for Kings county.

Estimating Equation.— I estimate the relationship between the adoption of the typewriter and women's outcomes using the following framework:

$$y_{ic}^{1920} = \alpha + \beta\Delta typ_c^{1880-1920} + \omega_c^{1880}\gamma + X_i^{1920}\delta + \varepsilon_{ic} \tag{5}$$

where, β from equation (5) captures the OLS relationship between the endogenous measure for typewriter adoption, the 1880 to 1920 change in typists in a county c, and women's individual level outcomes, y_{ic}, for women residing in county c. The use of individual level data for outcomes is intentional here to be able to account for differences in women's characteristics by using individual level controls represented by vector X_i^{1920}. Specifically, these individual level controls include race, state or country of birth, and birth cohort. To account for the baseline share of individuals employed in secretarial and clerical work across counties, I include the share of counties' workforce employed in the secretarial and general clerical occupations in

[29] Appendix Figure 19 plots the distribution of shifts across industries.

[30] By construction, these shares sum to one for each county, that is, $\sum_c \frac{emp_{kc}^{1880}}{emp_c^{1880}} = 1$, and consequently this shift-share design is free of what Borusyak et al. (2022) refer to as the "incomplete shares case".

1880 as controls represented by the vector ω_c^{1880}. This vector also includes the female share of a county at baseline. Finally, I show robustness of results to the inclusion of state fixed effects and additional baseline county controls. I also show that the results are not sensitive to the exclusion of all controls.

The first stage relationship between the instrument, the 1880 to 1920 predicted change in typists $\Delta\widehat{typ}_c^{1880-1920}$, and the actual change in typists $\Delta typ_c^{1880-1920}$ is as follows:

$$\text{First Stage:} \quad \Delta typ_c^{1880-1920} = \mu + \lambda \Delta\widehat{typ}_c^{1880-1920} + \omega_c^{1880}\Gamma + X_i^{1920}\eta + \epsilon_c \tag{6}$$

And, the reduced form equation is as follows:

$$\text{Reduced Form:} \quad y_{ic}^{1920} = \tilde{\alpha} + \tilde{\beta}\Delta\widehat{typ}_c^{1880-1920} + \omega_c^{1880}\tilde{\gamma} + X_i^{1920}\tilde{\delta} + \tilde{\varepsilon}_{ic} \tag{7}$$

where, $\tilde{\beta}$ captures the reduced form effect of the instrument for typewriter adoption on women's 1920 outcomes. Main results report estimates of the OLS (β), first stage (λ), reduced form ($\tilde{\beta}$), and 2SLS ($\tilde{\beta}/\lambda$) coefficients.

Identification.— In order for this empirical approach to identify the causal impact of typewriter adoption, the specified instrument, the 1880 to 1920 predicted change in typists, conditional on baseline controls, must be orthogonal to omitted characteristics that might be correlated with women's outcomes in 1920. Formally, this identifying assumption can be stated as follows:

$$\mathbb{E}[\Delta\widehat{typ}_c^{1880-1920} \times \tilde{\varepsilon}_{ic} | \omega_c^{1880}] = 0 \tag{8}$$

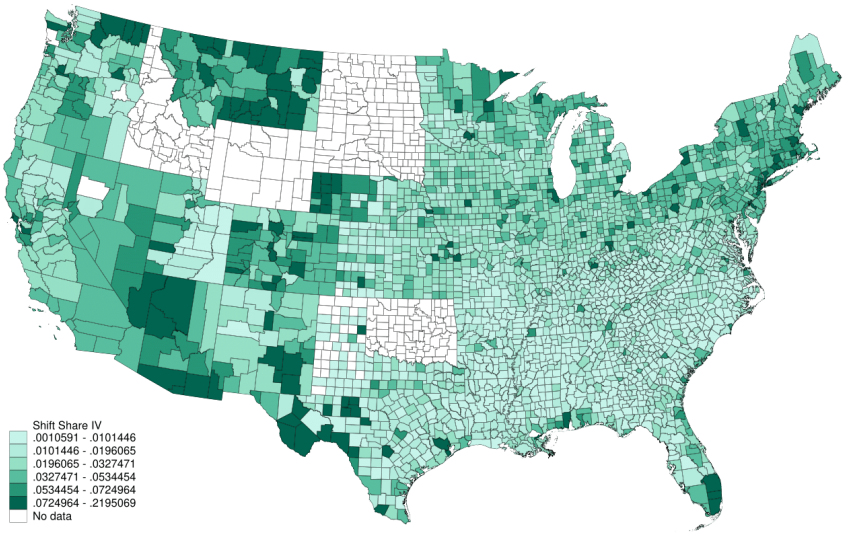
A recent econometric literature on shift share instruments proposes two paths for identification: exogeneity of the shifts (Borusyak et al., 2022) or shares (Goldsmith-Pinkham et al., 2020). In the case of the adoption of the typewriter, workers within counties were not making employment decisions at random. Instead, the technological shock brought about by the typewriter generated exogenous shifts in the aggregate demand for typists across industries. Based on the historical narrative, industries at the time were not expecting an invention such as the typewriter and adopted it based on their demand for information collection. Therefore, this empirical approach relies on a "shifts-based" identification which stems from the exogeneity of the shifts (Borusyak et al., 2022).

Although this assumption cannot be formally tested, relying on *national* shifts to indus-

tries' demand for typists assuages concerns that the instrument is related to *local* unobserved correlates of women's outcomes. Still, I provide further corroborating evidence for this assumption in two main ways: (1) I construct an alternative shift-share instrumental variable, which uses shifts constructed using the 1891 and 1911 Canadian historical censuses. Specifically, I construct the 1891 to 1911 national change in typists for Canadian industries. I then map sectors from the Canadian Census to US industries and interact these alternative shifts with initial employment shares from the US. My main results are robust to using this alternative instrument. (2) I test for pre-trends and show that, conditional on baseline controls, the instrument is not related to lagged women's labor force participation.

Spatial Variation of Instrument.— Figure 4 plots a map depicting the variation in the 1880 to 1920 predicted change in typists across counties. Some of the localities that have the greatest change in predicted number of typists include urban city centers. I show robustness of main results to limiting the analysis only to urban areas. Western counties experiencing large predicted changes (and actual changes as depicted in Appendix Figure 17) are counties where the railway and railroad industry was expanding to in these decades. This industry was also one of the top employers of typists and secretaries (Figure 2).

Figure 4: Spatial Variation in 1880-1920 Predicted Change in Typists

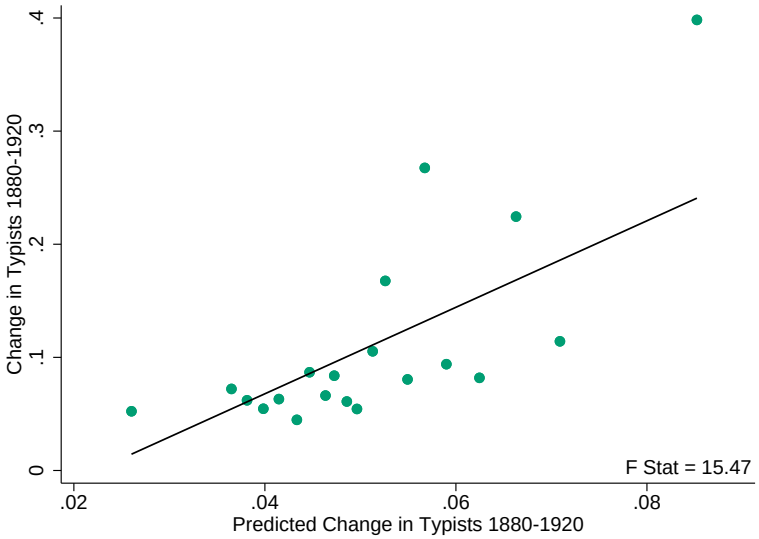


Notes: This map plots for each county the value of the instrument, the 1880-1920 predicted change in typists. Each of the colors represent ranges which correspond to different percentiles of the instrument. Starting from the lightest shade, the first range represents 0-25th percentile of values, second range represents 25th-50th, third 50th-75th, fourth 75th-90th, and fifth represents all values above the 90th percentile up until the maximum value of the change.

First Stage.— Figure 5 shows a binned scatterplot of the first stage relationship between the instrument $\Delta\widehat{typ}_c^{1880-1920}$, the 1880 to 1920 predicted change in typists, and the actual change

in typists $\Delta typ_c^{1880-1920}$. Both measures are residualized on baseline controls that include the share of women, share of clerical workers and share of secretaries in a county in 1880. The slope indicates that a 1 pp increase in the predicted change in typists is associated with an 3.8 pp larger actual change in typists. The F Statistic on the first stage is 15.47.[31]

Figure 5: First Stage Association between Real and Predicted Change in Typists



Notes: This figure plots a binned scatter plot of values of predicted change in typists against actual change in typists. Both variables are residualized on the baseline 1880 county level controls which include the share of women, share of workers employed in clerical work, and share of secretaries. The slope, intercept and joint test of significance (F-stat) are obtained from estimating the first stage relationship in equation (6).

4.2 Difference-in-Differences

To complement the main empirical specification which relies on utilizing variation in the aggregate demand for typists, I additionally use a difference-in-differences approach that instead utilizes exogenous variation in the supply of female typists across counties. Specifically, this approach uses data on counties and dates of existence of the Women's Christian Association (WCA), which were in operation prior to the invention of the typewriter and later provided the first typing classes for women. The intuition behind this approach is that counties which had WCAs in operation *prior* to the adoption of the typewriter were more likely to train early female typists than localities which did not have access to these organizations.[32] In turn, women from these localities would be more likely to be employed as typists and secre-

[31] Without residualizing on baseline controls, the F Statistic on the first stage relationship between the predicted and actual change in typists in 28.93.

[32] I only rely on those organizations that existed before the adoption of the typewriter to mitigate concerns that typewriting courses will also respond to greater demand for typists in the decades after the typewriter.

taries than elsewhere. I demonstrate this intuition or "first stage" result descriptively in Figure 1 which shows that after the invention of the typewriter, counties that already had WCAs ("treated") had a higher share of female typists than counties without WCAs ("control").

In order to study the effect of the adoption of the typewriter on women's outcomes using this alternative source of variation, I estimate the following specification:

$$y_{ct} = \alpha + \beta \cdot \mathbb{1}(WCA)_c \cdot \mathbb{1}(\text{Post-Typewriter})_t + \delta_c + \gamma_t + \varepsilon_{ct} \tag{9}$$

where, $\mathbb{1}(WCA)_c$ is equal to one for counties that had a WCA present by 1880 and $\mathbb{1}(\text{Post-Typewriter})_t$ equals one for decades after 1880. δ_c and γ_t represent county and decade fixed effects, respectively.

This approach however is limited by the nature of the data in two ways: (1) women in the labor force were not recorded before the 1870 Census and so my ability to check for pre-trends will be limited to only one pre-period, and (2) only 2 percent of all counties in the sample had WCAs present before 1880 (Appendix Figure 15), making the effective sample size of treated units small and reducing the statistical power of the analysis. Thus, I treat the results from this specification as further validation of the main results and only as complementary to the main shift share approach.

5 Effect of Typewriter Adoption on Women's Outcomes

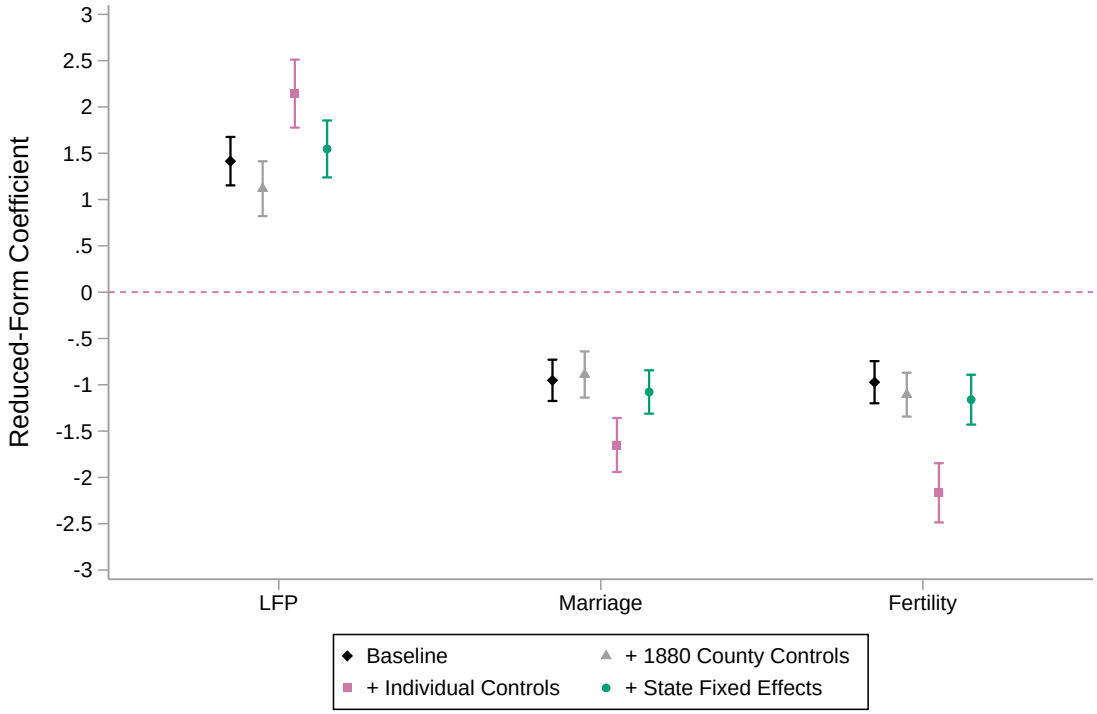
The invention and adoption of the typewriter into the US labor market created new employment opportunities for women. Did this change result in long term causal effects on women's labor force participation? And did the labor market effects induced by the technological change lead to changes in women's marriage and fertility rates? In this section, I quantify the effect on women's labor force participation, marriage, and fertility.

5.1 Women's Labor Force Participation, Marriage and Fertility

One of the contributions of this paper is to estimate the causal effect of a new work creating technological change on women's outcomes. To that end, I first quantify the effect of being in a location with greater exposure to the typewriter, as captured by the predicted 1880 to 1920 change in typists, on women's outcomes in 1920. Figure 6 plots the effect of a 1 percentage point (pp) increase in the predicted change in typists on women's labor force participation and downstream impacts on women's likelihood of being married and having children. These

estimates show that women in areas with a 1 pp greater predicted change in typists were 1.12-2.15 pp more likely to be in the labor force in 1920. This higher participation of women in the labor force further led to a 0.89-1.65 pp reduction in their likelihood of being married and a 0.97-2.17 pp decrease in their likelihood of having children. Importantly, these estimates are robust to the inclusion of 1880 county controls (estimates in gray), 1920 individual controls (pink), and also state fixed effects (green).

Figure 6: Typewriter Adoption and Women's LFP, Marriage, and Fertility in 1920



Notes: This figure plots the reduced form effect of the instrument, the 1880-1920 predicted change in typists, on working-age women's likelihood of: (1) participating in the labor force, (2) being married, and (3) having children in 1920. Coefficients in black represent reduced form effects that do not include any controls. Gray represent coefficients that control only for baseline county characteristics including the share women, share clerical workers and share secretaries of the county's working age population in 1880. Pink represent coefficients that in addition to controlling for county characteristics also control for 1920 women's individual level characteristics which include place of birth, year of birth and race. In addition to controlling for baseline county and individual characteristics, coefficients in green include state fixed effects.

Table 2 presents the corresponding OLS, First Stage and 2SLS results for these outcomes. The 2SLS estimates show that a 1 pp increase in typewriter adoption led to a 0.29-0.56 pp greater likelihood of women participating in the labor force, a 0.23-0.43 pp reduction in likelihood of being married, and a 0.28-0.56 pp lower probability of women having children.[33]

[33]Results from columns of the table that do not include individual controls (the first, third and fifth columns) are equivalent to results that would be obtained with using data aggregated to the county level. While Table 2

Taken together, these results show that the technological change brought about by the typewriter not only had first order effects on women's labor force participation but also downstream effects on their family outcomes.[34]

Table 2: Effect of Typewriter on Women's LFP, Marriage, and Fertility in 1920

	LFP	LFP	Married	Married	Fertility	Fertility
Panel A: First Stage						
$\widehat{\Delta typ}^{1880-1920}$	3.823	3.808	3.823	3.808	3.823	3.808
	(1.265)	(1.260)	(1.265)	(1.260)	(1.265)	(1.260)
F-stat	15.47	9.842	15.47	9.842	15.47	9.842
Panel B: OLS						
$\Delta typ^{1880-1920}$	0.0370	0.0443	-0.0221	-0.0316	-0.0232	-0.0364
	(0.015)	(0.016)	(0.009)	(0.011)	(0.014)	(0.018)
Panel C: Reduced Form						
$\widehat{\Delta typ}^{1880-1920}$	1.117	2.144	-0.889	-1.650	-1.107	-2.167
	(0.151)	(0.187)	(0.127)	(0.148)	(0.121)	(0.163)
Panel D: 2SLS						
$\Delta typ^{1880-1920}$	0.292	0.563	-0.233	-0.433	-0.289	-0.569
	(0.099)	(0.186)	(0.082)	(0.146)	(0.096)	(0.186)
Outcome Mean	0.262	0.262	0.617	0.617	0.533	0.533
Observations	29,095,813	29,095,813	29,095,813	29,095,813	29,095,813	29,095,813
Baseline Controls	Y	Y	Y	Y	Y	Y
Individual Controls	N	Y	N	Y	N	Y

Notes: This table reports coefficients from the first stage regression of the predicted and real change in typists (Panel A), OLS regressions using real change in typists (Panel B), reduced form regression of the predicted change in typists on outcomes (Panel C) and corresponding 2SLS regression (Panel D). The reduced-form coefficients (Panel C) correspond to coefficients reported in Figure 6 (in gray and pink). All regressions include 1880 county level controls. In addition, the second, fourth, and sixth columns include individual controls. Details of controls follow from Figure 6 notes.

Women's Outcomes in the Absence of the Typewriter.— To understand the magnitude of the changes brought about by the typewriter, I next ask what would have women's labor force participation, marriage and fertility rates in 1920 looked like in the absence of the typewriter? Using the reduced form estimates from Table 2, I employ a back-of-the-envelope calculation to answer this question.

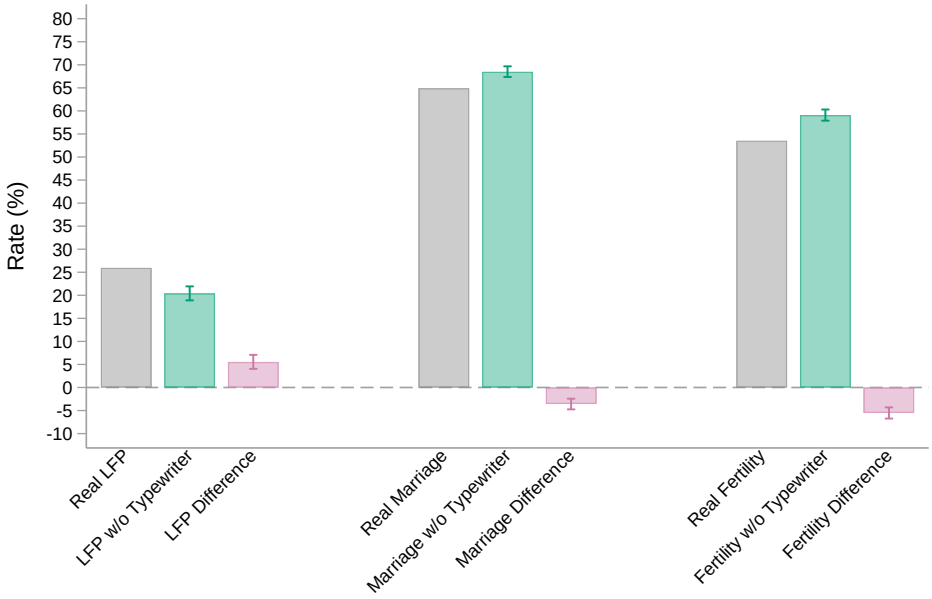
Figure 7 plots women's labor force participation, marriage and fertility rates in the absence of the predicted change in typists brought about by the typewriter (in green) along with actual rates (gray) and the differences from actual rates in 1920 (pink). Using the 95% con-

uses women's labor force participation in 1920 as an outcome, Appendix Table 2 instead reports results using the 1880 to 1920 change in women's labor force participation as the outcome. Table 2 Panel B also reports the OLS estimates which are smaller than the IV estimates reported in Panel D. This is consistent with the discussion of downward bias in OLS estimates originating from higher demand for female labor in other occupations in a locality crowding out demand for female typists (Section 4).

[34]The link between women's labor participation and family outcomes has been established in an extensive literature. For a review of this literature see Doepke et al. (2023).

fidence intervals for the estimates as bounds, this back-of-the-envelope calculation suggests that women's labor force participation in 1920 would have been 4.05-7.07 pp lower in the absence of the typewriter. Using the underlying number of women of working age, this implies that the invention and diffusion of the typewriter accounted for roughly 1.7 million additional women in the labor force in 1920. Consequently, this reduction in women's labor participation in the absence of the typewriter would have also led to 2.43-4.74 pp and 4.31-6.74 pp higher marriage and fertility rates. This is equivalent to approximately 1.1 million more married women and 1.7 million more women with children in 1920 without the labor market impacts of the typewriter. Appendix Section C.2 provides further details of this back-of-the-envelope calculation.

