The Nobel Journey of an Economics Detective:

Finding Gold in Gender Data

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Abstract

On October 9, 2023, Claudia Goldin received the Nobel Prize in Economics for her detective-like research on women's labor market outcomes. Her meticulous analysis of data and surveys uncovered critical insights to explain gender differences in labor force participation, earnings gaps, and educational attainment. She has dramatically advanced our understanding of gender inequality.

1 Introduction

> *I have always wanted to be a detective and have finally succeeded*

– Claudia Goldin (1998)

On October 9, 2023, the Royal Swedish Academy of Sciences has awarded the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel to Claudia Goldin "for having advanced our understanding of women's labor market outcomes." Three aspects

of this announcement are particularly noteworthy. First, Goldin is only the third woman to receive the Nobel Prize in economics, and notably, the first to be the sole recipient in a given year. Second, although her work on gender is highly acclaimed and is the main focus of this review, Goldin has also made important contributions to the fields of economic inequality, education, and economic history, among others. Finally, it's unusual for the prize to go to a detective!

Goldin's detective work originally began in . . . bacteriology as a high school junior. Then, as an undergraduate at Cornell University, she encountered Alfred E. Kahn, who introduced her to economics and the field of regulation. After her bachelor's degree in 1967, she moved to the University of Chicago to study industrial organization. She soon realized, however, that she wanted to combine her passion for history with economics. This realization led her to become an economic historian, writing a dissertation on the role of slavery in the American South under the supervision of Nobel laureate Robert Fogel. In the 1970s, the rise of social history brought attention to the family, and Goldin found that wives and mothers were often neglected due to a lack of data and information. Determined to fill this gap, she conducted extensive research that culminated in her seminal work, *Understanding the Gender Gap* (Goldin, 1990). The year of the book's publication, 1990, coincided with her appointment to Harvard University, where she became the first woman to receive tenure in the economics department.[1]

Two major themes in Goldin's research on gender are the progression of women's labor force participation and the evolution of the gender gap in earnings.

Goldin (1990) explores the impact of economic progress on women's economic status in the U.S., arguing that it has significantly reduced gender inequality. To demonstrate women's progress, Goldin uses a vast amount of information and data, including previously overlooked micro-level datasets from historical archives. Although many of her findings were consistent with existing beliefs, she also made significant contributions, which are outlined in this review.

Her research substantiates the widely held belief that prior to World War II, over 80% of married women exited the labor force at the time of marriage, and most did not return. Despite a small percentage of women who continued to work after marriage and accumulated high levels of work experience, the overall average experience of women did not increase significantly, even after World War II. This stability in work experience

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[1]She is also the first female economist to be offered or to achieve tenure at the University of Pennsylvania and Princeton University. 'Pas mal !', as the French would say.

contributed to the persistence of the gender pay gap. However, by the 1980s, women's experience levels began to rise relative to men's, narrowing the gender pay gap.

Taking a longer historical perspective, Goldin demonstrates that the earnings gap narrowed during the Industrial Revolution. Women's opportunities in manufacturing and clerical work increased alongside educational attainment until the 1930s. During this period, Goldin presents evidence of a substantial gap that cannot be explained by conventional productivity differences such as work experience, education, and tenure. This residual gender pay gap, called "wage discrimination," has in fact increased, partly due to the ambivalent role of economic progress in women's advancement. The shift from manufacturing to white-collar jobs was accompanied by an increase in gender discrimination, with women being confined to entry-level positions and excluded from jobs with long ladders of advancement.

The 1990 book lays the foundation for her subsequent research in gender studies. Goldin (1995) further explores the relationship between economic development and gender equality. As economies develop, women's labor force participation follows a U-shaped pattern. Initially, women's participation in low-income and agriculture-dominated societies is high. Women work as laborers on family farms. Then participation declines as income rises. This income effect comes with increased home production and social norms. Men perceive a stigma if their wives have to work. Ultimately, female labor participation increases as women's relative wages rise and barriers to employment fall. Indeed, as women's education improves and the value of their time in the market increases, they re-enter the paid labor force, moving along the rising part of a U-shaped curve. The substitution effect intensifies and dominates the income effect, reversing the previous trend. This implies that as women's wages rise, they work more hours. The growth in female wages is driven by a shift toward the service sector and higher levels of female education.

The expansion of female education is also a key topic in Goldin's research. Historically, male enrollment in secondary schools in the U.S. has often been *lower* than female enrollment. This trend is exemplified by the extraordinary early mass expansion of secondary education in the U.S. during the early twentieth century (Goldin and Katz, 2008). In contrast, male enrollment in college has historically been *higher* than female enrollment but the discrepancy has declined steadily since 1950. By 1980, female college enrollment had surpassed that of males, with a continuous increase ever since (Goldin et al., 2006).

In essence, Goldin's research addresses a number of central themes related to gender

differences in education, labor participation, earnings, and social norms. The following four sections provide a more detailed examination of these themes.

The first two sections are part of her search for a *descriptive* and analytical 'truth.' The identification of what she calls the 'Quiet Revolution' (see Section 2) illustrates her detective work, as does her analysis of the role of temporal flexibility in the last chapter of the great gender convergence phenomenon (see Section 3).[2] Her detective approach follows an iterative process of moving back and forth between evidence and theory, ensuring that conclusions are based on robust and consistent data analysis. The first step is to collect and provide solid data clues through the analysis of surveys and administrative data. Once these data clues have been established, it is essential to take a step back and consider which general framework or theory is the most appropriate fit. The final step is to verify that the evidence supports the proposed theory. In these two sections, I have endeavored to showcase her detective approach, which combines data and theory. The weight of the evidence is very persuasive. However, one limitation is the lack of strong identification strategies, which could result in the temporal flexibility or change in women's roles that defines the quiet revolution being confounded by other factors.

The final two sections represent Goldin's pursuit of a more *causal* and analytical 'truth.' Each section reviews a seminal paper that employs a clear identification strategy. Section 4 starts with simple facts: After 1970, the number of college-educated women in the U.S. rose significantly, as did the age of first marriage. Goldin and Katz (2002) link these changes to the spread of the birth control pill among young and unmarried women. Law changes in the late 1960s made the pill more accessible in some states. Using a difference-in-differences approach, they show that the pill lowered the costs for women of pursuing long-term professional education and postponed marriage. This, in turn, enhanced the feasibility and desirability of pursuing careers that require significant upfront investment, such as law and medicine. Section 5 examines a change in the audition procedures of symphony orchestras to study sex-biased hiring. Goldin and Rouse (2000) exploit a natural experiment in which orchestras began using screens to conceal candidates' identities during auditions. The results demonstrate a substantial increase in the likelihood of women

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[2]In response to the question posed by Steven Dubner in a Freaknomics Radio Episode "What do you mean by [the great gender convergence]?" Claudia Goldin answered: "I'm very much interested in converging roles having to do with the productive capacities of men and women. So that would be their education, their professional degrees, their life-cycle labor-force participation – meaning how many years have they been productive members of the workforce. And so, there are converging roles in these arenas and they have meant that men and women are significantly more alike in terms of how firms and employers would look at them and how they look at themselves."

advancing out of preliminary rounds and being selected in the final round.

> *Come, Watson, come! [...] The game is afoot.*
– Sir Arthur Conan Doyle (1904)

2   The Quiet Revolution

Goldin's personal experience with the evolving role of women in the workforce fueled her interest in the historical context of these changes (Goldin, 1998). This prompted her to investigate the reasons of the expansion of the U.S. female labor force at certain times and for certain cohorts. What factors contributed to the increase in the labor force participation (LFP) rate of married women in the U.S. from about 5% to 70% over the course of the century?

2.1   Searching for Data

Goldin initially tracked the growth of the female LFP by compiling extensive data from readily accessible sources. But remember that the eighties were a time before spreadsheets and fast computers. Extending her search back to the 1790s, Goldin produced series of estimates of LFP by age, marital status, race, and ethnicity, as well as series on earnings and work experience.

Her initial assumption was that published census documents would be sufficient, but she soon discovered two problems. First, the most recent data were often inadequate, while older data stored in dusty archives were surprisingly more reliable. This paradox is familiar: digital data can be easily deleted, overwritten, corrupted, or rendered unreadable, whereas information stored in books or on paper is safely preserved in public libraries and national archives. Second, Goldin realized that LFP data alone did not reveal who was participating and for how long. In 1981, she discovered gold in the U.S. National Archives: original surveys of women's retrospective work histories. The surveys provided information on the time spent by women in the labor force and, as Goldin termed it, their "hidden market work"–the unrecorded or underreported work of married women, such as informal jobs, home-based work, and other income-generating activities not reflected in official labor force statistics.

2.2 Searching for Facts

Using the collected data, Goldin shows that the most significant change in labor markets over the past century has been women's increased involvement in the economy. In the U.S., this development unfolded in three gradual phases (1890-1930, 1930-1950, and 1950-1970) followed by a revolutionary phase in the 1970s (Goldin, 2006).

The distinction between evolution and revolution in women's economic roles involves three aspects: "horizon," whether women view their LFP as long-term or intermittent; "identity," whether women derive individuality from their jobs or careers; and "decision making," whether labor force decisions are made jointly with a partner or independently. The transition from evolution to revolution marked a shift to dynamic decision-making with a long-term horizon and identity-driven choices. Women moved from 'jobs' to 'careers,' emphasizing human capital investment and more active participation in household negotiations and the labor market. The shift was universal, affecting women across all educational backgrounds.

Before the 1970s, women's advances in the labor market were due to evolutionary changes, such as changes in the nature of jobs, the abolition of marriage bars that restricted the employment of married women before 1950 (Goldin, 1990, chapter 6), reduced prices of household technologies, and decreased social stigma toward working women.

The quiet revolution began in the 1970s, changing women's career horizons and identities. They saw their mothers holding back their careers as housewives or limiting themselves to teaching or nursing jobs. Women started planning careers and seeing employment as central to their identities. They became active decision-makers about education, careers, and fertility.

2.3 Searching for a Theory

Theories provide focus and structure, preventing data from becoming a chaotic blur. Price theory may explain the increase in the LFP of married women. Following Mincer (1962), Goldin (1990) assumes that the female labor supply function, ℓ_s, can be written as

$$\ell_s = [\tilde{S}Y_m^{-\epsilon}]w^{\eta}, \tag{1}$$

and the labor demand function, ℓ_d, as

$$\ell_d = Dw^{-\delta}, \tag{2}$$

where Y_m is family income (excluding the wife's income), w is the wife's earnings, $\tilde{S}$ includes all labor supply factors except Y_m and w, D includes all demand factors except w, ϵ is the income elasticity, η is the (uncompensated) wage elasticity of supply, and δ is the elasticity of demand. The female LFP rate, ℓ, is the dependent variable for both supply and demand equations, reflecting that a 10% increase in married women raises labor supply and demand by 10%. Taking logs and totally differentiating yields

$$\ell_s^* = S^* + \eta w^*, \tag{3}$$

for the rate-of-change supply function, where $S^* = [\tilde{S}^* - \epsilon Y_m^*]$, and

$$\ell_d^* = D^* - \delta w^*, \tag{4}$$

for the rate-of-change demand function, where an asterisk (*) beside a variable denotes $\partial \log_e(\cdot)/\partial t$ (t = time).

When supply equals demand, equations (3) and (4) yield the two familiar reduced forms, again in rate-of-change form:

$$w^* = \frac{-S^*}{\eta + \delta} + \frac{D^*}{\eta + \delta} \tag{5}$$

for the wage, and

$$\ell^* = S^* \frac{\delta}{\eta + \delta} + D^* \frac{\eta}{\eta + \delta} \tag{6}$$

for the LFP rate.