Figure 7: Women's Outcomes in the Absence of the Typewriter



Notes: This figure presents results from the back-of-the-envelope calculation to compute the share of women in the labor force, share of women married and share of women with children in 1920. Women of working age (16-64) are used as the denominator. Reduced form estimates and 95 percent confidence intervals are obtained from the first, third and fifth columns of Table 2. Bars in gray plot actual rates in 1920, bars in green plot the outcomes in the absence of the predicted change in typists brought about by the typewriter and bars in pink plot the difference between the gray and green bars.

5.2 Validity and Robustness

Here I consider the robustness of the main results and perform tests to check the validity of the instrument. To provide corroborating evidence for the identifying assumption, I first perform a test of pre-trends by regressing lagged women's labor force participation in 1870 and 1880 on the instrument. Appendix Table 3 columns 1 and 2 show that, conditional on 1880

county controls, women's labor force participation in 1870 and 1880 is not positively related to the 1880 to 1920 predicted change in typists. Additionally, in the period before mass adoption of the typewriter, this relationship is statistically insignificant, making it unlikely that the instrument is predicting lagged outcomes. Appendix Figure 20 further plots the reduced form relationship between the instrument and women's labor force participation in each decade including decades after 1880 and shows that the effect is only positive starting in 1900, after the adoption of the typewriter. A related remaining concern might be that localities that were more exposed to the shock of the typewriter were already on an upward trend in terms of women's labor force participation. In Appendix Table 3 (column 3), I show that this is not the case and that the instrument is uncorrelated with changes in women's labor force participation from 1870 to 1880, the decade leading up to the invention and diffusion of the typewriter.

Because the instrument draws upon identifying variation at the shift level, in Appendix Figure 21, I check for balance of shifts with respect to 1880 industry (shift-level) characteristics. Other than a negative correlation with industries' female employment share (including married women and women with children), the shifts are not significantly correlated with any industry characteristic. This negative relationship is to be expected considering large employers of typists, such as the railway industry, were typically industries that predominantly employed men in 1880. To account for this, Appendix Figure 22 shows that results are robust to the inclusion of additional 1880 county controls for the share of women in the labor force, share of women who were married and the share of women with children. A related concern can arise from the correlation of shifts with unobservables resulting from counties' changing Black population at the time. Though Appendix Figure 21 shows no significant relationship between industry shifts and the share of an industry's female workforce that is Black, Appendix Figure 23 controls for the share of the 1880 county population that is Black and Appendix Figure 24 controls for the 1880 to 1920 changes in counties' share Black population to show that the results are not driven by Black migration flows taking place in the early twentieth century. These exercises also demonstrate that the results are not sensitive to the choice of baseline county controls.

To further rule out the possibility of unobservables being correlated with both women's outcomes and national shifts to industries in typewriter adoption, I construct an alternative

instrument which uses shifts constructed using sectors from the Canadian Census instead. Appendix Figure 25 shows that results are robust to using this alternative instrument. Section 4 and Appendix Section B.5 provide details of construction of this alternative instrument.

To confirm that the effects on women's labor force participation are predominantly driven by women entering occupations relying on the use of the typewriter, Appendix Figure 26 instead uses indicators for women working in each of the alternative white-collar occupations as the outcome. Indeed, the reduced form effect is largest for the typing and secretarial occupation, followed by general clerical work. A negative coefficient for teaching suggests that women were substituting away from teaching in favor of office-work. This is notable because teaching employed the largest fraction of women in white-collar occupations before the adoption of the typewriter (Appendix Figure 7).

Next, I show that my results are not sensitive to the choice of geography or the exclusion of certain counties. Appendix Figure 27 shows robustness of results to restricting the analysis to only urban areas. Appendix Table 4 reproduce the main results using State Economic Areas (SEA) as the geographic level instead of utilizing counties. Appendix Table 5 uses counties without boundary harmonization and shows that results are not sensitive to the method used for harmonization of county boundaries. Appendix Figure 28 computes the estimate for the reduced form effect of the instrument on women's 1920 labor force participation leaving out one county at a time and plots the 2,457 estimates on the same figure depicting that the estimates are not driven by any one county or set of counties.

Finally, I utilize the difference-in-differences specification to show that the main results are robust in interpretation even when using an entirely different empirical approach. Table 3, column 1 first confirms that counties with WCAs had a higher share of female typists and secretaries in the decades after the typewriter. The descriptive analogue for column 1 is depicted in Figure 1. Next, column 2 shows that treated counties also had a higher share of women in the labor force after the adoption of the typewriter. Specifically, the estimated effect of the treatment corresponds to a 15.1% increase relative to the mean share of women in the labor force across counties and decades. Lastly, columns 3 and 4 show that in the decades after typewriter adoption, counties with WCAs had a lower share of married women and women with children. As discussed in Section 4.2, due to low statistical power and a lack of sufficient pre-periods, I primarily view these results as further validation of the conclusions

drawn from my main findings.

Table 3: Results Using Difference-in-Differences Approach

	Share Female Typists	Share Women in LF	Share Women Married	Share Women with Children
$\mathbb{1}(WCA)_c \cdot \mathbb{1}(\text{Post-Typewriter})_t$	0.00923	0.0269	-0.0311	-0.0213
	(0.004)	(0.009)	(0.004)	(0.004)
Outcome Mean	0.00220	0.178	0.626	0.594
Observations	11,308	11,308	11,308	11,308
County Fixed Effects	Y	Y	Y	Y
Decade Fixed Effects	Y	Y	Y	Y

Notes: This table reports estimates of β from equation (8) using the share of working age women who are employed as typists (column 1), share participating in labor force (column 2), share that are married (column 3), and share that have children (column 4). All regressions use a balanced panel of counties and include county and decade fixed effects.

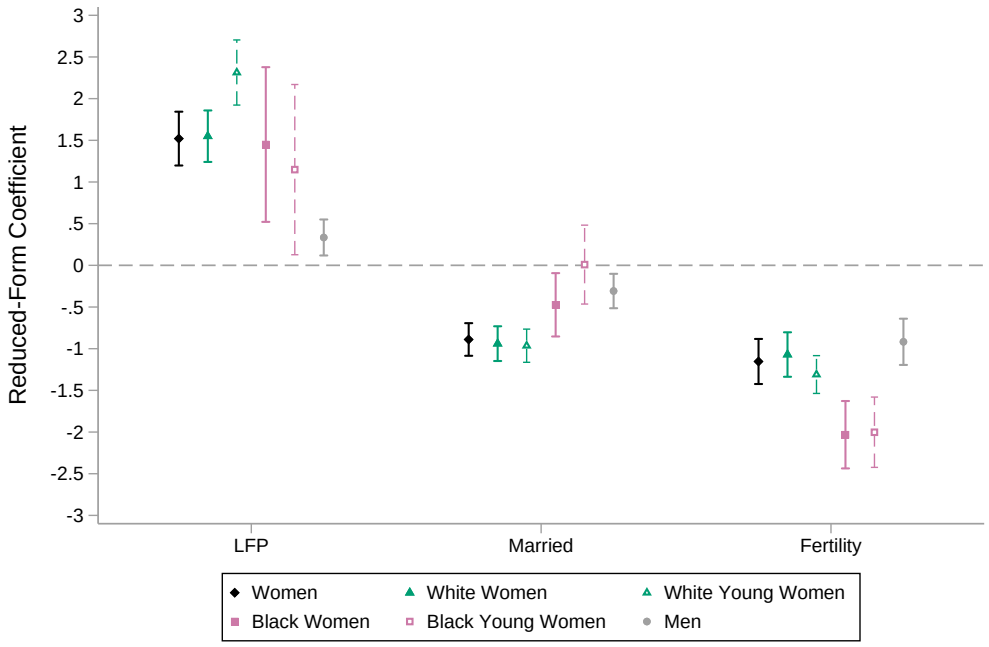
5.3 Heterogeneity by Race

I next ask whether the adoption of the typewriter had varying effects on women's outcomes by race? Specifically, what this technological change meant for Black women, who were not as likely as White women to be hired as typists and secretaries? Figure 8 plots reduced form effects of the 1880 to 1920 predicted change in typists separately for White (green coefficients) and Black (pink coefficients) women's outcomes. The baseline estimates for all women are presented for comparison using the black diamonds and are equivalent to the most conservative estimates that use 1880 county controls, 1920 individual controls, and state fixed effects from Figure 6. In response to a 1 pp increase in the predicted change in typists, Black women were 1.45 pp more likely to be in the labor force (compared to 1.55 pp for White women). To further understand how changes in labor force participation differed by age, this figure plots the estimates separately for young (age 16-30) Black and White women (hollow coefficients). Younger White women experienced larger increases in their labor participation, predominantly reflecting the entry of younger White women into typing. Participation of younger Black women was not statistically different from that of all Black women.

While White women experienced reductions, similar in magnitude to the overall reduction, in their likelihood of being married and having children, Black women did not experience similarly substantial changes to their likelihood of being married but experienced large declines in their probability of having children. This figure also plots in gray the reduced form effects of the instrument on men's outcomes. I interpret the 4.6 times smaller effect on men's labor participation (0.33 pp increase in labor force participation compared to 1.52 pp for women)

as a general equilibrium effect of the technological change. In fact, this is expected as we anticipate "all workers to benefit from technological progress, at least to some degree" (Autor, 2022). I next analyze the mechanisms underlying these observed changes in Black and White women's outcomes.

Figure 8: Reduced Form Effect on Black and White Women's Outcomes



Notes: This figure plots the reduced-form coefficients when limiting the sample separately to all women (black coefficient), White women (green), young (aged 16-30) White women (green hollow), Black women (pink), young Black women (pink hollow), and men (gray). All regressions control for baseline county characteristics, individual characteristics (not including race) and state fixed effects. Details of outcomes and control variables follow Figure 6 notes.

5.4 Mechanisms

Thus far, I have documented that typewriter adoption led to increases in White and Black women's labor participation, with downstream effects on their marriage and fertility outcomes. Below, I outline the mechanisms driving these results.

Indirect Crowding-In Effect on Black Women's Labor Participation.— To understand the forces underlying the increase in Black women's labor participation, I turn to the industries and occupations that Black and White women enter in response to the adoption of the typewriter. Figure 9 plots the reduced-form effect of a 1 pp predicted rise in typists on the likelihood of Black (pink coefficients) and White (green coefficients) women entering each of the different

industry (Panel A) and occupation groups (Panel B).[35] It shows that White women mainly joined clerical occupations across a variety of sectors and Black women substituted out of agricultural work and joined the domestic services industry to work as household service workers. This result suggests the presence of an indirect *crowding-in* effect of the typewriter, whereby as White women left housework to enter offices in response to the technological change, this increased Black women's labor participation who substituted for White women by entering domestic services work.

While historically it has been documented that Black women increasingly entered domestic service work in the early twentieth century (Jones, 2009), the mechanisms underlying this structural change are less well understood. This finding highlights a novel mechanism by which Black women entered domestic service work and underscores the role of technological changes in inducing indirect occupational shifts among Black women, a group not directly employed for new work created by the typewriter.[36] This result is, to the best of my knowledge, the first to empirically document a key factor underlying this structural change in Black women's labor.

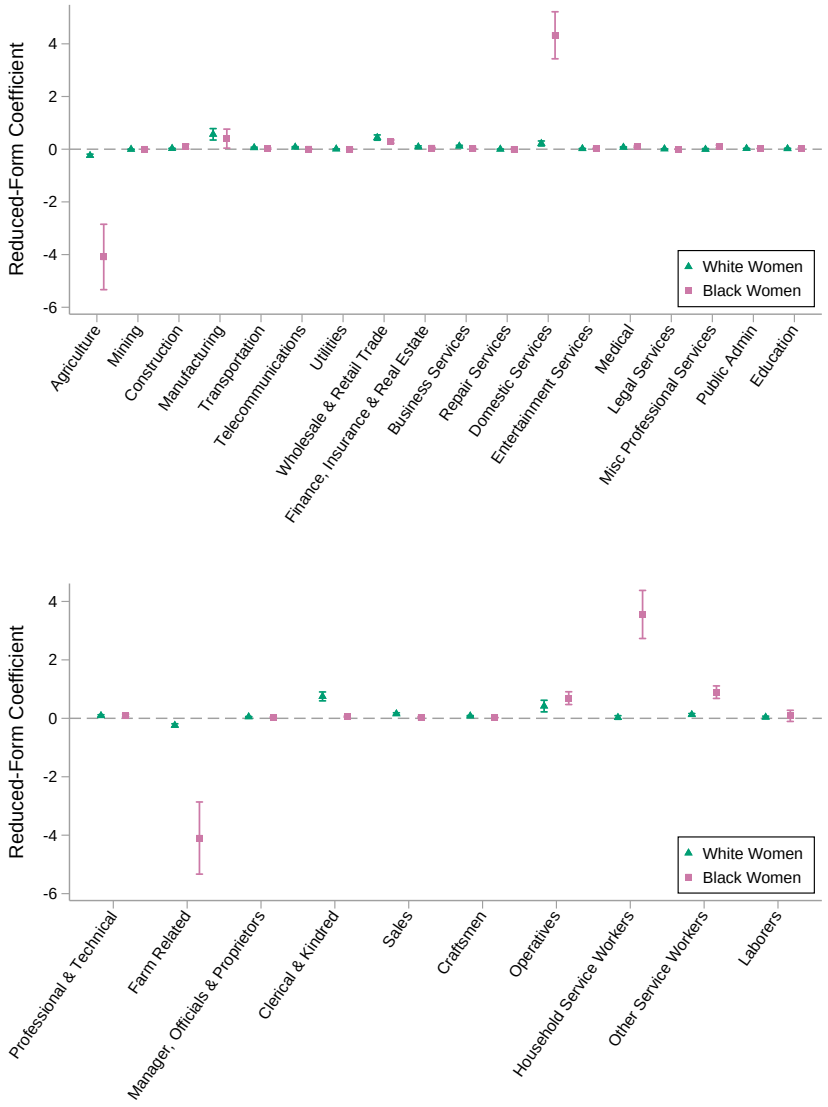
Marriage and Fertility Decisions.— Do the labor market impacts of the technological change result in women simply delaying marriage and having children or or do they ultimately forgo these decisions? Appendix Figure 29 Panel A plots the probability of White women being married at each age between 16 to 40 split by women who are in counties that are more versus less exposed to the shock of the typewriter. High (low) exposure is defined as counties with an above (below) median predicted change in typists.[37] I find that at all ages, White women in counties with above median exposure to the typewriter had a lower probability of being married. However, there is a small reduction in the gap for women in their late twenties implying that while some of the women with greater exposure to the typewriter never married, a small fraction delayed marriage until later ages. Panel B plots the probability of having children, conditional on being married, for White women. It shows that White women in above median exposure counties were less likely to have children than women in

[35] Industries and occupations are grouped based on groupings suggested for the *ind1950* and *occ1950* IPUMS variables.

[36] In related work, Federov (2024) studies the role of educational attainment and electrification in facilitating White women's shift out of domestic service work. Jutt and Parman (2024) show that the increasing supply of Black female domestic workers helped increase White women's fertility.

[37] Appendix Section C.3 provides details of this analysis.

Figure 9: Effect of Typewriter on Employment in Industries and Occupations by Race



Notes: This figure plots the reduced-form effect of the instrument, the 1880-1920 predicted change in typists, on Black (pink) and White (green) women's likelihood of working in industry (Panel A) and occupation (Panel B) groups. All regressions include controls for baseline county characteristics, individual characteristics, and state fixed effects. Details of controls can be found in notes to Figure 6.

below median areas across all ages.

Appendix Figure 29 Panels C and D plot these probabilities for Black women in 1920. Panel C shows that earlier in the age distribution, there was no significant difference in the probability of being married for Black women in above vs below median exposure counties. However, a consistent gap arises in the late twenties suggesting that some Black women in above median exposure counties were forgoing marriage altogether. Appendix Figure 30 Panel A reproduces this plot using an indicator for spouse being present in the household

and depicts a greater gap than when using an indicator for being married or not. Appendix Figure 30 Panel B reproduces Figure 8 using instead the outcome for spouse being present and shows a reduction in Black women's likelihood of living with their spouse. Together, these results suggest that while Black women's likelihood of being married did not experience the same reduction as White women did, in order to work in household services, they likely had to live away from their spouses.

Appendix Figure 29 Panel D shows that married Black women in counties with an above median predicted change in typists were less likely to have children at all ages. This result might be driven in part by the fact that married Black women in these counties often lived apart from their spouses (Appendix Figure 30, Panel B). Additionally, Figure 9 showed that Black women substituted away from agriculture, an occupation where their children could accompany them, to household services, which did not provide the same amenity. Lastly, Appendix Figure 31 shows that Black women working in domestic services were significantly less likely to have children, even when compared to other Black employed women in the same county.

Collectively, these findings reveal that a technological change that generated new work for White women also indirectly influenced Black women's employment, and these occupational shifts impacted both groups' long term family outcomes.

6 White Women's Intergenerational Mobility

The adoption of the typewriter created a unique opportunity for White women to enter the office space which consequently allowed them to work alongside and be connected to men, especially men of higher socioeconomic status. Did these interactions allow women to marry men of higher income than they would otherwise? And did this result in upward economic mobility for these women?

6.1 Descriptive Evidence

I begin by addressing these question descriptively and study whether typists married men of higher income than comparable women who were not employed as typists. I follow women from the 1920 to the 1940 Census using linked census data described in Section 3.3. I focus on intergenerational mobility for women specifically through the channel of marriage because

women in the early twentieth century frequently dropped out of the labor force upon getting married (Goldin, 1983) and marriage was one of the only channels of upward mobility given their career opportunities. In fact, only 12% of the 903,150 White women in the linked sample are recorded as having an occupation in 1940 when they are married.

To estimate the relationship between working as a typist and future spousal income, I use the following specification:

$$LogIncome_{spouse}^{1940} = \alpha + \beta \mathbb{1}(Typist^{1920}) + \gamma IncomeScore_{father}^{1920} + \Gamma X_i + \delta_c + \epsilon_i \tag{10}$$

where, the outcome variable is the logarithm of spousal income in 1940 and $\mathbb{1}(Typist^{1920})$ represents an indicator variable which is equal to 1 if the woman worked as typist in 1920. This specification controls for the woman's father's income score in 1920, her birthplace and her year of birth. I also include 1920 county fixed effects to only draw comparisons between women who lived in the same county at baseline.

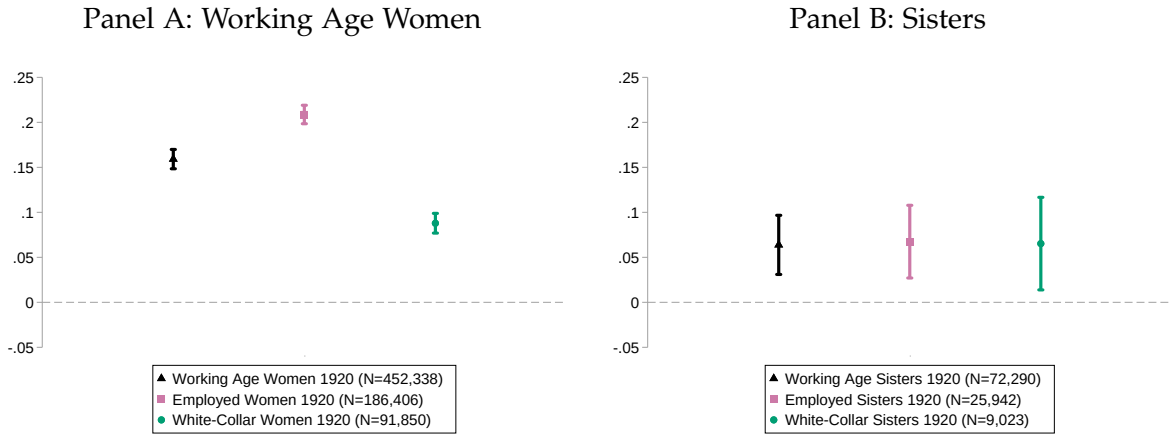
Figure 10 Panel A plots estimates of the β coefficient obtained from equation (9) for three different samples. The first sample includes all working-age women in 1920 (coefficient plotted in black), the second only includes women who were employed in 1920 (gray) and the third further restricts to women working in white-collar occupations in 1920 (green).[38] I find that compared to working-age women living in the same county in 1920, controlling for differences in fathers' economic status, women's birthplace and birth cohort, women working as typists were married to a spouse with 17.3% higher income than non-typists. This advantage increases to 23.2% when comparing to women employed in other occupations at baseline. Finally, being a typist is associated with 9.2% higher future spousal income even when compared to alternative white-collar occupations.

Next, Figure 10 Panel B plots coefficients that include fixed effects for fathers. This allows for a comparison between *sisters*, which eliminates unobserved differences across childhood households and families that might bias the results above. I find that typists marry men with 6.6% higher income when compared to their non-typist sisters who were also of working age in 1920 (in black). Importantly, this association is robust to restricting the comparison further only to sisters who were employed in 1920 (gray) and working in other white-collar

[38] I define women as being employed in a white-collar occupation if they are employed in one of the following categories of occupations: "Professional, Technical" (*occ1950* codes 1-99), "Managers, Officials, and Proprietors" (*occ1950* codes 200-290), and "Clerical and Kindred" (*occ1950* codes 300-390).

occupations (green).

Figure 10: Differences in Future Spousal Income of Typists and Non-Typists



Notes: This figure plots differences in spousal income of typists and non-typist working age women (Panel A) and only non-typist sisters (Panel B). Each plot uses three subsamples: (1) all working-age women (sisters) in 1920, (2) only employed women (sisters) in 1920, and (3) women (sisters) employed in white-collar occupations in 1920. Spousal income is obtained from the 1940 Census. All regressions include controls for father's income score in 1920, birth year, birthplace, and race. In addition, Panel A includes county fixed effects and Panel B includes father fixed effects.