Given a value for the elasticity of demand, δ, there are two equations in two unknowns–the shift terms of the supply and demand equations. The own-substitution (compensated wage) elasticity of supply (η^s) is computed from the Slutsky equation: $\eta = \eta^s - \alpha \cdot \epsilon$, where η is the (uncompensated) wage elasticity of supply, α the wife's full-time income divided by husband's (or family's) actual income, and ϵ the income elasticity.[3]

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[3]The term $\alpha \cdot \epsilon$ is also know as the total income elasticity.

Figure 1: Labor Force Participation Rates for Females and Males by Age and Marital Status: 1890 to 2004
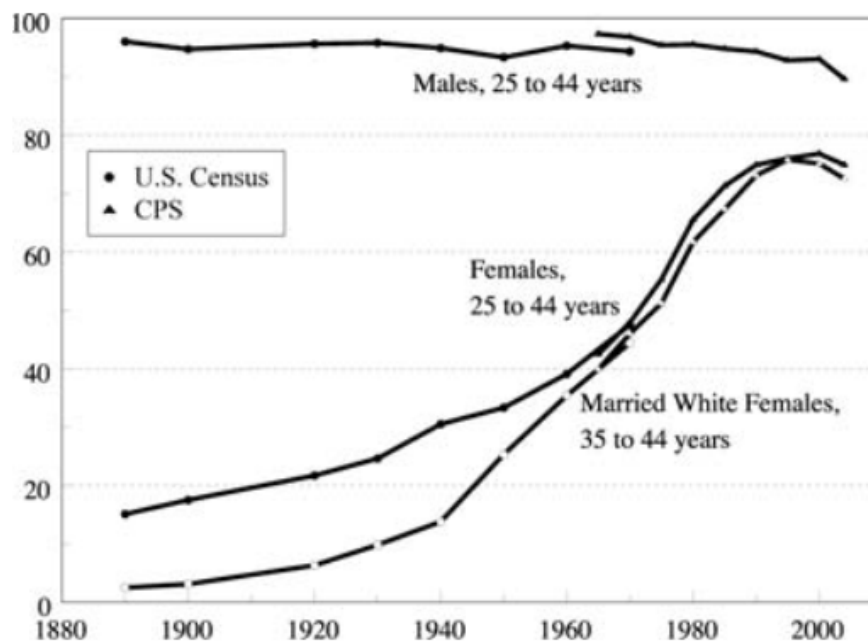
Notes: All races, marital statuses, and education groups are included unless indicated otherwise. Source: Goldin (2006).

Each of the following four phases of women's participation in the economy altered the key parameters of labor supply: the own-substitution (compensated wage) elasticity, η^s, and the income elasticity, ϵ.

2.4   The Four Phases

Phase I (1890-1930)   In 1890, only 19% of women aged 25 to 44 were employed (see Figure 1). Most of the jobs available to women were in manufacturing, as pieceworkers, in agriculture, and in domestic service. These jobs were often characterized by hazardous conditions and long hours. Educational inequalities limited their opportunities, as working women were generally less educated than the average population.

The 19% figure masks considerable heterogeneity, however. Most women left the labor market after marriage because of the social stigma attached to working wives (see Figure 2); it was widely believed that if a woman worked, it implied that her husband

Figure 2: What Percentage of the US Public Approves of Working Wives?
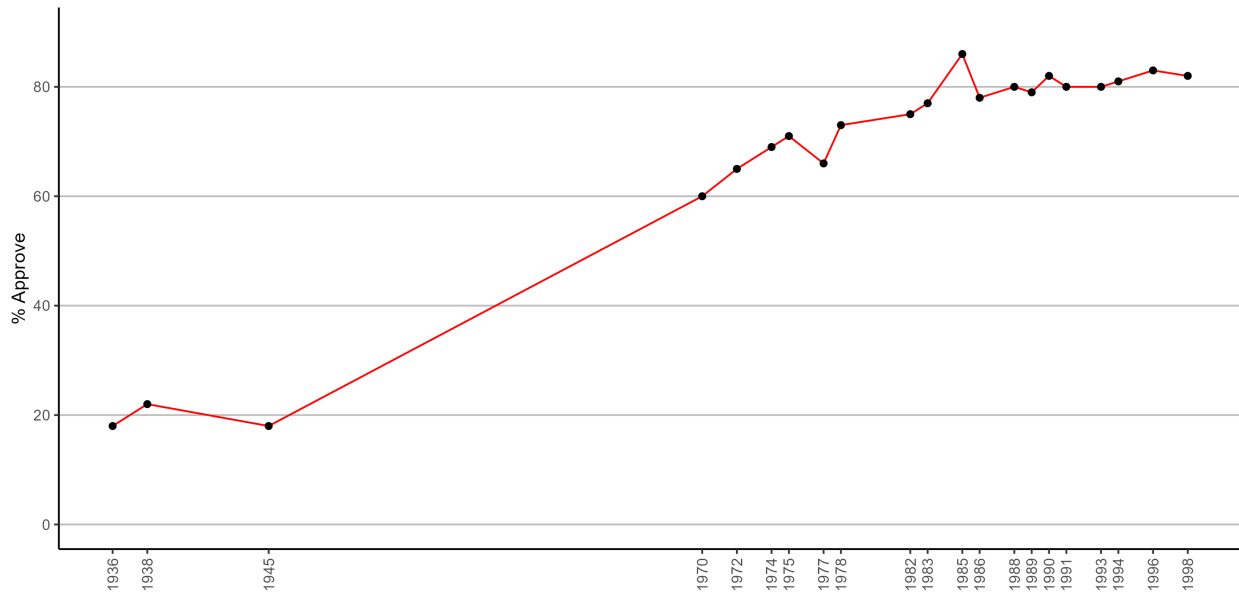
Notes: Percentage of respondents who approve of wives working when asked, "Do you approve or disapprove of a married woman earning money in business or industry if she has a husband capable of supporting her?" Variations of this question, reflecting social norms, were used until 1998. For instance, in 1936, participants were asked, "Should a married woman earn money if she has a husband capable of supporting her?" Source: OWID based on Fogli and Veldkamp (2011) and General Social Surveys.

had failed to provide for the family. Specifically, the LFP of married women was about 5%, with a stark racial divide: only 2.5% for white women compared to 22.5% for nonwhite women. In contrast, the LFP for single women was 40%, with 38.4% for white women and 59.5% for nonwhite women.

The situation for women began to change between 1910 and 1930 with increasing labor demand and rising high school graduation rates. Despite these gains for women, social stigma and lower average education kept the income effect large (and negative) and the substitution effect small. In other words, higher incomes for husbands decreased women's employment, and increased demand had a limited impact.

Nevertheless, we observe a slight increase in the LFP rate. During this phase, the rate rose by 9 percentage points (p.p.) for all women and by 7 p.p. for married women, signaling a gradual shift in women's work patterns.

Phase II (1930-1950)   The LFP rate for married women aged 35 to 44 rose sharply from about 10% in 1930 to 25% in 1950 (see Figure 1). This change was driven by factors largely exogenous to female labor supply, including: 1) an increased demand for clerical work due to the advent of new information technologies; 2) the abolition of marriage bars around the 1940s, which facilitated employment for married women; and 3) the spread of electric household technologies, such as washing machines and refrigerators, which reduced the time needed for household chores and facilitated women's employment.

Two other changes affected income and substitution elasticities: 1) the introduction of scheduled part-time work in the 1940s, and 2) the increasing social acceptance of employed married women (see Figure 2). Both changes reduced elasticity to a husband's income, leading to a decline in the income effect and a substantial increase in the substitution effect. Consequently, married women's LFP increased by 16 p.p., marking a significant shift in their labor market participation.

Phase III (1950-1970)   The participation of married women in the labor market increased significantly, especially for older (45-54) and younger (25-34) women. For those aged 35-44, participation rose from 25% to 46% (see Figure 1).

Female labor supply became more elastic and responsive to wage changes. Concurrently, the income effect declined as married women became more educated and their involvement in the labor market gained social acceptance (see Figure 2). Despite increased participation, women of this era were often caught off guard. They remained secondary earners in their households and passive actors in their careers, without actively choosing their occupations. Their human capital grew through formal education or vocational training rather than on-the-job experience, with many working as secretaries, teachers, nurses, social workers, and librarians. We can also argue that their so-called passivity was partly due to social norms that dictated which jobs were "acceptable" for women. Professions such as doctors and lawyers were certainly considered as "men's" jobs.

Phase IV (1970 - ...)   The birth cohorts of the late 1940s marked a shift in women's approach to education and career planning. Women began to invest significantly in their human capital, as evidenced by a sharp increase in college attendance relative to men.

Since the 1970s, occupational segregation by gender has significantly declined. Women shifted from traditionally female occupations (e.g., teachers, nurses, librarians, and social

workers) to a more diverse range of occupations, pursuing careers as doctors, lawyers, professors, and managers. Family dynamics also shifted, with a notable delay in marriage, as the median age at first marriage increased by 2.5 years in just seven years (see also Section 4). These changes reflect a broader transformation, redefining women's roles beyond the domestic sphere with a greater focus on professional development and personal autonomy, including the decision to marry later in life.

Women broadened their horizons. During the 1970-1980 period, teenage women developed more accurate expectations about their future working lives. In the mid-1960s, only 33% of teenage girls expected to be in the labor force at age 35, while actual participation was 65%. By 1980, over 80% of teenage girls expected to be working at age 35, close to the actual rate of 75%. This shift indicates a dramatic change in young women's perception of their role in the labor market, from a traditional view to one that embraces active participation in the labor force.

Women transformed their identities. Beginning in the 1970s, the nature of how women perceived themselves began to change significantly. A woman's profession and career became central to defining her identity. Female first-year students began to place greater value on peer recognition and financial success.

Alterations in identity led to significant changes in the parameters of the Slutsky equation for women. Both income and substitution elasticities converge to those of men in the 1990s. Women began to view employment as part of a long-term career and integral to their life satisfaction and social identity, resulting in stronger attachment to the labor force. Leaving the workforce is now seen as a loss of identity, similar to the experience of unemployed men. This shift is observed across all income levels and educational backgrounds, with ethnographic research confirming that even low-income women view work as a source of personal identity.

2.5 Conclusion

The forces driving the three phases of evolution and the quiet revolution are complex. In the early 20th century, few adult and married women were in the labor force, with high income elasticity and low substitution elasticity, limiting participation despite economic growth. In the second phase, income elasticity declined with better jobs and education, while substitution elasticity increased with part-time work. By Phase III, female labor supply was highly elastic, leading to a surge in labor force participation as demand in-

creased. Young women in the 1960s and 1970s, influenced by rising participation rates, feminism, the pill, and rising divorce rates, began to plan careers alongside or before families, investing more in education and pursuing professional careers. The quiet revolution was underway. This led to longer career horizons and an identity shift that put career on par with marriage.

However, women's participation rates and the proportion of women working full-time have plateaued, with little or no growth since around 1990, after a century of steady growth (see also England et al., 2020). Factors such as workplace flexibility, family leave policies, and persistent gender norms continue to hinder women's employment choices and represent an avenue for future research.

# 3   The Grand Gender Convergence

The previous section highlighted the significant increase in women's participation in the U.S. labor market, a trend also observed in other countries, including France. Figure 3 shows the LFP rate for women and men in France from 1975 to 2023, based on INSEE Employment Surveys. In 2021, 70% of women aged 15 to 64 participated in the labor market, up from 55% in 1975. Although men's participation rates remain higher, the gender gap has significantly narrowed.[4] The quiet revolution has also taken place in France and other developed countries, but as far as I know it has not been shown.

Other gender gaps have also converged, prompting Goldin (2014) to remark, "Of the many advances in society and the economy in the last century, the converging roles of men and women are among the grandest." The narrowing of the gender pay gap is a significant illustration of this convergence (Blau and Kahn, 2017).