Lastly, to estimate the relationship between working as a typist in 1920 and women's intergenerational mobility, I rely on the following rank-rank specification:

$$Rank\ Husband = \alpha + \beta_0 \mathbb{1}(Typist^{1920}) + \beta_1 Rank\ Father + \beta_2 \mathbb{1}(Typist^{1920}) \times Rank\ Father + \epsilon \tag{11}$$

where, $\mathbb{1}(Typist^{1920})$ is an indicator variable that equals one when a woman is recorded as working as a typist in 1920. *Rank Husband* is measured based on 1940 income of the husband of the woman linked from the 1920 to the 1940 Census. *Rank Father* is her father's rank in 1920 based on an occupational income score measure (Abramitzky et al., 2021). Husbands and fathers are then ranked in the national income distribution of their respective cohorts following Chetty et al. (2014, 2020). The constant term, α, then represents the absolute rank mobility, based on husband's income, for women not working as typists. β_0 measures the difference in this expected husband rank for women who worked as typists in 1920. β_1 captures relative mobility through marriage of women who were not employed as typists, that is the association between women's fathers' ranks and their husbands' ranks. Lastly, β_2 measures how this relative mobility differs for women who were employed as typists, or how the intergenerational mobility through marriage differs for women who worked and did not work as typists.

Figure 11, Panel A plots regression lines corresponding to equation (10) and a binned

scatterplot showing husband's mean income rank by father's income ventile for women who worked and did not work as typists in 1920. Panel A shows that future husbands of typists out-earned husbands of non-typists for every ventile of father's income distribution, with gaps being the greatest for women born to fathers at the bottom of the distribution. In fact, women born to fathers at the 25th percentile who worked as typists, married men with an average income rank that was 17.9 percentiles above the average rank of husbands of non-typists.

Next, I compare the mobility advantage offered by the typing and secretarial occupation with that of teaching. Teaching was a similar white-collar occupation employing a large number of women, but it did not provide the same amenity in terms of being able to interact with higher earning men. Figure 11, Panel B replaces the indicator for working as a typist in equation (10) with an indicator measure for working as a teacher in 1920. Compared to typists, teachers do not enjoy the same economic mobility advantages. Teachers with fathers at the 25th percentile of the income distribution are able to marry men with an average income rank only 3.6 percentiles higher than the average income rank of non-teachers (compared to 17.9 percentiles for typists). This small gap in mobility between teachers and non-teachers disappears at the upper tail of father's income distribution. While teachers and non-teachers with fathers at the 75th percentile have no significant difference in average rank of husband, typists with fathers at the 75th percentile are married to men with an average income rank that is 7.4 percentiles higher than non-typists.

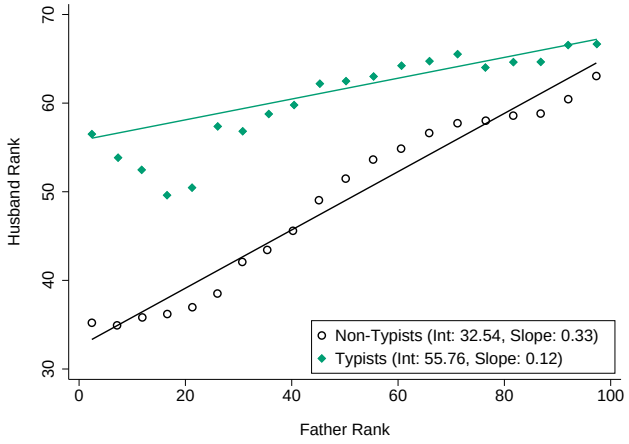
Lastly, Panel C restricts the sample only to typists and teachers and re-runs the regression specified in equation (10) to depict gaps in upward mobility when directly comparing typists to teachers. I find that for typists and teachers with fathers at the 25th percentile, typists marry men with average income ranks that are 14.3 percentiles higher than the husbands of teachers. This mobility gap between typists and teachers persists regardless of fathers income score rank. Appendix Figure 32 plots this direct comparison between typists and nurses (Panel A), and also between typists and telephone operators (Panel B). In both cases, working as a typist is associated with a mobility advantage for all ventiles of father's income distribution.

6.2 Causal Effect of Typewriter Adoption on Women's Economic Mobility

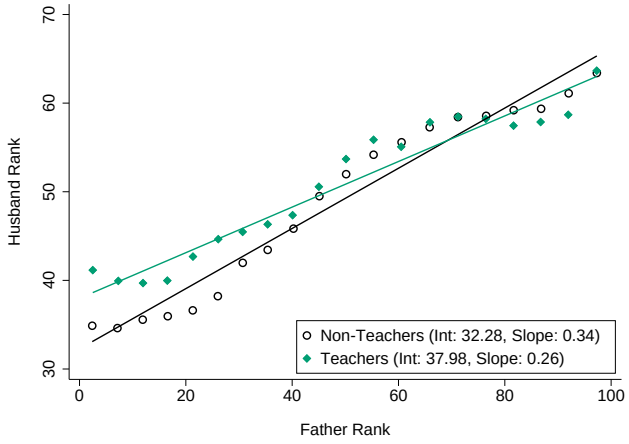
A key contribution of this paper is to study the causal impact of a technological change on women's intergenerational mobility through marriage. To estimate a causal relationship between typewriter adoption and women's intergenerational mobility, I instrument for type-

Figure 11: Typewriter and the Intergenerational Mobility of Women

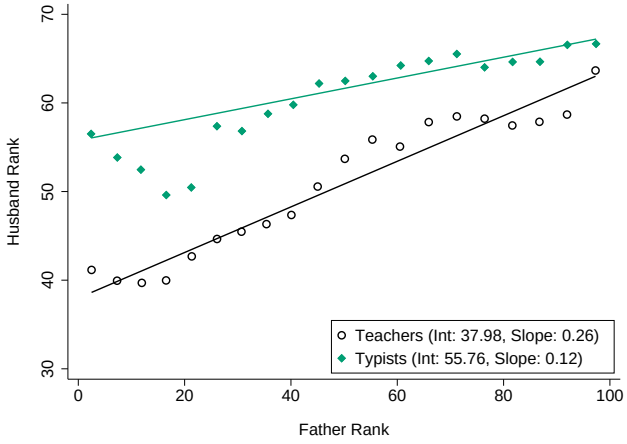
Panel A: Typists and Non-Typists in 1920



Panel B: Teachers and Non-Teachers in 1920



Panel C: Typists vs Teachers in 1920



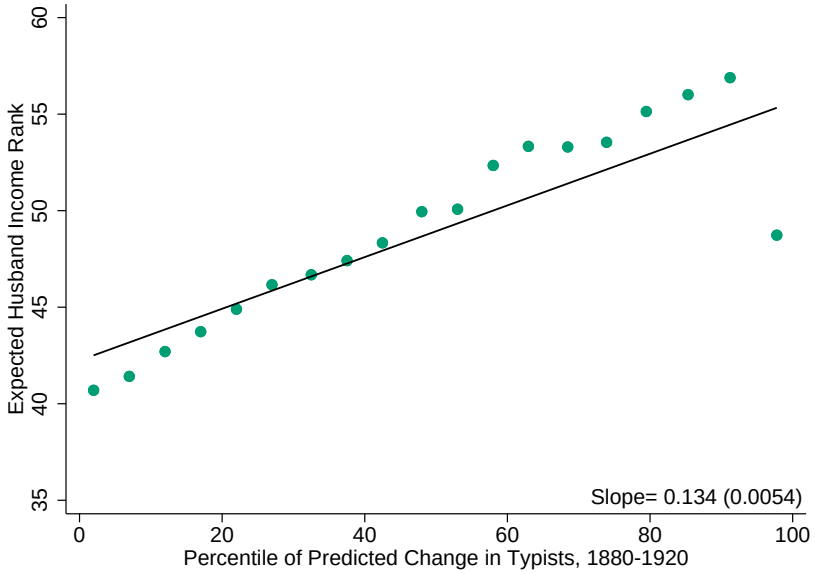
Notes: Panel A plots the mean income rank of husband by father's income rank, for typists and non-typists. Panel B uses an indicator for working as a teacher in 1920 instead in equation (10). Panel C restricts the sample only to typists and teachers so that non-typists from equation (10) are in fact teachers. Husbands are assigned percentile ranks relative to all other husbands born in the same birth year. Fathers are ranked relative to all fathers with children born in the same birth year.

writer adoption using the 1880 to 1920 predicted change in typists.

Figure 12 plots a binned scatterplot to show the relationship between ventiles of the instrument, the predicted change in typists, and husband's expected income rank. Specifically, husband's mean *expected* income rank conditional on father's socioeconomic status is obtained by regressing observed husband income rank on father's income score rank as well as the woman's and her husband's birthplaces and ages. It shows a striking positive relationship between increasing exposure to the typewriter as captured by the instrument and the expected income rank of women's future husbands. Specifically, for every 1 percentile increase

in exposure to the typewriter, future husband's income rises by 0.13 percentiles.[39]

Figure 12: Typewriter Exposure and Husband's Expected Income



Notes: This figure plots a binned scatterplot depicting the relation between ventiles of the instrument, the 1880-1920 predicted change in typists, and husband's expected income rank. Husband's expected income rank is obtained by regressing observed husband income rank on father's income score rank as well as the woman's and her husband's birthplaces and ages. Father's 1920 income is based on an occupational income score measure. Husband's income is recorded from the 1940 Census. The sample is restricted to white women who are linked from the 1920 to 1940 Census and are recorded as being single in 1920 and married in 1940. Controls include spouse's year of birth, spouse's birthplace, spouse's race, own birth year, own birthplace, own race, and father's age.

Appendix Figure 36 plots regression lines corresponding to equation (10), but replacing the indicator for having worked as a typist to an indicator for being in a county with an above median exposure to the typewriter as measured by the county's 1880 to 1920 predicted change in typists. It shows that conditional on growing up with father's at the 25th percentile of the income distribution, women in counties in 1920 with greater exposure to the typewriter marry men with incomes that are 3.8 percentiles higher. Together, these results imply that greater exposure to the typewriter allowed women to marry men of higher income rank.

6.3 Key Mechanism and Discussion

Combining the descriptive and causal results, I argue that greater exposure to the typewriter allowed women to marry men of higher income, and that this same "mobility advantage" was not present in their alternative occupational choices. Consequently, these findings are

[39]This result is robust to using an alternative occupational score measure from Ruggles et al. (2021) for fathers (Appendix Figure 33), to the inclusion of additional links made using ML (Appendix Figure 34), and to reweighting the linked sample to the underlying population on observable characteristics (Appendix Figure 35).

consistent with a hypothesis that the typing and secretarial occupation allowed women to meet and interact with men of higher socioeconomic status as compared to their alternative avenues. These interactions could be direct, i.e. take place within the same workplace, or indirect whereby women connect with higher-income men in alternative social settings that they have access to through their occupational circle.

While I cannot directly test this hypothesis in the data as individual workplaces are not recorded in census data, I provide suggestive evidence in support of this hypothesis by following the husbands that the women are recorded as being married to in the 1940 Census back to the 1920 Census. Using this approach, Table 4 documents three associations: compared to husbands of non-typists, husbands of typists are (1) 9.5 pp more likely to be living in the same county in 1920 as their future wives (2) 14.4 pp more likely to be working in white-collar occupations in 1920 and (3) 9.1 pp more likely to be working in white-collar occupations in the same county in 1920 as their future wives. This suggests that compared to non-typists, women who worked as typists had greater opportunity to interact with and consequently marry higher-earning men.

Table 4: Associations Between Working as a Typist and Husband Characteristics in 1920

	(1)	(2)	(3)
	Residing in Same County as Future Husband, 1920	Husband Working in White-Collar Occ, 1920	Husband Working in White-Collar Occ in Same County, 1920
$\mathbb{1}(Typist^{1920})$	0.0947	0.144	0.0908
	(0.002)	(0.002)	(0.002)
Outcome Mean	0.298	0.102	0.0408
Observations	903,150	903,150	903,150

Notes: This table reports results from three separate regressions where an indicator for working as a typist in 1920 is regressed on (1) having resided in 1920 the same county as future husband, (2) having a husband who worked in a white-collar occupation in 1920, and (3) having a husband who worked in a white-collar occupation in the same county as his future wife.

Evidence for this mechanism can also be found in works of historians and popular media from the time. For example, Waller (1986) writes that "marriage prospects [for female secretaries] were enhanced because so many men choose a wife amid the deft-fingered clerks in preference to the society misses." In fact, magazine and newspaper short stories from the late

nineteenth and early twentieth century often featured men marrying their typists. In 1891, the Chicago Tribune ran a famous story titled "Married His Typewriter."[40] These themes are also found in other forms of print media such as advertisements (Appendix Figure 3, Panel C) and postcards.[41]

By helping women enter new work in offices and allowing them to interact with men from different socioeconomic backgrounds from their own, the typewriter acts as a "meeting technology" for women's marriage outcomes.[42] Consequently, women who were more exposed to the typewriter and worked as typists, were able to marry out of their socioeconomic background and gain economic mobility, making the typewriter an engine of upward mobility for women. This is especially meaningful at a time when assortative mating in the US was high and women had few opportunities to marry out of their socioeconomic background (Eriksson et al., 2023).

7 Conclusion

The 19th and 20th centuries saw dramatic changes in women's status in the US economy. The invention and adoption of the typewriter in this time period presents a unique episode of a large predominantly task-creating technological change that had many unintended long-term consequences on women's changing roles in the economy.

By creating millions of new jobs for women, adoption of the typewriter led to an increase in women's labor force participation rates. The labor market effects induced by the technological change led to a decrease in women's marriage and fertility rates. I find that the typewriter not only changed White women's outcomes by allowing them to enter secretarial work but also had indirect effects on Black women's outcomes. In fact, as White women left the household to join office-work, Black women substituted for them by gaining employment in domestic services. The new work created by this technological change allowed White women to enter the office space and work alongside and be connected to men of higher socioeconomic status. This allowed many women to marry higher earning men than they would otherwise, resulting

[40] Working as a typist early on was also commonly referred to as being a typewriter in the late nineteenth century.

[41] A popular postcard image from 1909, titled "I love my wife but oh! you kid," depicts a relationship between a secretary and her boss (Library of Congress, 1909).

[42] This terminology is borrowed from a literature studying "meeting opportunities" for marriage outcomes (Goldman et al., 2024).

in upward economic mobility for women through the channel of marriage.

In a world of rapid technological change, where many modern technologies not only replace workers but also create new work, my findings highlight the consequences of task-creating technological changes. They underscore the importance of understanding the *unintended* consequences of technological changes — not only in terms of employment but also across other aspects of economic and social life — for different groups of workers who might be directly or indirectly affected by the change. In the case of the technological change offered by the invention of the typewriter, it had unanticipated effects on not only women's employment but also their family outcomes and intergenerational mobility.

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Online Appendix

Keys to Upward Mobility: Typewriter Adoption and Women's Economic Outcomes

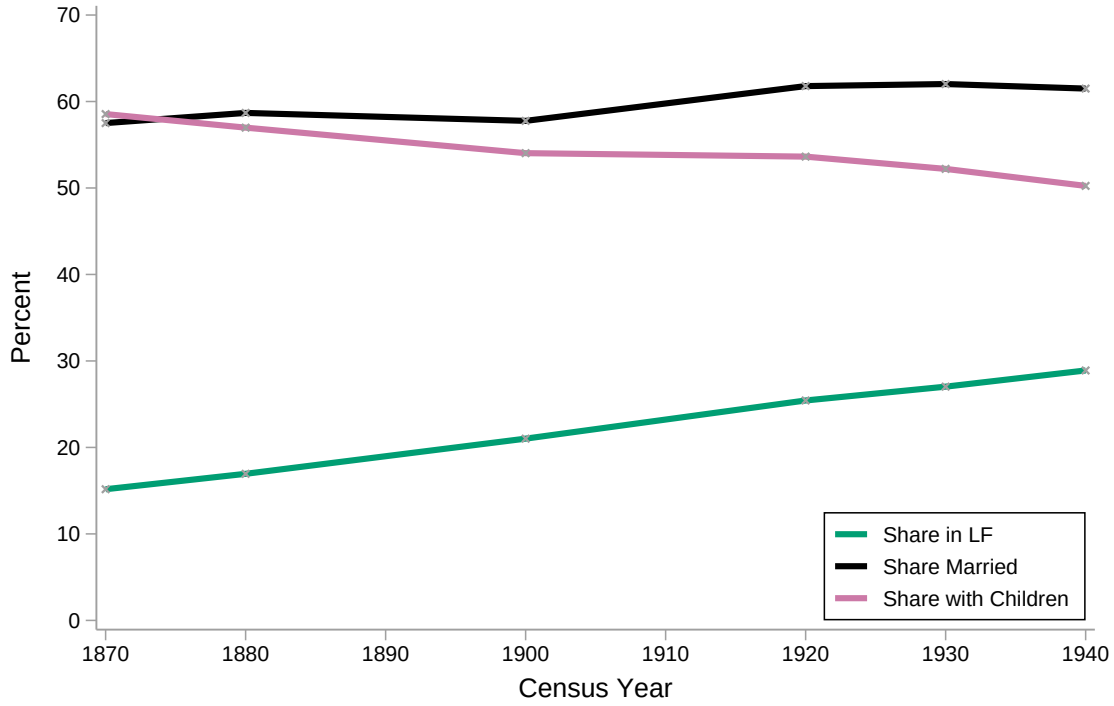
Myera Rashid

Appendix Table of Contents

A Appendix Figures and Tables

A.1 Appendix Figures

Appendix Figure 1: Women's Labor Force Participation, Marriage and Fertility Rates, 1870-1940



Notes: This figure plots the share of women in the labor force (green), married (black) and share of women with children (pink) from 1870-1940. The denominator includes working age women (aged 16-64). Numbers for each decade are calculated from the US population decennial censuses. The *labforce* variable is used to calculate labor force participation, *sploc* for marriage, and *nchild* for children. Results are identical if *occ1950* or *empstat* are instead used to compute share of women who are employed. Importantly, for 1880, this figure computes labor force participation from v2019 of the census data. Recent versions of the data at the time of the analysis of this paper included an error that incorrectly inflates women's labor force participation. See Data Appendix for details of author's correction of this. Data for 1890 is omitted as that complete count census does not exist. Data point for 1910 is also omitted as women's labor force participation is recorded differently than in other censuses (see Goldin (1990) for further details).

Appendix Figure 2: Sholes and Glidden Machine

Notes: This figure depicts the first typewriter manufactured by E. Remington and Sons, the Sholes and Glidden machine. Image taken from Smith (1922) (Fig 2, p.4). This image is a reproduced version of an original photograph by the Remington Company.