In France, in 2022, women in the private sector earned an average annual wage 23.5% lower than men: €19,980 for women versus €26,110 for men (Godet, 2024). This gap partly results from women working 10.1% fewer hours per year than men. Controlling for hours worked, the gender pay gap in full-time equivalent earnings is 14.9%. Notably, both the gaps in hours worked and pay have narrowed since 1995, when the hours gap

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[4]Part of the narrowing of the gender gap is due to the decline in men's LFP between 1975 and the mid-1990s. One reason for this decline is the increased duration of education, which has reduced the participation rate of young men aged 15-24. In addition, the LFP rate for men aged 50-64 fell significantly in the 1980s, mainly due to the lowering of the retirement age to 60 and increased opportunities for early retirement (Cabannes, 2014).

Figure 3: Labor Force Participation Rates of Women and Men in France
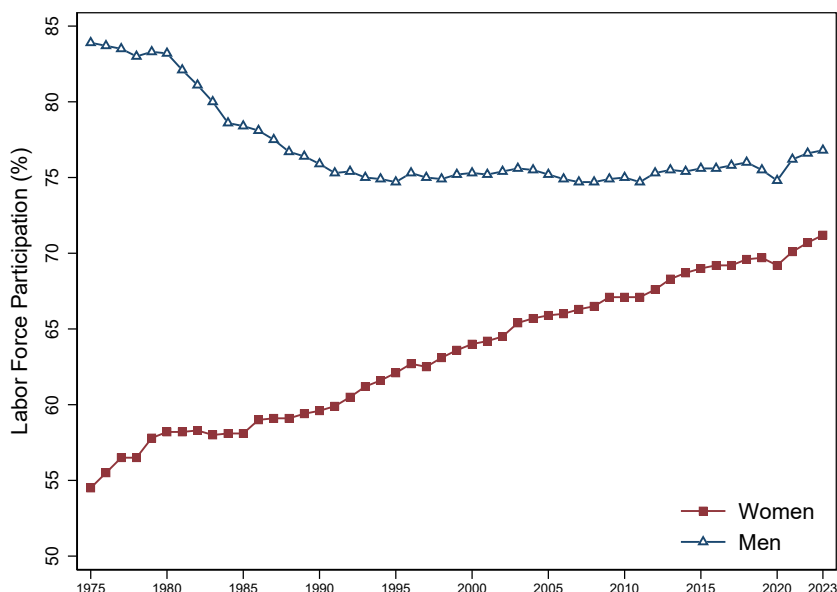
Note: Data from INSEE Employment Surveys, long-term series on the labor market.

was 5 p.p. higher and the pay gap was 7 p.p. higher.

The pay gap is emblematic because wages summarize an individual's education, training, experience, and labor market participation. The pay gap thus reflects differences in work between genders. Closing the gap would ensure that women and men receive equal pay for equal work, reinforcing the principle of fairness in the labor market.

There are many explanations for the gender pay gap (see Blau and Kahn, 2017). Historically, this gap highlights differences in human capital and treatment in the labor market, including discrimination. Legislation and anti-discrimination policies have mitigated gender-based wage discrimination, while gender disparities in human capital investment have converged. Notably, the gender gap in education has reversed, with women now more likely than men to graduate from university. These developments have contributed to narrowing the gender pay gap. Other explanations include differences in psychological attributes and noncognitive skills, which can impact productivity and rewards. For instance, women often shy away from competition (Gneezy et al., 2003; Niederle and Vesterlund, 2007) and bargaining (Babcock and Laschever, 2003; Exley et al., 2020). In fact, as shown in De Sousa and Hollard (2023), even a small gender gap in performance, attributed to psychological factors and noncognitive skills, can affect women's long-term

human capital formation, thereby perpetuating disparities in the labor market.

According to Goldin (2014), achieving gender equality in the economy does not depend on government intervention, improving women's bargaining skills, or men taking on more domestic responsibilities. Instead, achieving equality requires changes in the labor market, particularly in job structure and compensation, to reduce the role of temporal flexibility and the costs to firms of substituting one worker's hours for another's.

3.1   Temporal Flexibility: Searching for Data Clues

Work flexibility is a complex and multidimensional concept. It includes the number and timing of hours worked, such as being "on call," providing "face time," and being available for clients and meetings. These temporal demands are generally more important for highly educated workers, so Goldin (2014) focuses on college-educated individuals and high-wage occupations.

To demonstrate that gender equality requires changes in work organization and compensation, Goldin begins to collect solid data clues. The first clue is that the gender pay gap widens with age. This clue is observed in the U.S., but also in France. In 2022, the average full-time equivalent gender pay gap in France is 14.9%, rising from 4.7% for workers under 25 to 26.1% for those 60 and over.

A second clue comes from estimating gender earnings gaps by occupation (and industry). Goldin (2014) states that "the majority of the current earnings gap comes from within occupation differences in earnings rather than from between occupation differences." One way to demonstrate this clue is by observing the variation in the coefficient on female dummy in a Mincerian log earnings regression. Using the American Community Survey (ACS, 2009-11) sample and absorbing the effect of all occupations "decreases the coefficient on female by no more than one-third."

Goldin breaks down occupations into groups such as business, health, science, and technology, revealing significant differences in the gender pay gap. For example, business occupations have much larger gender gaps than tech occupations, including engineers, information systems professionals, and programmers. The regressions also show that if hours are allowed to affect earnings differently by occupation, business occupations have the largest coefficient on hours, while tech occupations have the smallest. This means that business occupations, but also legal and financial occupations, have the largest elasticities

of earnings with respect to hours, leading to a significant nonlinearity: working more hours leads to disproportionately higher earnings.

Two points are noteworthy. First, the claim that "what happens within each occupation is far more important than the occupations in which women wind up," is contentious. Women and men segregate into different occupations *and* industries. Using the Panel Study of Income Dynamics, Blau and Kahn (2017) confirm that occupation explains one-third of the gap in 2010, but also represents the largest single factor.[5] Goldin could not control for industry in her ACS sample, but Blau and Kahn (2017) could, showing that industry (14 categories and government employment) is the second factor at 18%. Combined, occupation and industry differences account for more than half of the 2010 gender pay gap because predominantly female occupations and industries typically pay less than male-dominated ones. Women and men are now less segregated into different occupations and industries than before, but this segregation explains a larger portion of the gap.[6] Additionally, differences across firms matter as men and women often work in different firms (Card et al., 2016; Sorkin, 2017; Folke and Rickne, 2022). In France, for example, comparing jobs in the same occupation and employer reduces the full-time equivalent pay gap by nearly 11 p.p., from 14.9% to 4% (Godet, 2024). The factors driving the tendency for women and men to segregate into different industries, occupations, and firms represent a promising avenue for future research.[7]

The second point is that the explanatory power of between-occupation and within-occupation factors depends on the level of occupational aggregation. More granular classifications emphasize between-occupation factors, while broader classifications highlight within-occupation factors. Regardless of the level of aggregation, factors such as temporal flexibility can explain the gender pay gap both within and between occupations. For example, consider a heterosexual couple of lawyers: if the man, a partner in a large law firm, earns 20% more per hour than the woman, a general counsel, the classification of their jobs–either as the same occupation or as different ones—-determines whether within-occupation or between-occupation factors explain the pay gap.[8] Temporal flexi-

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[5]Goldin (2014) controls for 469 three-digit occupations, while Blau and Kahn (2017) control for 21 occupations and experience variables (not available in ACS).

[6]In 1980, occupation and industry explained 27% of the gap, with actual experience being the most significant factor (Blau and Kahn, 2017).

[7]Gender homophily, or the tendency to associate with others of the same gender, could partly explain the gender segregation observed in the labor market. De Sousa and Madies (2024) conduct a lab experiment to understand gender homophily in team formation.

[8]A general counsel serves as the chief in-house lawyer for a company or governmental department. A

bility of a job may serve as a unifying explanation for occupational sorting and differences within occupations, irrespective of the specific classification of jobs. Flexibility may explain why a woman is a general counsel and a man is a partner. The bottom line is not that most of the current earnings gap is attributable to within-occupation differences rather than between-occupation differences, but rather that the earnings gap varies significantly across occupations, sectors, and firms.

3.2   Searching for a Theory

Goldin's theory of compensating differentials explains wage differences by the costs of flexibility. Wages vary based on how much employers have to compensate workers for providing job flexibility. The key idea is that some occupations exhibit linearity with respect to hours worked, while others exhibit convexity. Thus, in some occupations, working 70 hours a week pays twice as much as working 35 hours, while in others, earnings increase more than proportionally with hours worked.
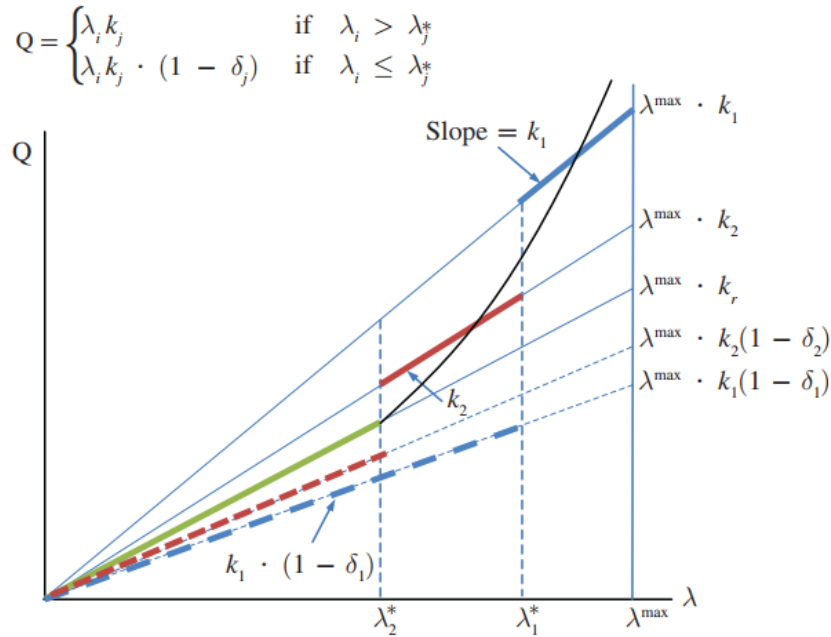
The theory is summarized in Figure 4, with a simplified production process where input time (λ) is plotted on the horizontal axis and output (Q) is plotted on the vertical axis.[9] Each slope (k_j) represents the productivity per unit of time of an occupation j. For example, a lawyer in position 1, such as a partner, who works the maximum number of hours ($\lambda_{\max}$) achieves high productivity ($\lambda_{\max} \cdot k_1$). However, if that lawyer works fewer hours than a critical threshold (λ_1^*), her productivity drops significantly due to a penalty, $k_1 \cdot (1 - \delta_1)$. This lawyer faces a stark trade-off: work long hours to maximize earnings or work fewer hours and incur a substantial productivity penalty.

A lawyer in position 2, such as a corporate counsel, earns less per unit time (k_2) but faces a smaller penalty for reduced hours, as $k_1 \cdot (1 - \delta_1) < k_2 \cdot (1 - \delta_2)$. This position offers more flexibility for those unable to commit to long hours. Finally, consider a third position r, such as a government lawyer, with a linear relationship between hours and earnings, represented by the (green) line $\lambda_{\max} \cdot k_r$. These three positions create a nonlinear relationship between earnings and hours as individuals choose among positions or occupations, influenced by the size of the penalties.

partner in a law firm holds a high-ranking position, traditionally signifying co-ownership in the partnership and entitlement to a share of the profits as an equity partner

[9]Input time $0 < \lambda \leq 1$ is the fraction of full-time employment worked by the employee i or some metric concerning which hours are worked.