Appendix Figure 3: Typewriter Advertisements

Panel A: 1875

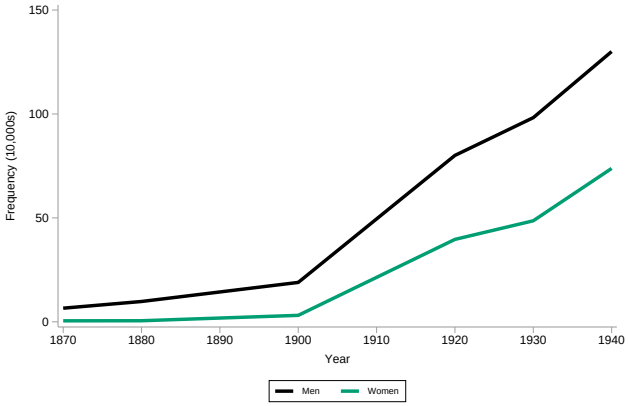
Panel B: 1905

Panel C: 1939

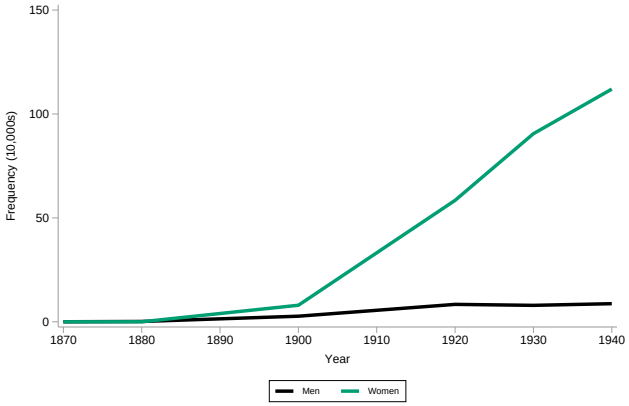
Notes: This figure plots three different historical advertisements for the typewriter: (1) Panel A is the first ad of the typewriter from 1875, (2) Panel B from 1905, and (3) Panel C from 1939. Image for Panel A is obtained from Messenger, Robert (2021), Panel B from Ads By Dee, The Internet Antique Shop (NA), and Panel C from New World Cartographic (NA)

Appendix Figure 4: Evolution of Related White-Collar Occupations

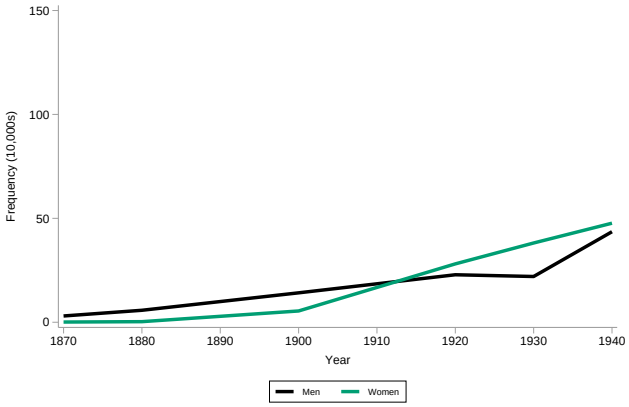
Panel A: Clerical and Kindred



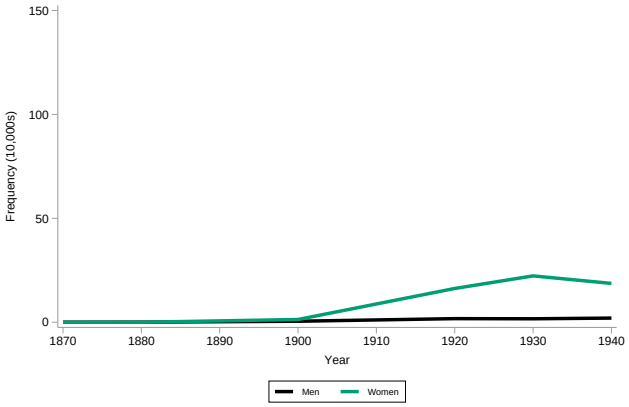
Panel B: Typing, Stenography and Secretarial



Panel C: Bookkeeping

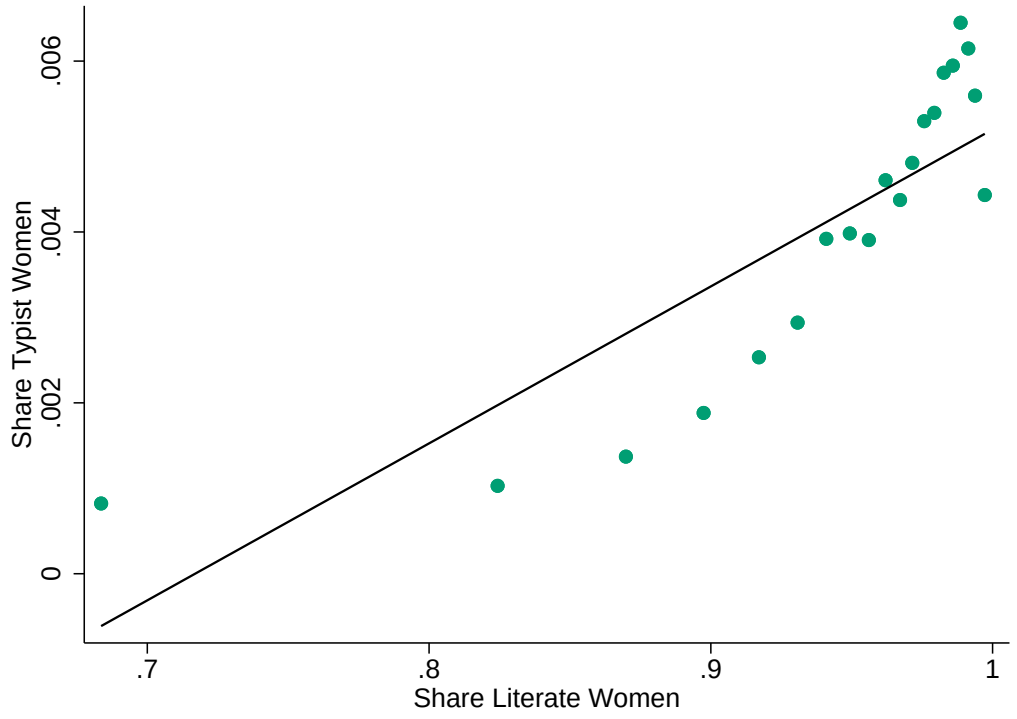


Panel D: Telephone Operation



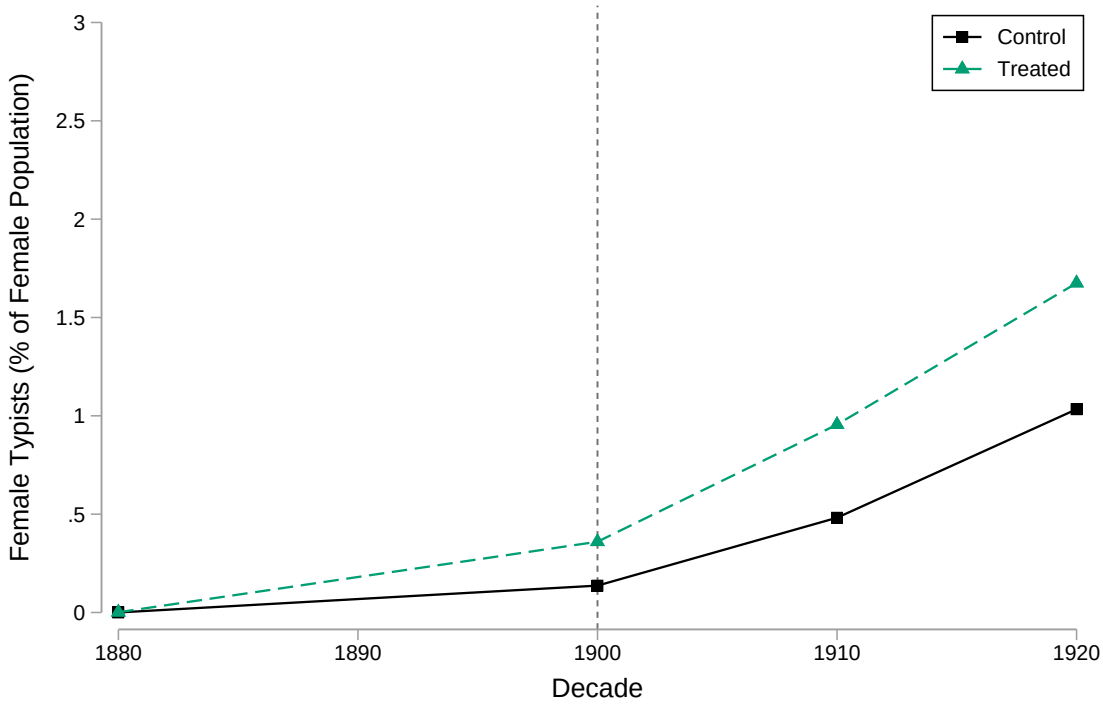
Notes: This figure plots the number of total workers (black line), female workers (green), and male workers (gray) from 1870 to 1940 for the following white-collar occupations: Clerical and Kindred work (Panel A, *occ1950 = 390*); Typing, Stenography and Secretarial work (Panel B, *occ1950 = 350*); Bookkeeping (Panel C, *occ1950 = 310*); Telephone Operation (Panel D, *occ1950 = 365*).

Appendix Figure 5: Relationship between Share Literate and Share Typists for White Women in Counties, 1900-1920



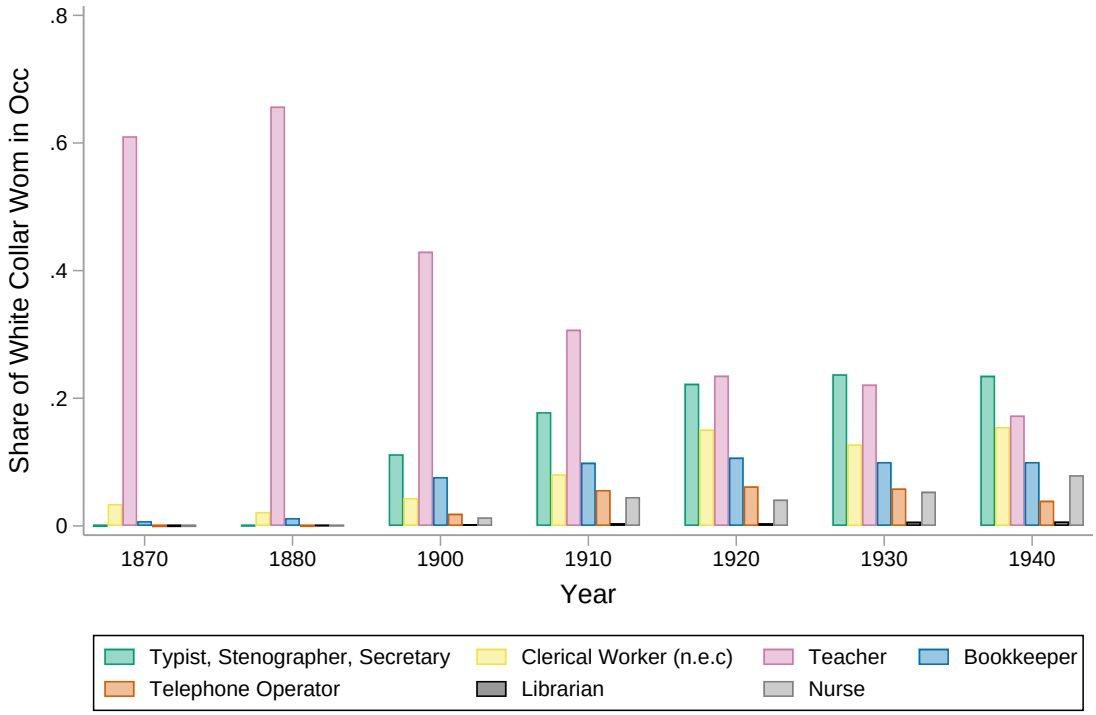
Notes: This figure plots a binscatter depicting the relationship between share of White women who are literate in a county and share of White women who are employed as typists in the county. This figure pools together data for 1900, 1910 and 1920.

Appendix Figure 6: Mean Share of Women Employed as Typists by Control vs Treated States



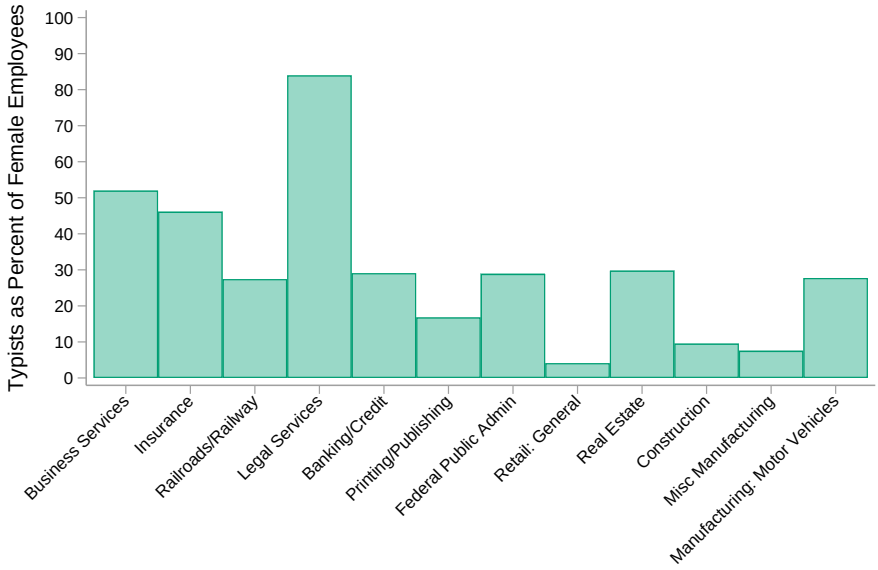
Notes: This figure plots mean female typists as a percent of the female population for states that had mandatory schooling laws by the end of 1900 (treated, green line) and those that did not (control, black line) in each decade.

Appendix Figure 7: Share of White-Collar Female Workers Employed Across Comparable Occupations



Notes: This figure plots the number of women in seven comparable occupations as a share of the working-age women employed in white-collar work. Here white collar-work is defined as occ1950 codes 1-99 and 200-399.

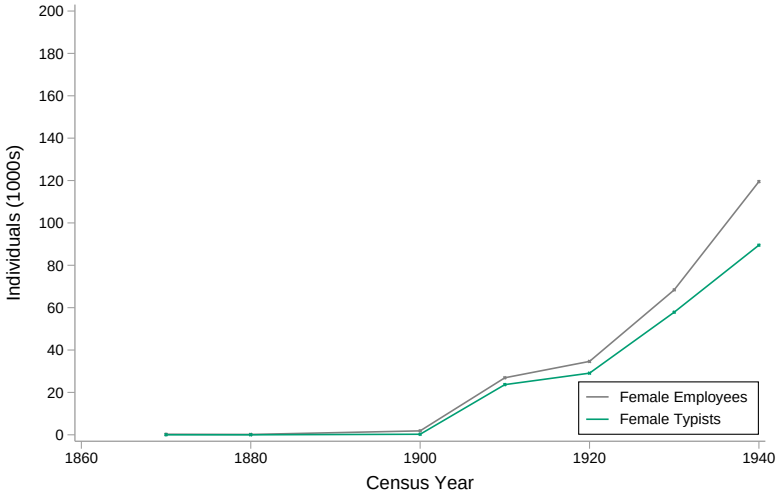
Appendix Figure 8: Employment of Female Typists Across Industries, 1920



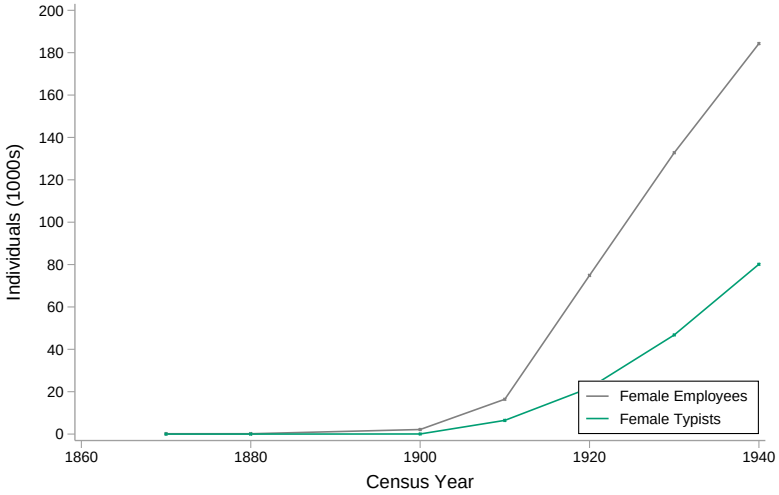
Notes: This figure plots on the x-axis, in descending order, the top 12 industries that employ the highest number of female typists in 1920. Each of these industries employ at least 10,000 female typists. On the y-axis, it plots female typists as a share of the total industry employment. Three digit industry codes from the *ind1950* variable are used for industry classification.

Appendix Figure 9: Example Industries Where Entry of Women Driven By Female Typists

Panel A: Legal Services

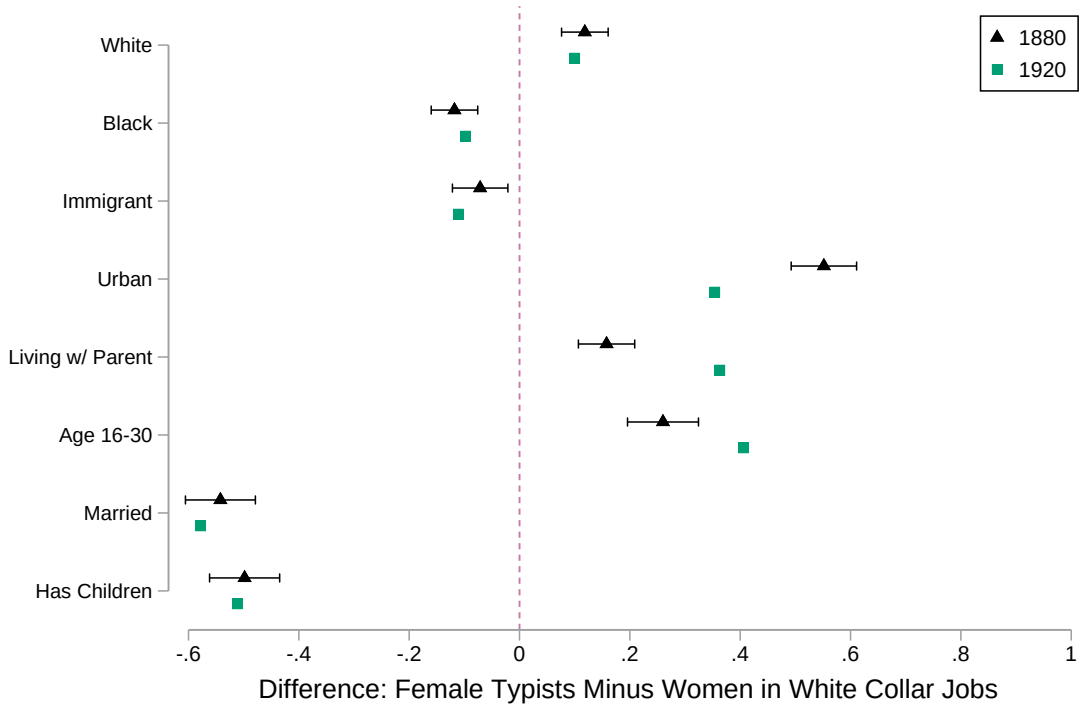


Panel B: Banking and Credit Agencies



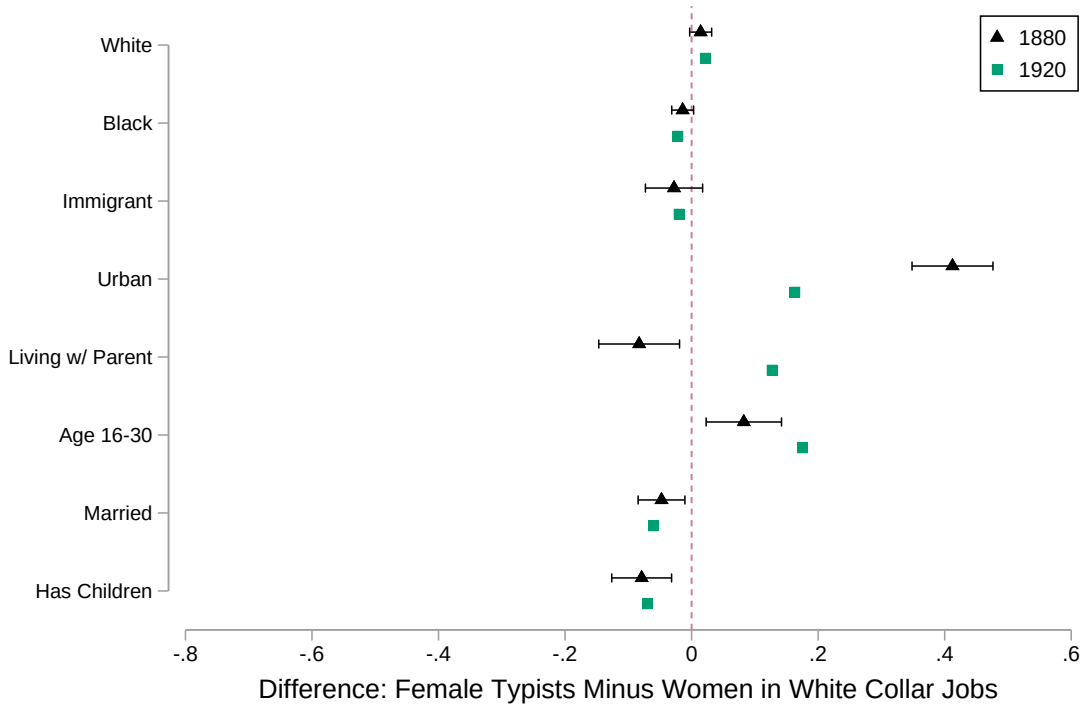
Notes: This figure plots the total number of female employees and the number of female typists for each decade for the Legal Services (Panel A) and the Banking and Credit Agencies (Panel B) industries.

Appendix Figure 10: Characteristics of Typists Compared to Working Age Women, 1880 & 1920



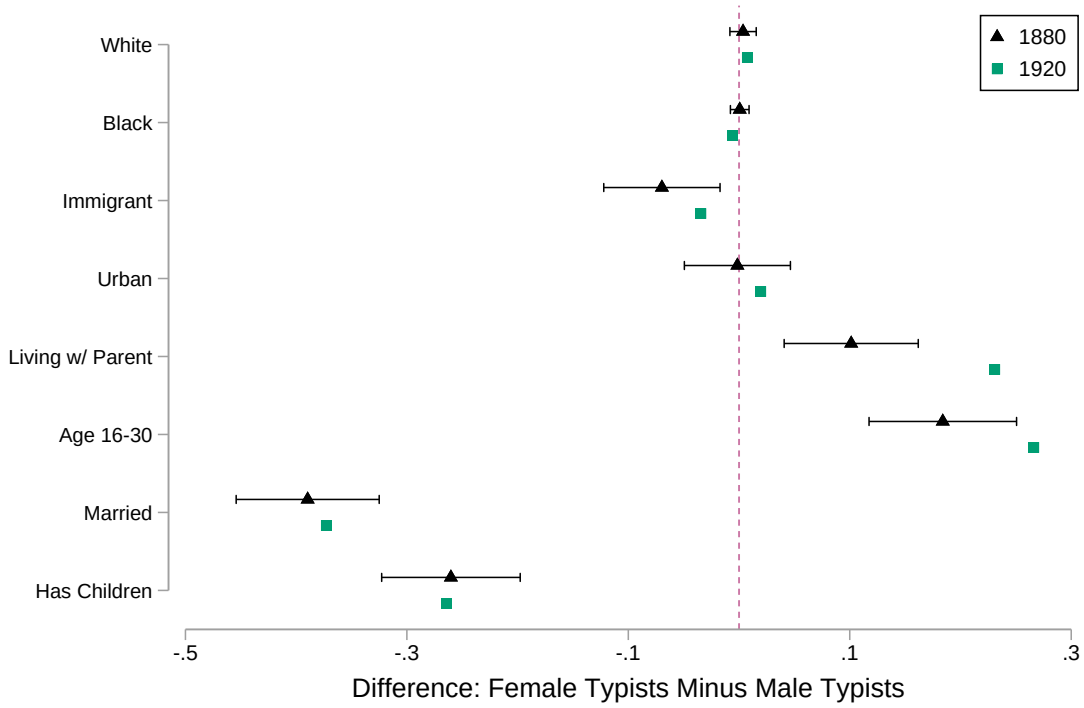
Notes: This figure plots the differences in means of female typists and working age women for each of the characteristics listed in 1880 (black triangles) and 1920 (green squares). The coefficients represent how much more or less likely a typist is than the working age non-typist woman in that decade to satisfy the particular characteristic. A value of 0 on the x-axis represents no difference.