Figure 4: A Theory of Occupational Pay Differences

$$Q = \begin{cases} \lambda_i k_j & \text{if } \lambda_i > \lambda_j^* \\ \lambda_i k_j \cdot (1 - \delta_j) & \text{if } \lambda_i \leq \lambda_j^* \end{cases}$$

Notes: Each line shows the relationship between output (Q) and time input (λ) for different occupations j where $0 < \lambda \leq \lambda^{\max}$. For occupations 1 and 2, output drops discretely if time input falls below λ_j^*. Occupation r maintains a linear relationship between time worked and earnings. An employee, i, who works between λ_1^* and $\lambda^{\max}$ will be in occupation 1, an individual between λ_1^* and λ_2^* will work in 2 and all others will work in r, if they remain in the labor force. Source: Goldin (2014).

This framework has important implications. Nonlinearity in compensation occurs in occupations where absenteeism is costly, client handoffs are difficult, and team coordination is critical (e.g., finance, consulting, law). Linearity occurs in occupations where workers can easily substitute for each other and information systems facilitate handoffs (e.g., healthcare, pharmacy). As a result, nonlinear occupations tend to lower relative earnings for women, especially those with children, making it harder to balance family and work. Conversely, linear occupations offer higher relative earnings for women, encouraging female LFP and favoring both family and career goals.

3.3   From Theory to Data

Which jobs characteristics are associated with the gender gap through occupational wage differentials? Goldin uses two complementary methods to demonstrate the impact of temporal flexibility on earnings and the gender gap, one based on occupational charac-

teristics and the other based on case studies.

3.3.1 Occupational Characteristics

Using O*Net data, Goldin analyzes five key occupational characteristics:[10]

1. Time pressure: How often does a job require the worker to meet strict deadlines? Lower pressure means less need to be present at specific times and more flexibility.

2. Contact with others: How much does a job require the worker to be in contact with others (face-to-face, phone, or otherwise)? Less contact indicates greater flexibility.

3. Establishing and maintaining interpersonal relationships over time. Less interpersonal relationships indicate greater flexibility.

4. Structured vs. unstructured work: How structured is a job versus allowing the worker to set tasks, priorities, and goals? Less structure means higher flexibility.

5. Freedom to make decisions: How much decision-making freedom, without supervision, does the job offer? More freedom suggests greater flexibility.

Tech and science occupations score much lower than business and law on these characteristics, indicating less need for presence, lower time pressure, and more independent work. Health occupations present a mixed picture. There is a clear relationship between O*Net scores and the gender pay gap, especially for college graduates. Tech and science jobs offer greater flexibility and smaller gender pay gaps compared to business and law.

3.3.2 Case Studies

Goldin (2014) presents three case studies to support her theory. The first two document a strong convexity between earnings and hours, and the last a linear relationship.

The first case is business (Bertrand et al., 2010). For Chicago Booth School MBAs, who graduated between 1990 and 2006, the gender pay gap starts at nearly zero but grows significantly over time. Ten to fifteen years post-graduation, men earn 75% more than women, even after controlling for MBA performance (e.g., the number of finance courses

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[10]The Occupational Information Network (O*NET) is a free online database, developed by the U.S. Department of Labor, that contains hundreds of job definitions.

taken). The main drivers of the pay gap are differences in hours worked and career interruptions. Women often take more time off or move to lower-paying, flexible positions, especially after having children. The finance and corporate sectors that hire these MBAs heavily penalize reduced or flexible work hours, exacerbating the gender pay gap.

Another case study, drawn from Michigan Law School Alumni Research dataset, reveals that the gender pay gap for lawyers increases with time since obtaining a Juris Doctor (JD).[11] Annual earnings are significantly higher for those working more hours per week, even after controlling for factors like years off and part-time work. Moreover, hourly fees rise with weekly hours, confirming the nonlinearity of earnings with respect to hours worked among lawyers. Women are overrepresented in lower-hour groups, where a higher percentage have children, impacting the gender pay gap.

The final case involves pharmacists, a high-income occupation with a small gender pay gap and minimal penalty for reduced hours (Goldin and Katz, 2016). Standardized medications and comprehensive information systems enable pharmacists to easily hand off clients without compromising service quality and earnings. Over recent decades, independent practice has declined, and the proportion of female pharmacists has increased significantly. Pharmacists, mainly employed by large firms and hospitals, benefit from flexibility and experience almost perfect linearity in pay relative to hours worked, with little to no wage penalty for part-time work.

3.4 Offsprings

Goldin's work has sparked renewed interest in gender differentials in labor markets. A first offspring is the "child penalty" literature. For example, Kleven et al. (2019) show that in Denmark, the arrival of children creates a long-term gender earnings gap of about 20%, driven by differences in hours worked, labor force participation, and wage rates (see also Goldin et al., 2022 for the US and Meurs and Pora, 2019 for France).

The second offspring examines non-wage factors or amenities. For example, Le Barbanchon et al. (2020) find that unemployed women in France have lower reservation wages and shorter acceptable commutes than men. Women value commuting 20% more than men, which accounts for 14% of the residual gender pay gap. The gender gap in commuting is mainly supply-side driven, as female workers do not receive less demand

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[11]A JD or Juris Doctor is a professional graduate degree in law.

from distant employers.

3.5   Conclusion

Earlier phases of gender convergence emphasized the increase in women's human capital attributes, such as education and job experience. The final chapter focuses on flexibility and the disproportionate rewards for long and specific working hours in some occupations. For instance, many tech and science occupations, and certain physician specialties exhibit built-in flexibility due to the independent nature of projects and information systems. In contrast, other occupations, such as partners in large law firms, impose high wage penalties for shorter hours or interruptions. Changing the use and reward of temporal flexibility is critical. How firms adapt to technological changes and evolving employee preferences will be key. Importantly, this last chapter is not just about women; it addresses broader issues that can improve everyone's lives.

4   The Power of the Pill

At the end of the 20th century, *The Economist* (December 23, 1999) asked whether there was "one invention that historians a thousand years from now will look back on and say, 'That defined the 20th century.' It is also one that a time-traveler from 1000 would find breathtaking–particularly if she were a woman. That invention is the *contraceptive pill*."