Appendix Figure 11: Characteristics of Typists Compared to White-Collar Women, 1880 & 1920



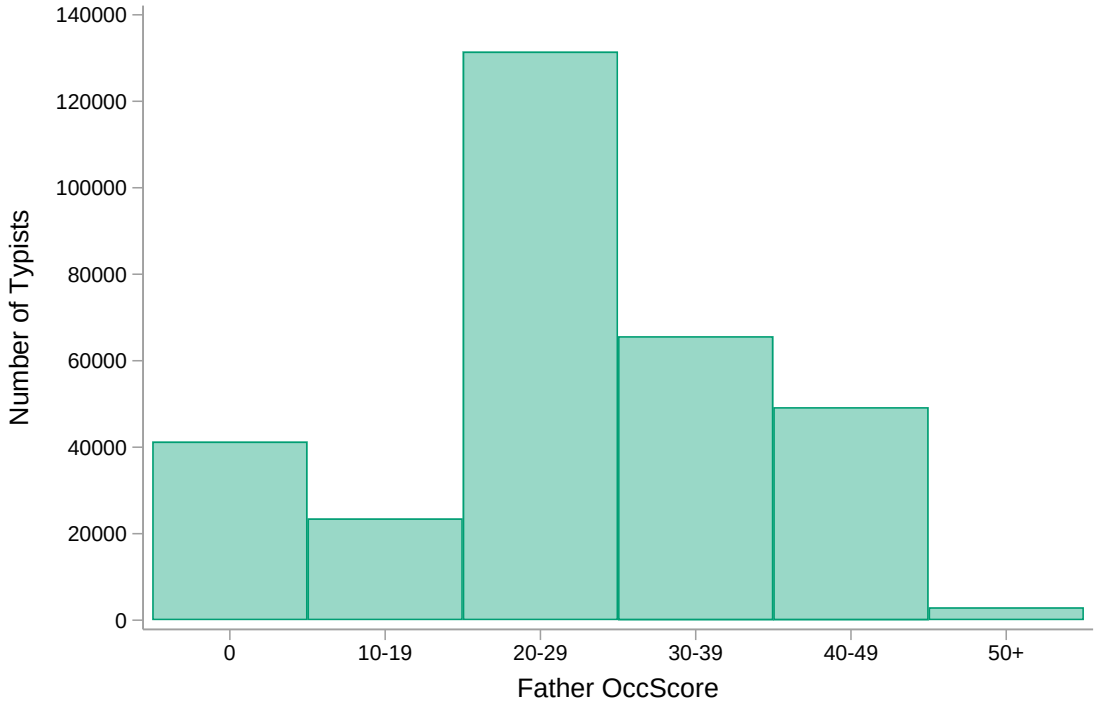
Notes: This figure plots the differences in means of female typists and working age women employed in white-collar occupations for each of the characteristics listed in 1880 (black triangles) and 1920 (green squares). The coefficients represent how much more or less likely a female typist is than the white-collar non-typist woman in that decade to satisfy the particular characteristic. A value of 0 on the x-axis represents no difference.

Appendix Figure 12: Characteristics of Female Typists Compared to Male Typists, 1880 & 1920



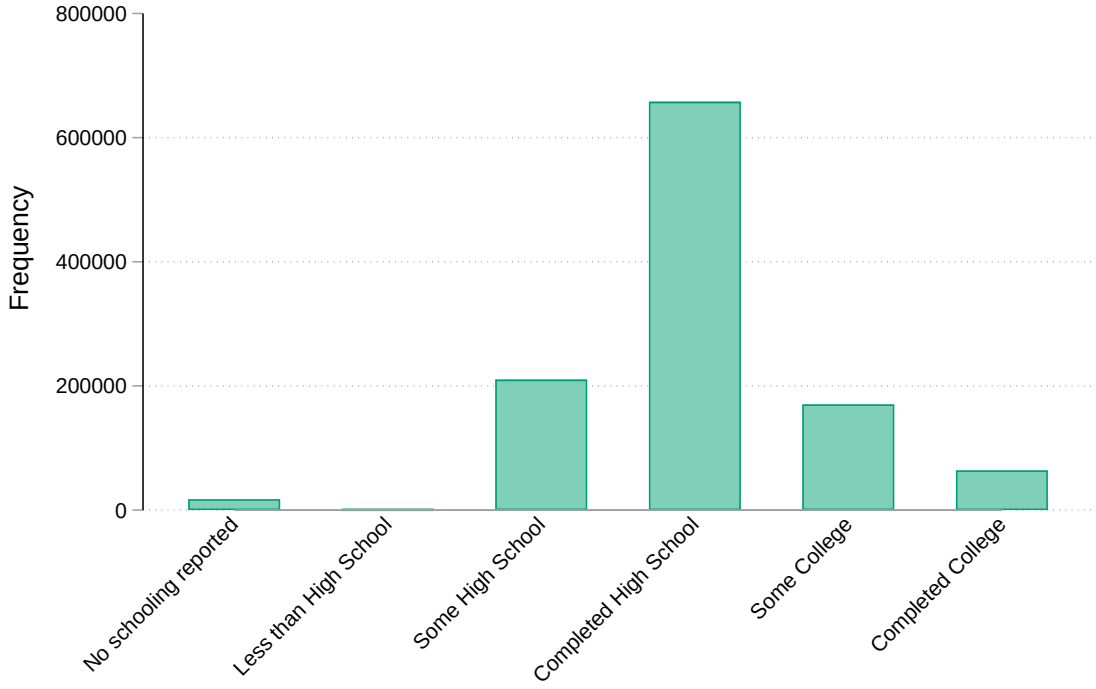
Notes: This figure plots the differences in means of female typists and male typists for each of the characteristics listed in 1880 (black triangles) and 1920 (green squares). The coefficients represent how much more or less likely a female typist is than a male typist in that decade to satisfy the particular characteristic. A value of 0 on the x-axis represents no difference.

Appendix Figure 13: Typists by Father Occupation Income Score, 1920



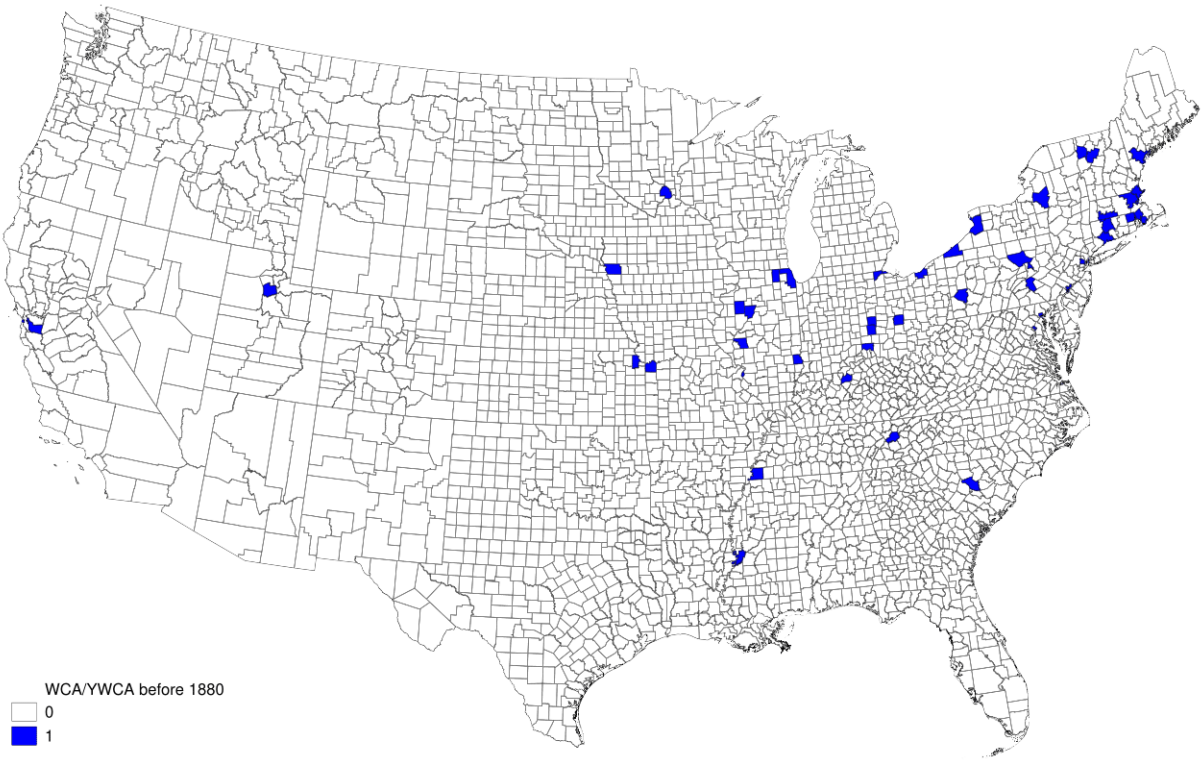
Notes: This figure plots the number of typists across bins of father's occupational income score constructed using the *occscore* variable in 1920. The smallest bin represents women with fathers at the bottom of the occupational income distribution. The sample only includes female typists that are recorded as living with their fathers to be able to observe their fathers' occupations and consequently occupational income scores.

Appendix Figure 14: Educational Attainment of Typists, 1940



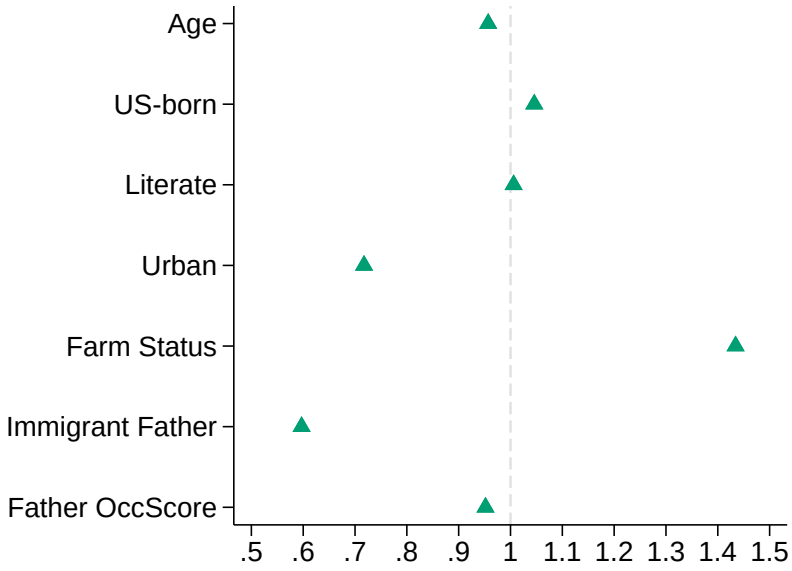
Notes: This figure plots the number of typists across educational attainment categories using the *educ* variable in the 1940 Census.

Appendix Figure 15: Counties with WCA Chapters, 1880



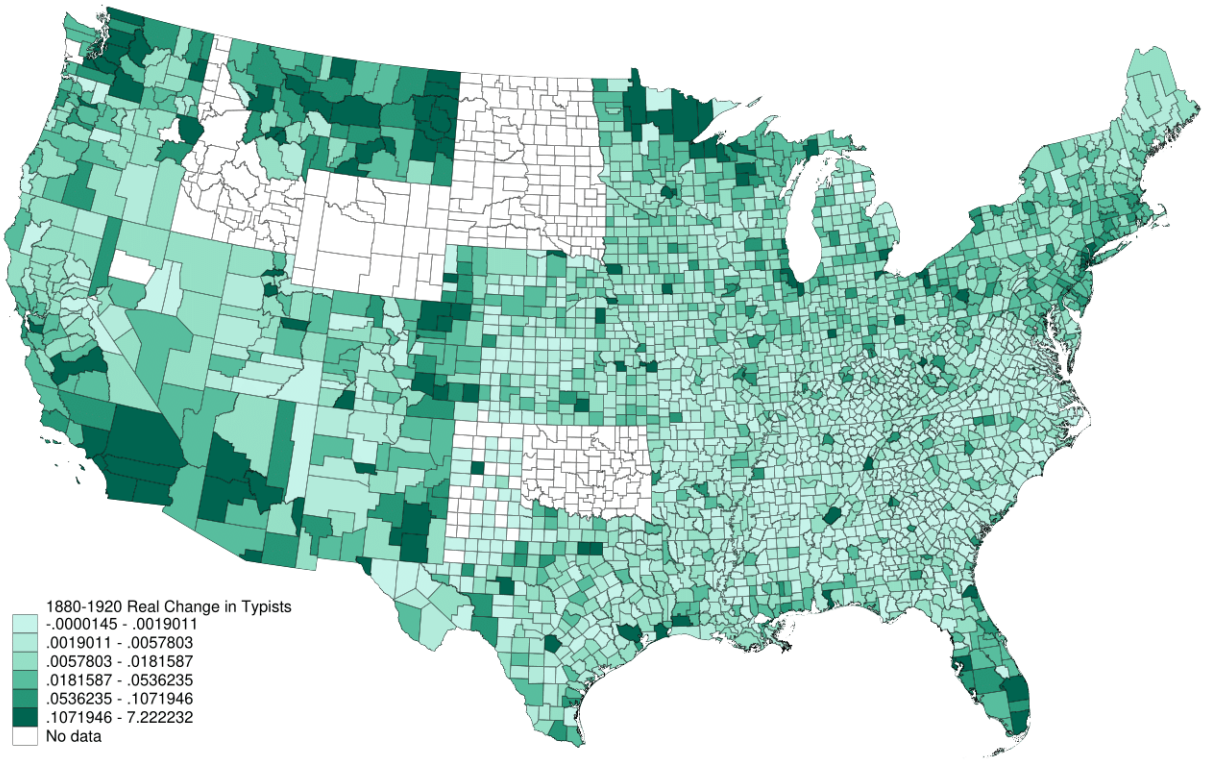
Notes: This figure plots in blue counties that had at least one WCA or YWCA chapter present before 1880.

Appendix Figure 16: Representativeness of 1920-1940 Linked Sample



Notes: This figure illustrates the representativeness of genealogical links from the FamilySearch Family Tree relative to the 1920 population of single White women aged 16-30. For each attribute, the x-axis represents a ratio indicating the mean of that attribute in the matched sample relative to the population mean. Dotted line for a ratio of 1 indicates perfect representativeness and values below (above) indicate under- (over-) representation of individuals with that attribute in the linked sample.

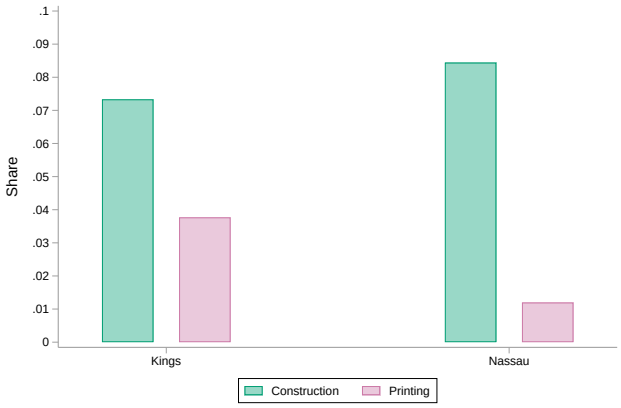
Appendix Figure 17: Spatial Distribution of 1880-1920 Change in Typists Across Counties



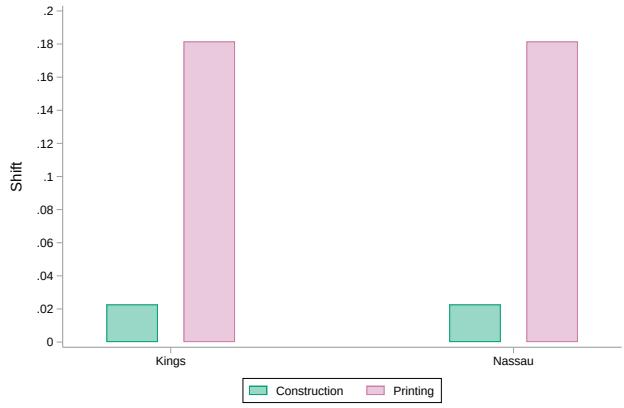
Notes: This figure plots the values of the 1880-1920 actual change in typists across counties. Starting from the lightest shade, the first range represents 0-25th percentile of values, second range represents 25th-50th, third 50th-75th, fourth 75th-90th, and fifth represents all values above the 90th percentile up until the maximum value of the change.

Appendix Figure 18: Intuition Behind Shift Share Approach

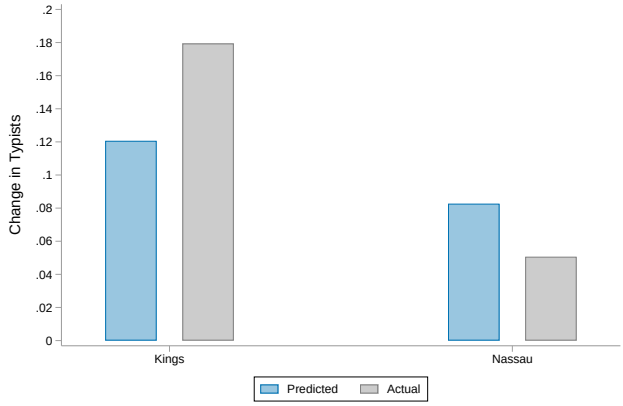
Panel A: 1880 Shares (s_{kc}^{1880})



Panel B: Shifts (g_k)

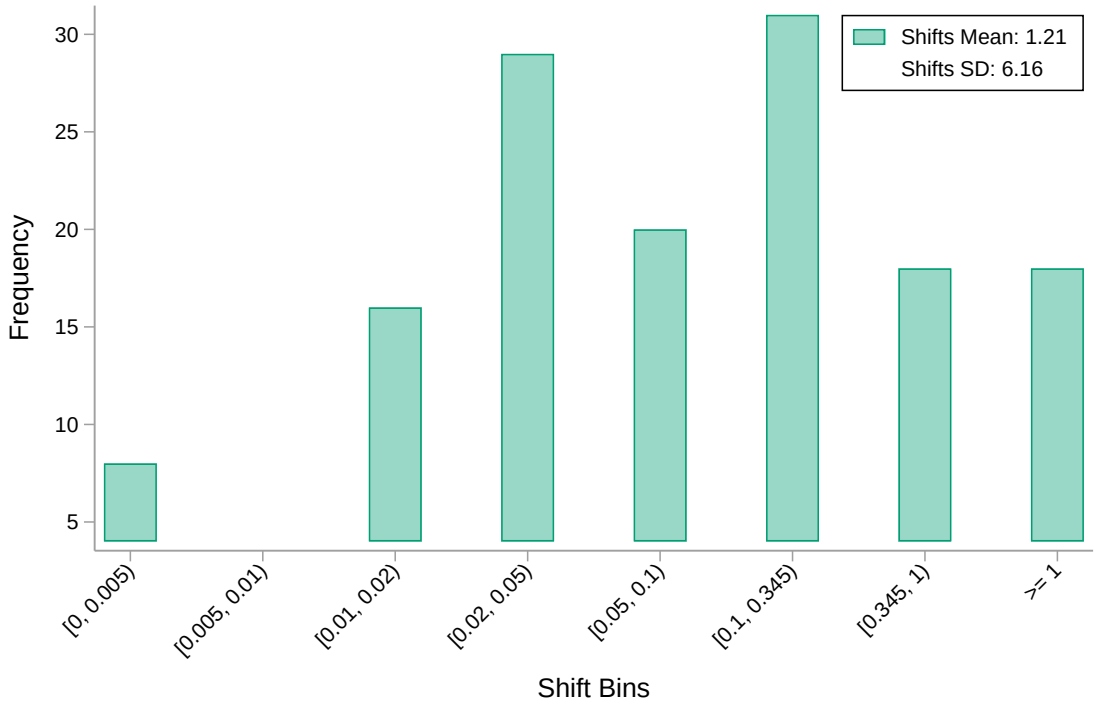


Panel C: Predicted vs Actual Change in Typists



Notes: This figure depicts the intuition behind the shift share approach. The example uses two neighboring counties in New York: Kings and Nassau, and two industries in those counties: Construction and Printing & Publishing. Panel A plots the share of workers employed in each industry in each county (s_{kc}^{1880}) . Panel B plots the 1880-1920 national change in typists for each industry (g_k). Panel C plots the resulting shift share IV, the predicted change in typists (blue bar) after aggregating over all industries for each of two counties. It also plots the endogenous variable, actual change in typists in the gray bar.

Appendix Figure 19: Distribution of Shifts

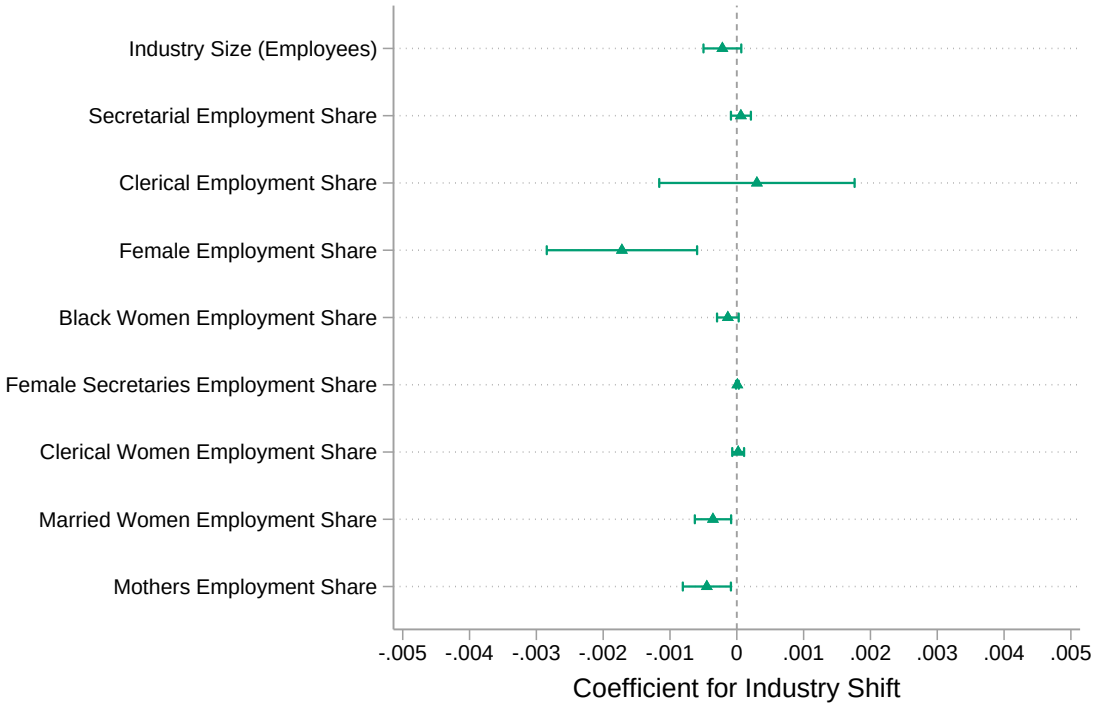


Notes: This figure depicts the distribution of the shifts g_k and reports their mean and standard deviation.

Appendix Figure 20: Test of Pre-Trends: Reduced Form Effect on Women's Labor Force Participation

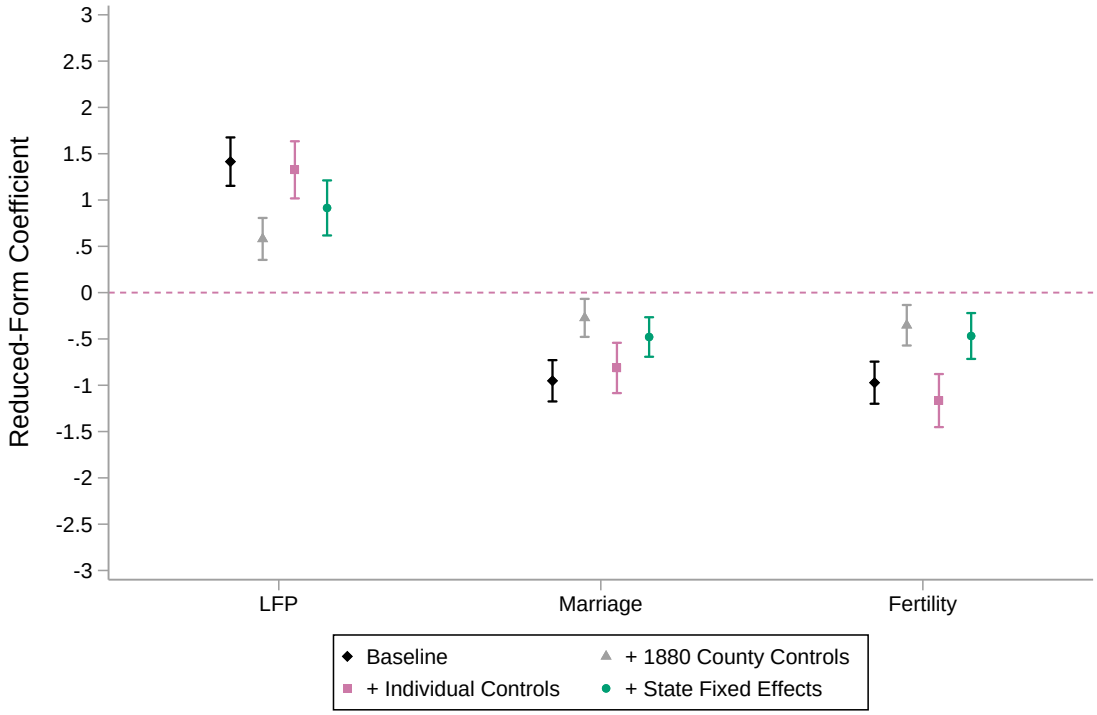
Notes: This figure plots the reduced-form effect of the instrument, the 1880-1920 predicted change in typists, on women's labor force participation in each decade from 1870 to 1940. The regression sample is restricted to working age women. All regressions include baseline county controls. See notes to Figure 6 for details of controls. 1910 is omitted due to 1910 WLFP recorded differently from other censuses, whereby it overstates the true lfp of women (see Goldin (1990) for additional details).

Appendix Figure 21: Balance of Shifts on 1880 Industry Characteristics



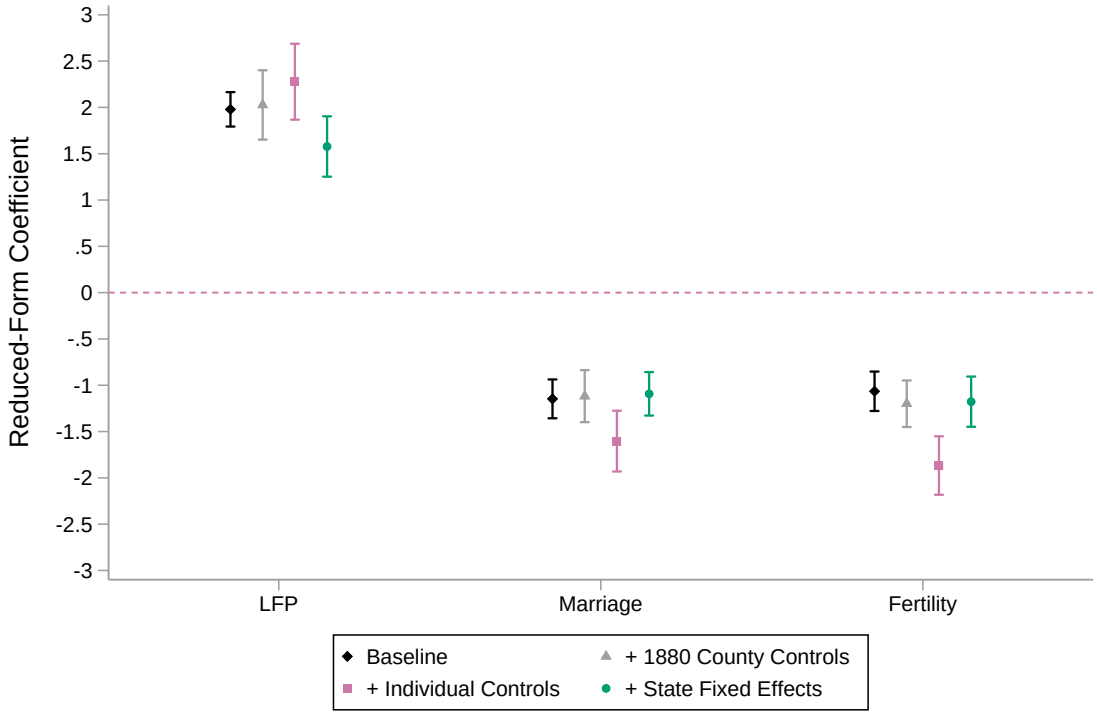
Notes: This figure plots the coefficients of regressing each of the listed industry characteristics from 1880 on industry shifts (g_k). These characteristics include the industry size as measured by the employment share, and the share of employees that are secretaries, clerical workers, women, black women, female secretaries, female clerks, married women and women with children.

Appendix Figure 22: Reduced Form Results, Additional Controls



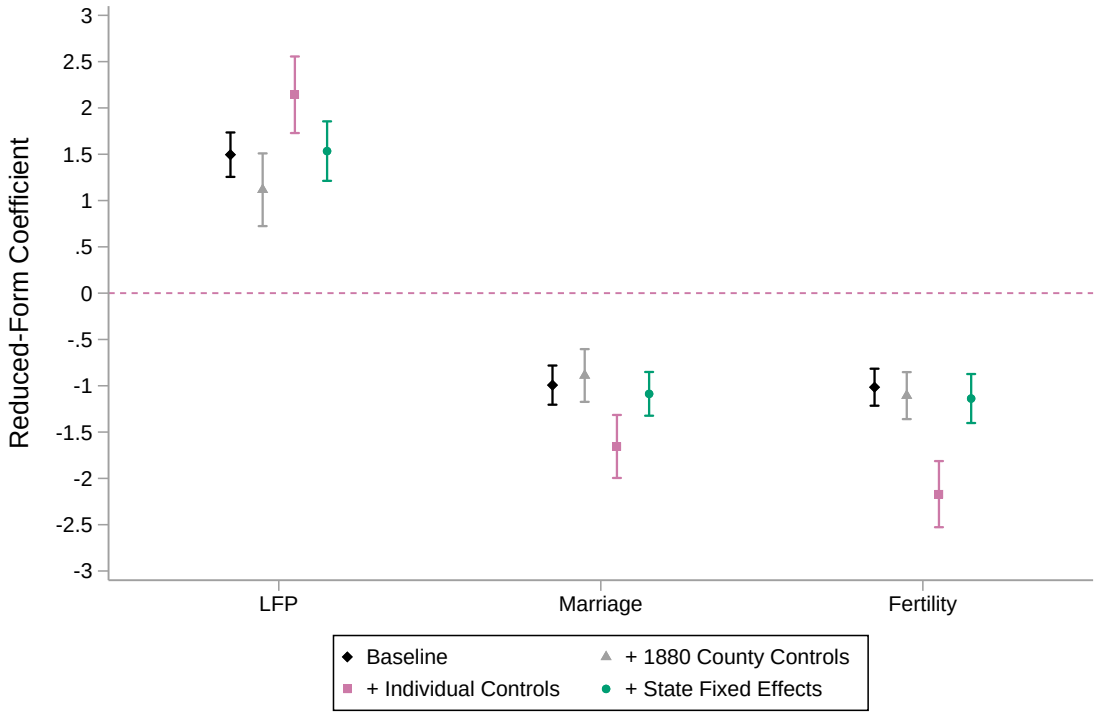
Notes: This figure plots Figure 6 but using additional 1880 county level controls. The new set of 1880 county controls include the share of women in the labor force, the share of women married, share of women with children, share of women, share of secretarial workers, and share of clerical workers. Rest of the notes follow from Figure 6.

Appendix Figure 23: Reduced Form Results, Controlling for Black Share of Population



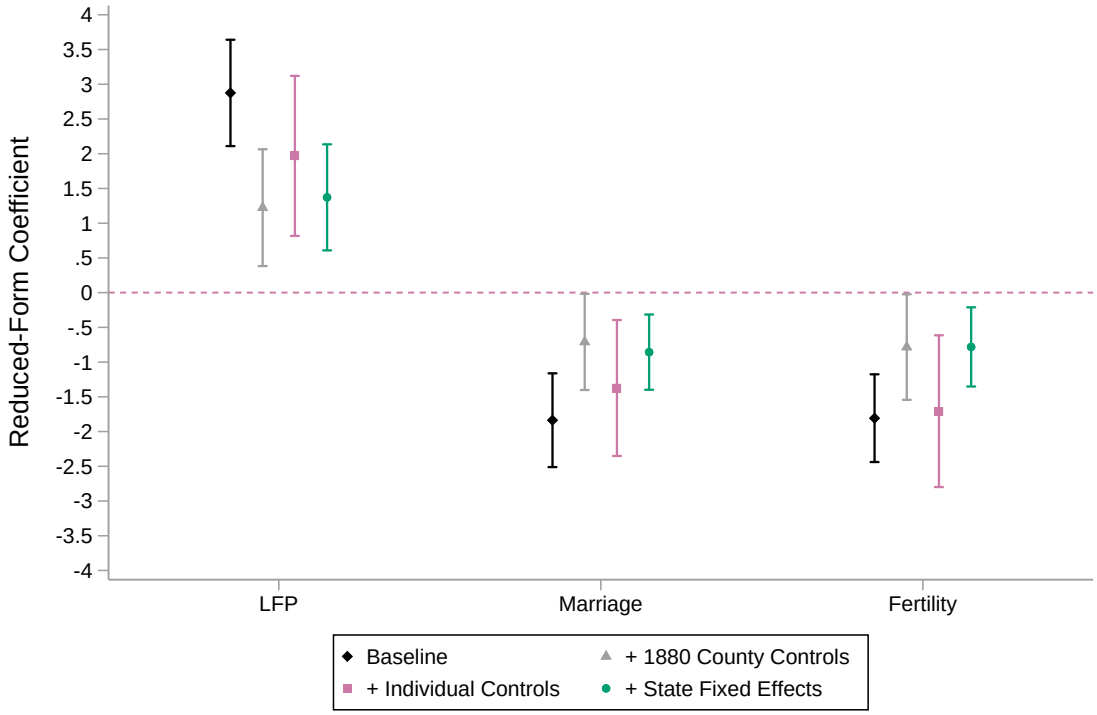
Notes: This figure plots Figure 6 but using an additional 1880 county level control for the share of black population. Rest of the notes follow from Figure 6.

Appendix Figure 24: Reduced Form Results, Controlling for 1880-1920 Change in Black Share of Population



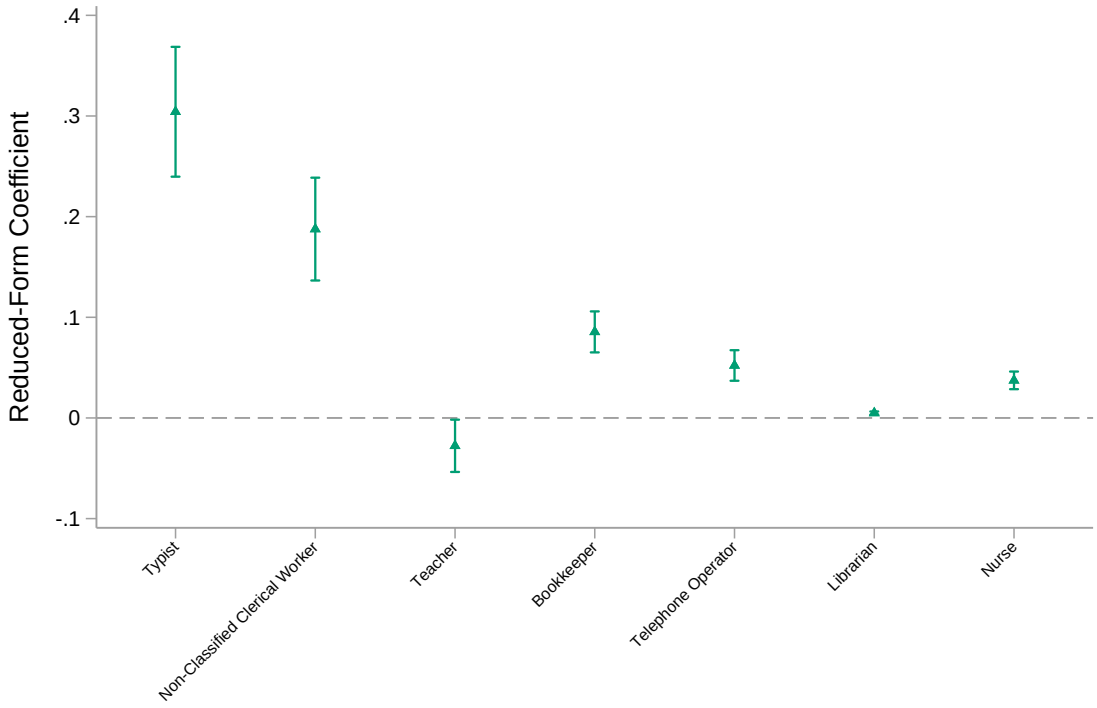
Notes: This figure plots Figure 6 but using an additional county level control for 1880 to 1920 change in the share of black population. Rest of the notes follow from Figure 6.

Appendix Figure 25: Reduced Form Effects Using Shifts from Canadian Censuses



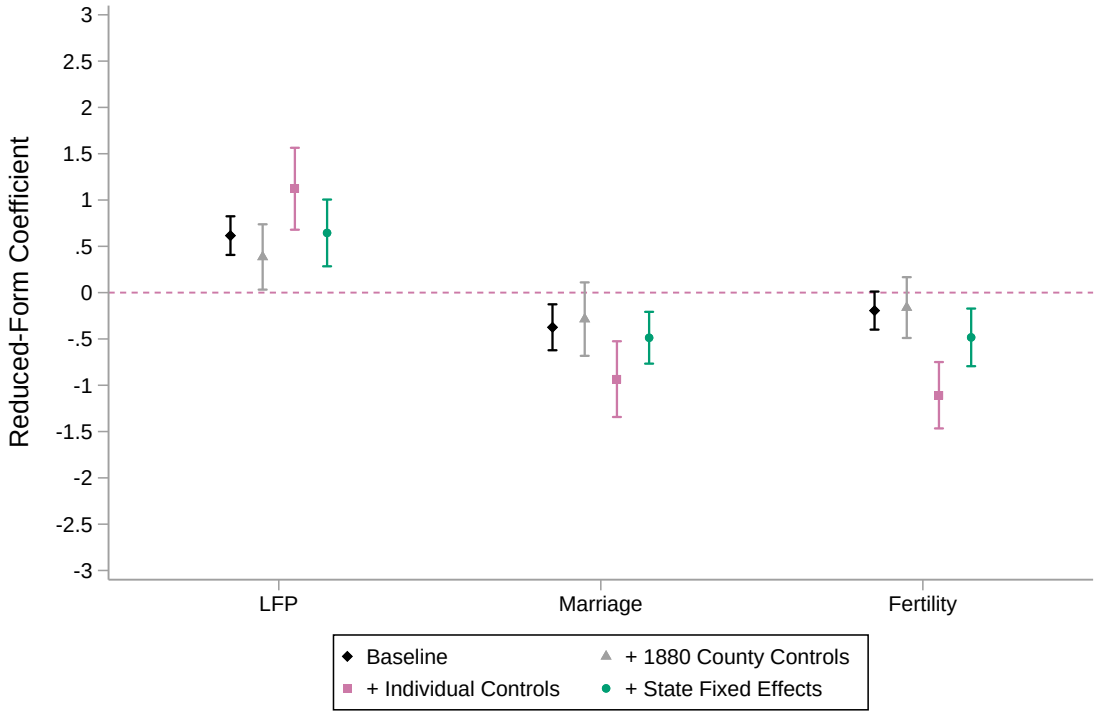
Notes: This figure plots the reduced-form effect of the alternative instrument which uses shifts constructed from the 1891 and 1911 Canadian censuses. The rest follows from Figure 6 notes. Construction of this alternative instrument is presented in Appendix Section B.5.

Appendix Figure 26: Reduced Form Effect on Working in Alternative White-Collar Occupations



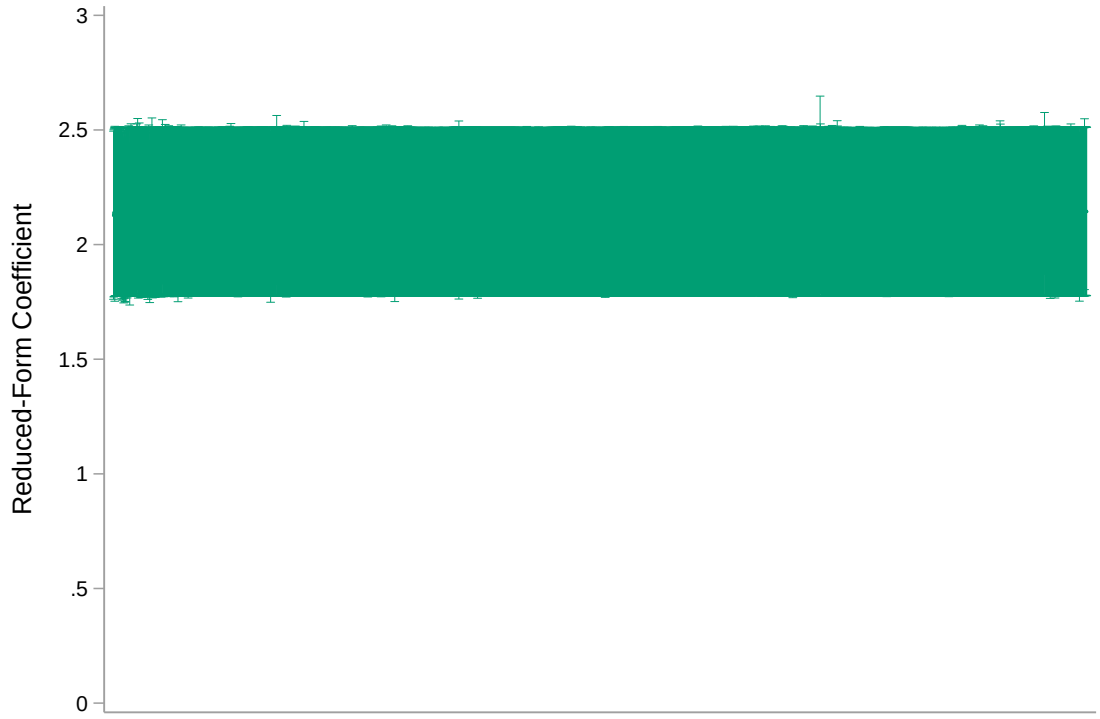
Notes: This figure plots the reduced-form effect of instrument on indicator variables for being employed in each of the white-collar occupations on the x-axis. All regressions include 1880 county controls, 1920 individual controls and state fixed effects. See notes to Figure 6 for further details.

Appendix Figure 27: Reduced Form Effects, Only Urban Counties



Notes: This figure plots Figure 6, restricting the sample to only urban counties for the analysis. Urban is defined using the *urban* variable from IPUMS.

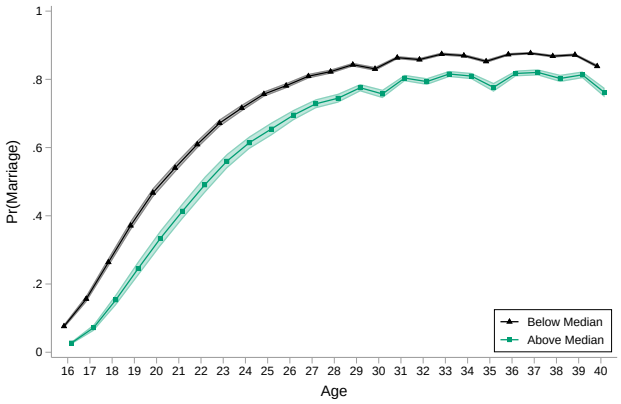
Appendix Figure 28: Reduced Form Effect on Women's Labor Force Participation, Leave-One-Out Exercise



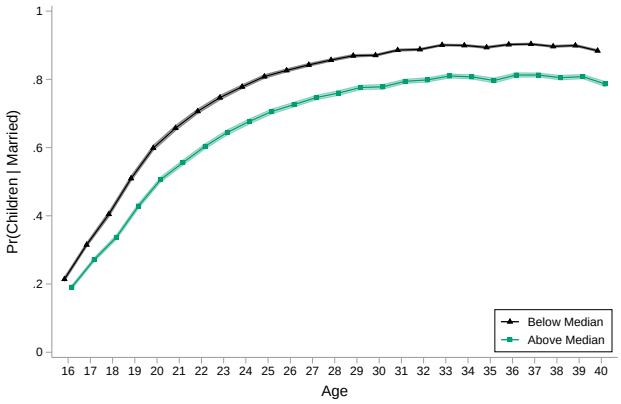
Notes: This figure plots the estimates from running the reduced form regression on women's labor force participation while leaving one county out of the sample for each regression. In total these are estimates from 2,457 regressions corresponding to the number of counties in the sample for analysis

Appendix Figure 29: Probability of Marriage & Children by Age

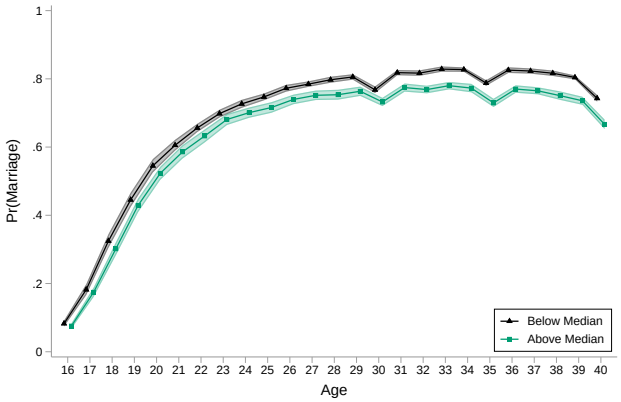
Panel A: Pr(Marriage) – White Women



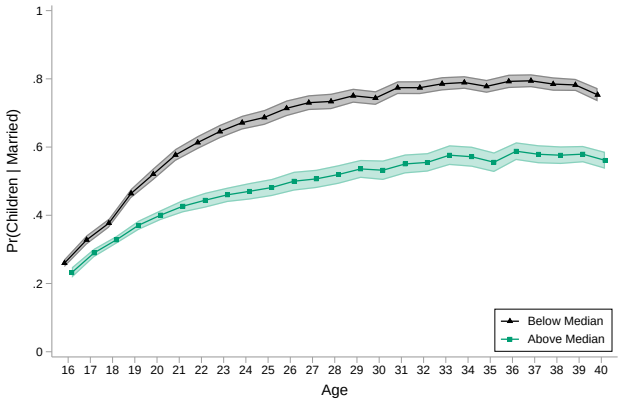
Panel B: Pr(Children | Marriage) – White Women



Panel C: Pr(Marriage) – Black Women



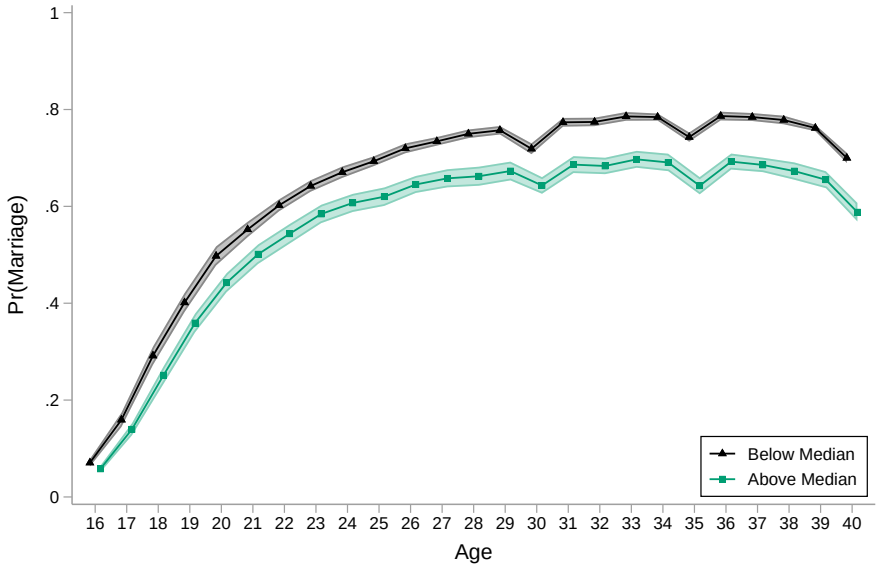
Panel D: Pr(Children | Marriage) – Black Women



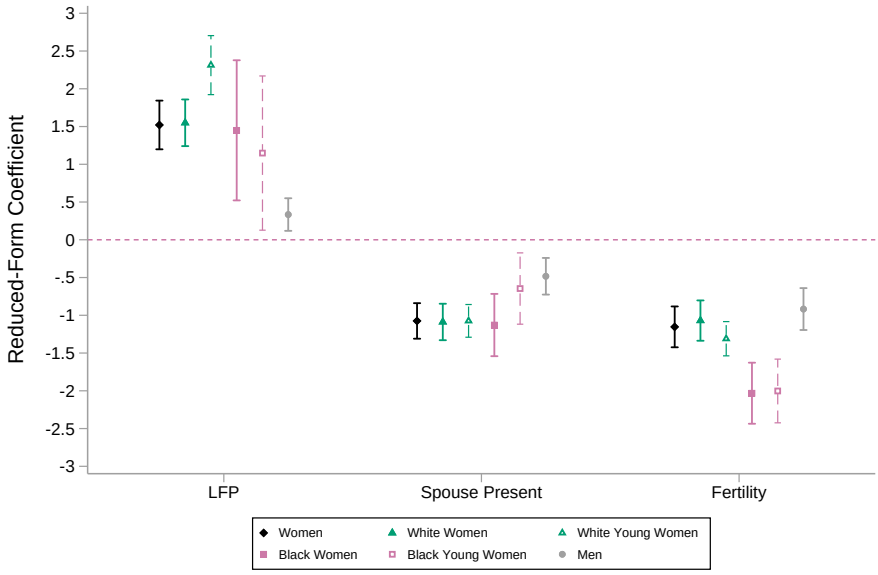
Notes: This figure reports the probability of being married and having children, conditional on being married, for White and Black women at various ages who are residing in counties with above vs below median predicted change in typists in 1920. Panel A reports the probability of being married for White women in each age group and Panel B reports the probability of having children conditional on being married. Panels C and D report these probabilities for Black women. Appendix Section C.3 provides details of the specification used to obtain coefficients for these plots.

Appendix Figure 30: Using Spouse Present Instead of Marital Status

Panel A: Pr(Spouse Present) – Black Women

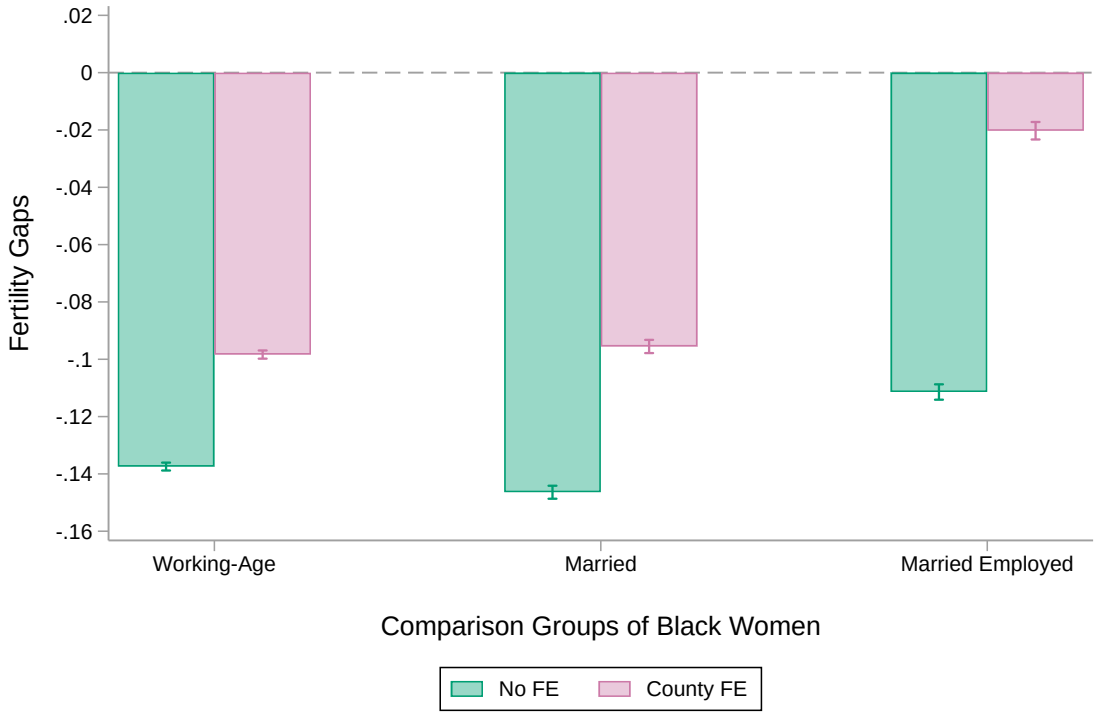


Panel B: Heterogeneity Using Spouse Present



Notes: This figure in Panel A reports the probability of having a spouse present for Black women at various ages who are residing in counties with above vs below median predicted change in typists in 1920. Panel B plots Figure 8 but using an indicator for spouse present.

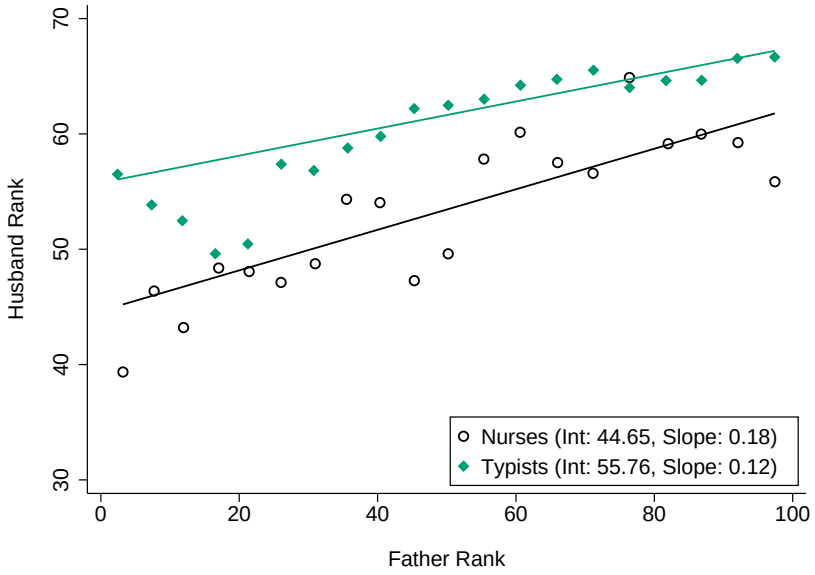
Appendix Figure 31: Fertility Gaps between Black Women Employed in Domestic Services and Other Black Women



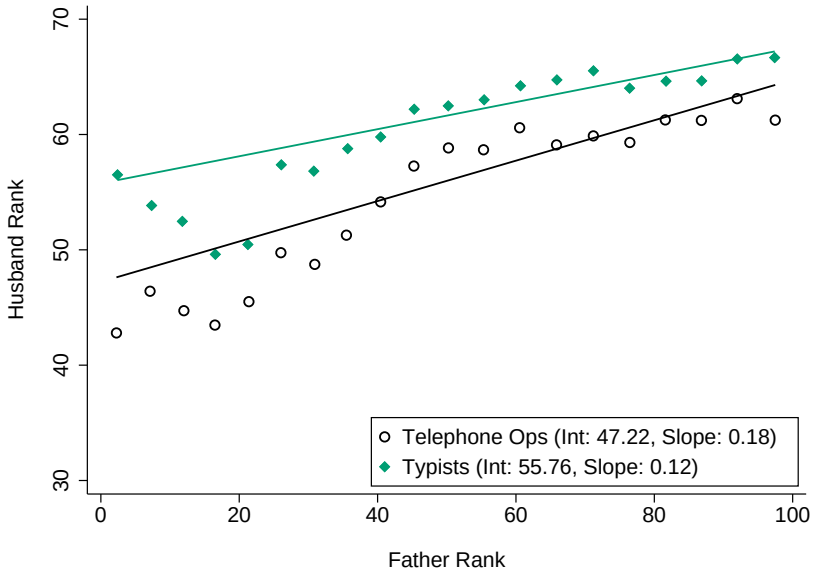
Notes: This figure plots gaps in the likelihood of having children for married Black women employed in domestic services and other Black women who are also of working age (first column), married (second column), and married and employed in other occupations (third column). Bars in pink add county fixed effects.

Appendix Figure 32: Mobility Advantage of Typists Relative to Alternative Occupations

Panel A: Typists vs Nurses in 1920

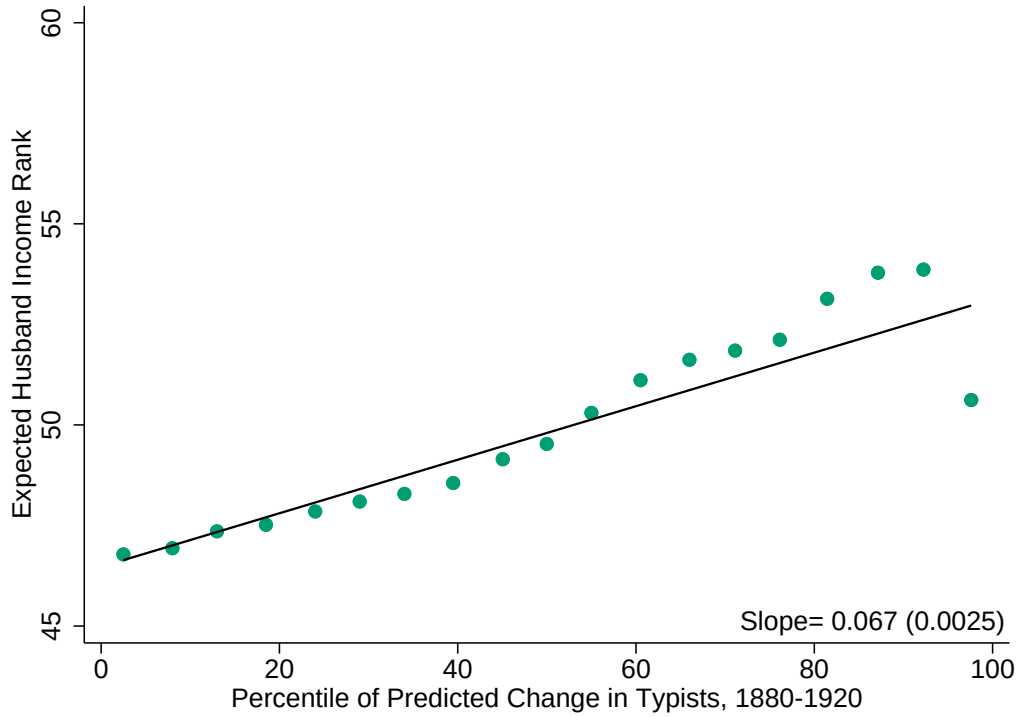


Panel B: Typists vs Telephone Operators in 1920



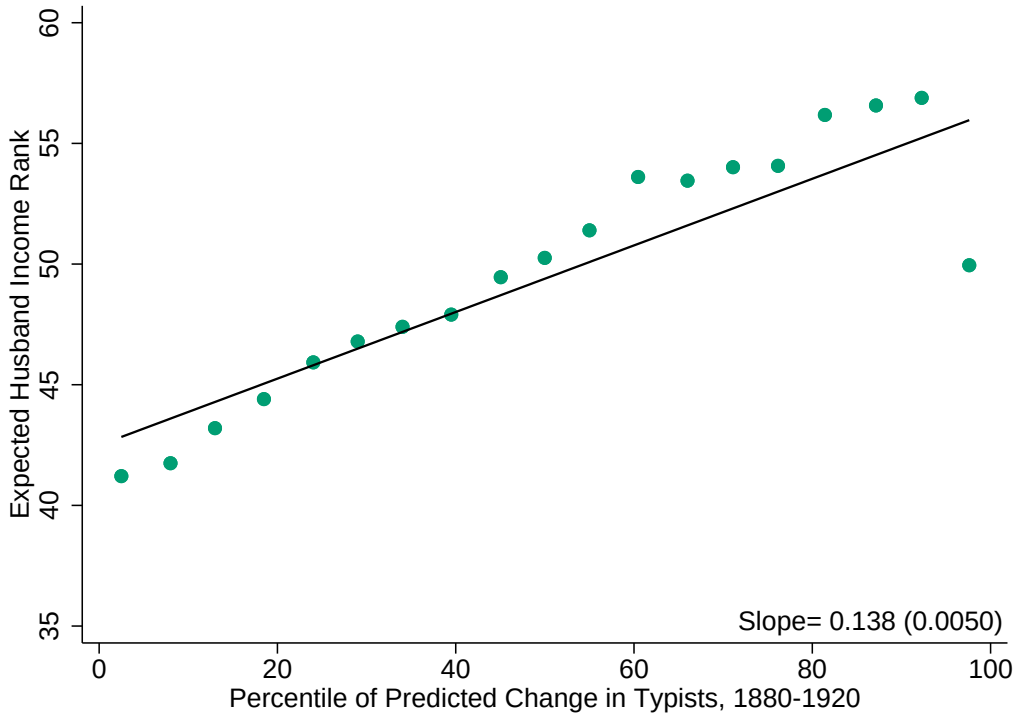
*Notes:*This figure plots Figure 11 Panel C but instead restricting the sample only to typists and nurses (Panel A) and to typists and telephone operators (Panel B).

Appendix Figure 33: Typewriter Exposure and Husband's Expected Income, Using OccScore for Dad



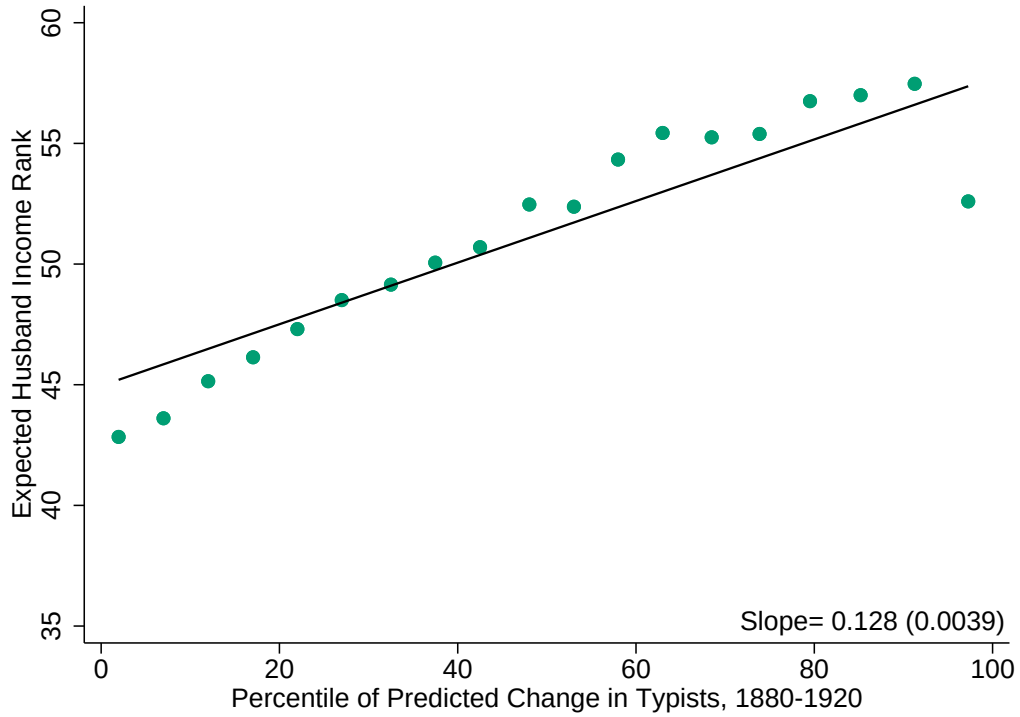
*Notes:*This figure reproduces Figure 12 but using the OccScore measure from IPUMS for father's socioeconomic status instead of the constructed occupation income scores from Abramitzky et al. (2021). The rest of the notes follow from Figure 12.

Appendix Figure 34: Typewriter Exposure and Husband's Expected Income, Using Additional ML Links



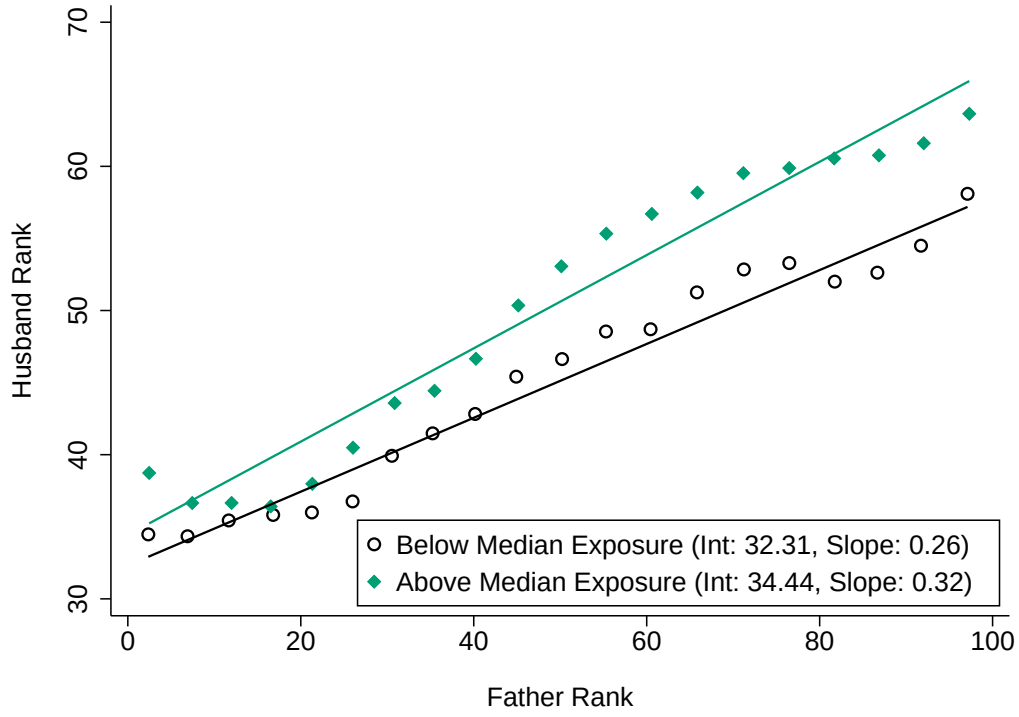
*Notes:*This figure reproduces Figure 12 but using all available links from the Census Tree for my sample of interest, not just genealogical links from the FamilyTree. The rest of the notes follow from Figure 12.

Appendix Figure 35: Typewriter Exposure and Husband's Expected Income, Reweighted Sample



*Notes:*This figure reproduces Figure 12 but using Inverse Probability Weights (IPW) based on observable characteristics to reweight the linked sample to the underlying population of single White women aged 16-30. The rest of the notes follow from Figure 12.

Appendix Figure 36: Typewriter and the Intergenerational Mobility of Women



Notes: This figure plots the mean income rank of husband by father's income rank, for women in counties with above (green diamonds) vs below (black circles) median exposure to the typewriter. Exposure is defined using the 1880 to 1920 predicted change in typists. Regression lines are obtained using an indicator for being in a county with an above median value of the instrument in equation (10). Husbands are assigned percentile ranks relative to all other husbands born in the same birth year. Fathers are ranked relative to all fathers with children born in the same birth year.

A.2 Appendix Tables

Appendix Table 1: Relationship between Mandatory Schooling and Supply of Typists, TWFE

	(1) Female Typists (% of Female Population)	(2) Male Typists (% of Male Population)
Treated*Post1900	0.445	0.0313
	(0.112)	(0.023)
Outcome Mean	0.641	0.130
Observations	188	188
State Fixed Effects	Y	Y
Decade Fixed Effects	Y	Y

Notes: This table reports results from a Two Way Fixed Effects (TWFE) specification that regresses an interaction term, *Treated*Post1900*, on two different outcome variables (represented by each column). States are defined as Treated if they had mandatory schooling laws in place by the end of 1900. All regressions include state and decade fixed effects. Outcome data comes from the 1880, 1900, 1910 and 1920 Censuses. Data on treatment comes from Goldin and Katz (2008). See Appendix Section C.1 for further details of this analysis.

Appendix Table 2: Effect on 1880-1920 Change in Women's Labor Force Participation

	First Stage	OLS	Reduced Form	2SLS
$\widehat{\Delta typ}^{1880-1920}$	1.179		1.239	
	(0.393)		(0.199)	
$\Delta typ^{1880-1920}$		0.0641		1.050
		(0.019)		(0.342)
Outcome Mean	0.0450	0.0804	0.0804	0.0804
Observations	2,447	2,447	2,447	2,447
Baseline Controls	Y	Y	Y	Y
First Stage F-Stat	32.487	32.487	32.487	32.487

Notes: This table reports the coefficients from the first stage regression of the predicted and real change in typists (column 1), OLS regression of real change in typists on the 1880-1920 change in women's labor force participation (column 2), reduced form regression of the predicted change in typists on change in women's labor participation (column 3) and corresponding 2SLS regression (column 4). All variables are constructed at the county level and regressions are weighted by the share of working age women in a county in 1880. All regressions include baseline county level controls.

Appendix Table 3: Test of Pre-Trends —
Reduced-Form Effect on Pre-Period Women's Labor Force Participation

	1870 LFP	1880 LFP	$\Delta LFP^{1870-1880}$
$\widehat{\Delta typ}^{1880-1920}$	-0.795	-0.413	0.0898
	(0.301)	(0.304)	(0.133)
Outcome Mean	0.151	0.169	0.0212
Observations	2229	2447	2229
Baseline County Controls	Y	Y	Y

Notes: This table reports the effect of the instrument, the 1880-1920 predicted change in typists, on lagged women's labor force participation. The regression sample is restricted to working age women. The outcome variable in first two columns is the share of working age women in 1870 and 1880 in a county that are participating the labor force. Baseline controls include the share of county working age population that is women, and the share of workers employed in clerical and secretarial occupations in 1880. The third column uses the 1870 to 1880 change in women's labor force participation at the county level as the outcome.

Appendix Table 4: Effect of Typewriter on Women's LFP, Marriage and Fertility, Using SEA as Geography

	LFP	LFP	Married	Married	Fertility	Fertility
Panel A: First Stage						
$\widehat{\Delta typ}^{1880-1920}$	0.953***	0.896**	0.953***	0.896**	0.953***	0.896**
	(0.354)	(0.357)	(0.354)	(0.357)	(0.354)	(0.357)
F-stat	16.79	11.45	16.79	11.45	16.79	11.45
Panel B: OLS						
$\Delta typ^{1880-1920}$	0.0852***	0.102***	-0.0425**	-0.0676**	-0.0711***	-0.106***
	(0.020)	(0.027)	(0.020)	(0.027)	(0.024)	(0.033)
Panel C: Reduced Form						
$\widehat{\Delta typ}^{1880-1920}$	$\widehat{\Delta typ}^{1880-1920}$	0.792***	1.445***	-0.537***	-1.082***	-0.506***
-1.261***						
	(0.205)	(0.338)	(0.150)	(0.272)	(0.173)	(0.336)
Panel D: 2SLS						
$\Delta typ^{1880-1920}$	0.830***	1.614***	-0.564***	-1.208***	-0.531***	-1.408***
	(0.295)	(0.569)	(0.198)	(0.427)	(0.192)	(0.484)
Outcome Mean	0.261	0.261	0.618	0.618	0.534	0.534
Observations	31,180,910	31,180,910	31,180,910	31,180,910	31,180,910	31,180,910
Baseline Controls	Y	Y	Y	Y	Y	Y
Individual Controls	N	Y	N	Y	N	Y

Notes: This table reports coefficients corresponding to running regressions using State Economic Areas (SEA) as the main level of geography instead of counties. Specifically it reports coefficients from the first stage regression of the predicted and real change in typists (Panel A), OLS regressions using real change in typists (Panel B), reduced form regression of the predicted change in typists on outcomes (Panel C) and corresponding 2SLS regression (Panel D). Panel C represents coefficients reported in Figure 6 (in gray and pink). All regressions include 1880 SEA level controls. In addition, Columns 2, 4 and 6 include individual controls.

Appendix Table 5: Effect of Typewriter on Women's LFP, Marriage and Fertility, Not Using Any County Boundary Harmonization

	LFP	LFP	Married	Married	Fertility	Fertility
Panel A: First Stage						
$\widehat{\Delta typ}^{1880-1920}$	2.291**	2.306**	2.291**	2.306**	2.291**	2.306**
	(0.902)	(0.914)	(0.902)	(0.914)	(0.902)	(0.914)
F-stat	21.18	14.65	21.18	14.65	21.18	14.65
Panel B: OLS						
$\Delta typ^{1880-1920}$	0.0681***	0.0781***	-0.0278	-0.0449*	-0.0555**	-0.0791***
	(0.014)	(0.017)	(0.020)	(0.025)	(0.023)	(0.030)
Panel C: Reduced Form						
$\widehat{\Delta typ}^{1880-1920}$	1.146***	2.181***	-0.889***	-1.658***	-1.112***	-2.183***
	(0.158)	(0.193)	(0.135)	(0.156)	(0.126)	(0.168)
Panel D: 2SLS						
$\Delta typ^{1880-1920}$	0.500**	0.946**	-0.388**	-0.719**	-0.485***	-0.947**
	(0.195)	(0.377)	(0.161)	(0.291)	(0.186)	(0.370)
Outcome Mean	0.261	0.261	0.618	0.618	0.534	0.534
Observations	29,372,733	29,372,733	29,372,733	29,372,733	29,372,733	29,372,733
Baseline Controls	Y	Y	Y	Y	Y	Y
Individual Controls	N	Y	N	Y	N	Y

Notes: This table reports coefficients corresponding to running regressions using non-harmonized county boundaries. This implies that counties are matched over time without any reweighting based on changing populations. Specifically it reports coefficients from the first stage regression of the predicted and real change in typists (Panel A), OLS regressions using real change in typists (Panel B), reduced form regression of the predicted change in typists on outcomes (Panel C) and corresponding 2SLS regression (Panel D). Panel C represents coefficients reported in Figure 6 (in gray and pink). All regressions include 1880 county level controls. In addition, Columns 2, 4 and 6 include individual controls.

B Data Construction

B.1 1880 US Census Data WLFP Correction

Throughout the analysis of the paper, I rely on historical US census data from 1870 to 1940 (Ruggles et al., 2021). Specifically, I access these data using the NBER computing system. These data are improved over time (e.g. adding more observations, adding new variables, cleaning pre-existing variables) and each update is assigned a version. The analysis of this paper uses the most recent version of the data available at the time: v2022. However, during the analysis of the paper, I came across an error in the coding of women's labor force participation in 1880 in the versions of the data after v2019. I delineate this error and correction below.

Specifically, this error miscodes approximately 1 million women in the 1880 census from *occ1950* code 980 (Keeping House) to code 290 (Managers, officials, and proprietors (n.e.c.). This error then also affects the *labforce* and possibly the *ind1950* variables. This error was also confirmed by IPUMS but a corrected version was not released by the time of the analysis of this paper. Due to this error, women's labor force participation in 1880 appears to be artificially higher than it should be. Supplementary Figure 1 Panel A plots true women's labor force participation using the 1880 v2019 data and Panel B instead uses the v2022 data. Panel B, green line shows that women's labor force participation in 1880 is much higher than it was in reality due to the error. Notice that other variables needed to construct the share of women who are married or with children are not affected (black and pink lines in the figure).

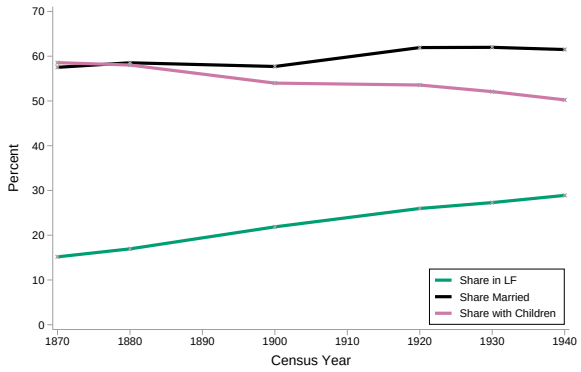
To correct for this error but to consistently use the most up-to-date version of the census data, I use occupation related, industry and labor force variables from the v2019 version of the 1880 census data. Specifically, only for the 1880 census, I merge in corrected variables from v2019 version of the data into the v2022 version of the data. Code to implement this is provided in the replication package.

B.2 Women's Christian Association Data, 1857-1880

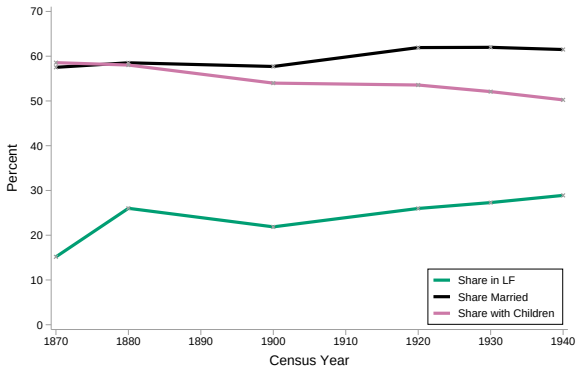
The Women's Christian Association (WCA) data are hand-collected by the author from WCA national conference proceedings and other association publications. Specifically, information contained in the association publications are used to construct a dataset of WCA chapters,

Supplementary Figure 1: 1880 Women's Labor Force Participation Error

Panel A: v2019 data



Panel B: v2020-v2022 data

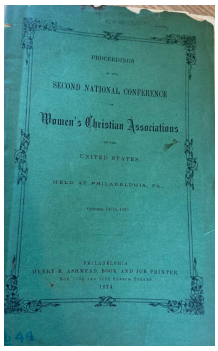


Notes: This figure plots Appendix Figure 1 using v2019 (Panel A) of the census data and then v2020-v2022 (Panel B) of the census data, where v2019 is free of the miscoding error that incorrectly inflates women's lfp rates in 1880. This error is present in v2020-v2022 of the 1880 data. Women's labor force participation is plotted using the labforce variable. The picture is the same if instead the *occ1950* variable is used to construct the share of women in occupations for pay.

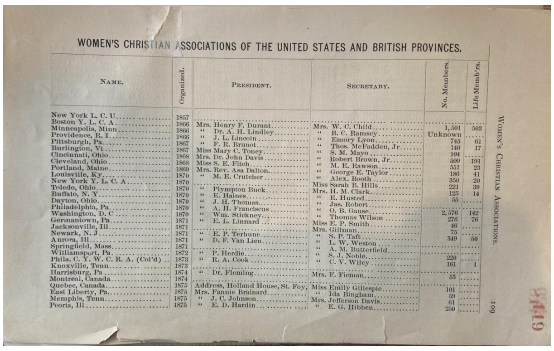
including YWCA and other smaller local women's organizations that were affiliated with the WCA. Supplementary Figure 2 shows examples of the kinds of publications used to construct the database. The resulting dataset contains the decade that a county first has a WCA chapter present.

Supplementary Figure 2: WCA Data Sources

Panel A: National Conference Proceedings



Panel B: Statistical Tables



Notes: This figure depicts examples of data sources used to construct the WCA database.

B.3 State Level Compulsory Education Data

I access data on state level compulsory education from Goldin and Katz (2008) kindly provided on Claudia Goldin's webpage: https://goldin.scholars.harvard.edu/pages/data. I follow the instructions found in the associated data files to combine data from 1910-1939 with

additional data from 1900-1909. Using the 1900-1909 file allows me to have a treatment variable at the state level that indicates which states had schooling laws by the end of 1900. I count those that have schooling laws by 1900 as treated.

I then combine the state level schooling data with state level census data from 1880-1920 which contains information on the share of male and female typists. Combining the two datasets results in a balanced panel of states that I can then run the schooling laws analysis on used in Section 2.3.

B.4 Linked Data

I access linked data following men and women from the 1920 Census to the 1940 Census from the Census Tree website (https://www.censustree.org/). These links are based on the methods described in Buckles et al. (2023). Specifically, from these data the main analysis only uses genealogical links that come directly from the FamilySearch Family Tree and are labeled in the dataset as $family\_tree = 1$. I also show robustness of the main result to using the additional links provided.

Using the *histid* variables from each of the census years, I merge in individuals' information from the 1920 and 1940 Censuses. Using information on race, sex, age, marital status, and father and spouse's locations in the household, I construct the sample for analysis which is restricted to White women who are single, aged 16-30, and observed as living with their father in 1920. They are further restricted to being married and living with their spouse in 1940. The main sample of linked women then consists of 903,150 White women.

B.5 Using Canadian Census Data to Construct Alternative Instrument

The paper uses an alternative instrument constructed using shifts from Canadian census data. Specifically, the alternative instrument is depicted by the following:

$$\Delta\widehat{typ}_c^{'} = \sum_{k=1}^{K} s_{kc}^{1880} \; g_k^{'} \tag{1}$$

where, $(g_1^{'}, ..., g_K^{'})$ represent a set of shifts to industries k (common to all counties c) and are captured as the *national* 1891 to 1911 change in the number of typists relative to initial industry

employment for Canadian sectors:

$$g_k^{'} = \frac{typ_k^{1911} - typ_k^{1891}}{emp_k^{1891}} \tag{2}$$

and, $(s_{c1}^{1880}, ...s_{cK}^{1880})$ represent the set of pre-period *shares* from the US Census and are as in the original instrument.

To construct the alternative shifts, $g_k^{'}$, I obtain samples of the Canadian 1891 and 1911 censuses from Ruggles et al. (2025). Specifically 1891 is a 9% sample and 1911 a 5% sample. I use variables on occupation, industry and person weights to construct the alternative shifts. The occupation and industry variables (*occ95us* and *ind95us*) are already mapped to industries and occupations in the US historical censuses. I then interact these shifts with pre-period 1880 shares from the US, s_{kc}^{1880}.

C Additional Analyses

C.1 Education Analysis

Here, I describe the two-way fixed effects (TWFE) specification underlying Appendix Table 1 which depicts the relationship between adoption of mandatory schooling by states and the supply of female typists. The specification is as follows:

$$y_{st} = \alpha + \beta \cdot \mathbb{1}(Treated)_s \cdot \mathbb{1}(\text{Post-1900})_t + \delta_s + \gamma_t + \varepsilon_{st}$$

where, y_{st} represents the share of male or female typists in a state and decade, $\mathbb{1}(Treated)_s$ is equal to 1 if a state adopted mandatory schooling by the end of 1900, $\mathbb{1}(\text{Post-1900})_t$ is equal to 1 if the decade is 1900 or greater, and δ_s and γ_t represent state and decade fixed effects respectively. The estimate of β then captures the relationship between early adoption of mandatory schooling and the outcomes. These estimates are reported in Appendix Table 1.

C.2 Back-of-the-Envelope Computation

In this section, I describe the back-of-the-envelope computation used in Section 5.1 to assess the contribution of the typewriter to women's labor force participation, marriage and fertility rates in 1920. I walk through this computation using the example of women's labor force participation as the outcome:

$$\begin{aligned}
\frac{WomInLF_c^{1920}}{WomPop_c^{1920}} &= \alpha + \beta \Delta \widehat{typ}_c^{1880-1920} + \Gamma X_c^{1880} + \epsilon_c \\
\frac{WomInLF_c^{1920}}{WomPop_c^{1920}} - \beta \Delta \widehat{typ}_c^{1880-1920} &= \alpha + \Gamma X_c^{1880} + \epsilon_c \\
\frac{\sum_c WomInLF_c^{1920} - WomPop_c^{1920} \beta \Delta \widehat{typ}_c^{1880-1920}}{\sum_c WomPop_c^{1920}} &= \alpha + \Gamma X_c^{1880} + \epsilon_c
\end{aligned}$$

where, we first begin with the county level reduced form regression of the instrument, the 1880-1920 predicted change in typists, on the share of women in the labor force in 1920. This regression also includes baseline county level controls for the share of women in 1880 and the share of workers employed in clerical and secretarial occupations in 1880. The estimates of β obtained from running this regression can be found in Table 2 column 1 (Panel C). The corresponding coefficients for marriage and fertility rates can be found under columns 3 and 5.

Next, we subtract $\beta \Delta \widehat{typ}_c^{1880-1920}$ from the share of women in the labor force in 1920 and simplify to obtain the expression on the left hand side of the last equation. Computing this expression results in the rates without typewriter adoption plotted in the green bars in Figure 7. Then, subtracting the green bars from the gray bars (real rates) results in the pink bars.

It should be noted that this back-of-the-envelope calculation is a partial equilibrium explanation. Specifically, it relies on the assumption that when the channel of typewriter adoption is shut down, by subtracting $\beta \Delta \widehat{typ}_c^{1880-1920}$, the underlying population of working age women in 1920 does not enter the labor force.

C.3 Probability of Marriage and Having Children by Age Analysis

Here, I outline the specification underlying Appendix Figure 27. This figure computed the probability of being married (Panels A and C) and having children (conditional on being married, Panels B and D) for White and Black women in each age group. I run the following linear probability model for women in each age group:

$$Y_{ic} = \alpha + \beta IV_c^{AboveMedian} + \epsilon_{ic}$$

where, Y_{ic} is an indicator for whether the woman of a particular age in a locality is married in 1920 or has children conditional on being married. $IV^{AboveMedian}$ is an indicator for whether individual is in a county that has an above median value of the instrument, the 1880-1920 predicted change in typists. Estimates of α are the plotted in black for women counties that have below median exposure and estimates of $\alpha + \beta$ are plotted in green for women in counties that have above median exposure.

Appendix References

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