In a joint paper with Larry Katz, Claudia Goldin examines the impact of the birth control pill on women's careers and marriage patterns. Motivated by shifts among college graduate women born around 1950, Goldin and Katz (2002) note that the proportion of women among first-year law students rose from 10% in 1970 to 36% in 1980. In addition, less than 30% of female college graduates born in 1957 married before age 23, compared to nearly 50% of those born in 1950. They argue that the pill and legal changes for young, unmarried women significantly influenced these trends.

The US Food and Drug Administration's approval of the oral contraceptive pill on May 9, 1960, marked a major turning point in women's lives, with both direct and indirect effects. Directly, the pill provided certainty about pregnancy, reducing the costs of long-term career investments. Before reliable contraception, women faced the dilemma of abstinence or the constant uncertainty of unintended pregnancy, imposing significant

personal and professional constraints on women's lives. Carole Cato, who grew up in a poor farming community in Virginia in the 1940s and 1950s, recalled living in constant fear of pregnancy, describing it as a tightrope, always wondering, is this going to be the time [I get pregnant]?"[12]

The pill indirectly impacted the marriage market by allowing *all* individuals to delay marriage without significant penalties. The pill created a "thicker" marriage market, facilitating better matches and enabling women to invest in careers without sacrificing their personal lives. By lowering the cost of career investment and allowing marriage to be delayed, the pill enabled more women to pursue professional careers, driving larger economic and social changes.

4.1 The Detective Work

What is remarkable about this paper is that Goldin and Katz provide a compelling explanation for shifts in women's careers and marriage age, backed up by meticulous data and statistics. They build their argument methodically, like detectives, rather than jumping straight from hypothesis to econometrics.

Their empirical argument on the effect of the pill on women's career and marriage decisions exploits the timing and impact of legal changes in the U.S. during the late 1960s and early 1970s. State laws on the age of majority and statutes for minors significantly affected trends in contraceptive use. Before 1969, most states required parental consent for minors to obtain contraceptives, with the age of majority set at 21 in most states.[13] By 1971, thirty states allowed women aged 18 and older to obtain the pill, and twelve states permitted those aged 16 and younger to obtain it. By 1974, only two states had an age of majority above 18 without emancipation laws of minors. These legal changes, partly due to the Vietnam War, eased access to contraceptives for younger women.

Due to varying laws and legal changes, the diffusion of the contraceptive pill followed different paths for married and unmarried women. Initially, the pill spread quickly among married women, but access for unmarried women was delayed by legal restrictions and prevailing social norms. After lowering the age of majority and extending mi-

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[12]https://www.npr.org/2020/05/09/852807455/how-the-approval-of-the-birth-control-pill-60-years-ago-helped-change-lives.

[13]Only six states had the age of majority set at 18. In 5 states (Arkansas, Idaho, Nevada, Oklahoma, Utah), the age of majority was lower for women than for men, likely due to younger marriage ages.

nors' rights, the pill rapidly spread among unmarried women. Pill use among women aged 18-20 rose from about 10% for those born in 1945 and rose to 30% for those born in 1950. Post-1950, the increase in pill use was primarily among those obtaining it before age 18, a demographic with negligible use in earlier cohorts.

Goldin and Katz (2002)'s analysis continues by examining whether factors such as age, education, religion, and race could confound the observed societal changes. Using cross-sectional data from the 1971 National Survey of Young Women,[14] they show that the pill's spread among young, unmarried women was linked to legal changes. By controlling for these factors, they find pill use was 33-40% higher among women aged 15-19 in states with nonrestrictive laws, with the largest increase among college women, likely due to university health services.

4.2 The Conceptual Work

The rapid spread of the pill among young, unmarried women is closely tied to changes in state laws and the belief in young people's decision-making autonomy. This prompts the question: How did the pill's diffusion impact young women's professional career investments?

The pill's diffusion influenced career decisions through direct and indirect effects. To model the direct effect, consider n women and men, where each man i brings income (Y_i) and each woman j brings nurturing qualities (N_j) and potential career contribution (α_j) to a marriage. The utility lost from abstinence before the pill is represented by λ_o. In a two-period model, if a couple marries in the first period, the man receives N_j and the woman receives Y_i. If they delay marriage to the second period and the woman invests in a career, the man receives $N_j + \alpha_j - \lambda_o$ and the woman receives $Y_i + \alpha_j - \lambda_o$. If $\alpha_j > \lambda_o$, they benefit from the delay and the woman invests in her career. Conversely, if $\alpha_j < \lambda_o$, they marry in the first period and the woman does not pursue a career.

In this framework, a man's attractiveness to women is fully captured by his income (Y_i), while a woman's attractiveness to men depends on her nurturing qualities or the combination of her nurturing and career contributions, adjusted for abstinence utility loss ($F_j = \max[N_j, (N_j + \alpha_j - \lambda_o)]$). Women with $\alpha \geq \lambda_0$ invest in careers and delay marriage. The pill reduces λ from λ_0 to λ_p, lowering the career investment cutoff and increasing

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[14]The survey covers 4,211 unmarried women, of whom 1,314 had sexual experience.

the fraction of women who delay marriage and pursue careers. This also enhances the attractiveness of career-oriented women (high α) in the marriage market.

The pill's impact on women's career and marriage decisions can be categorized into three groups.

1. Women with $\alpha \geq \lambda_0$ delay marriage and pursue careers regardless of the pill, with an increased marriage value ($\Delta F_i = \lambda_0 - \lambda_p$).

2. Women with $\lambda_0 > \alpha > \lambda_p$ would marry early without the pill but delay marriage and pursue careers with it, increasing their marriage value ($\Delta F_i = \alpha - \lambda_p$).

3. Women with $\alpha < \lambda_p$ do not pursue careers regardless of the pill and may experience worse partner matches.

This framework models the direct effect of the pill and assumes that pregnancy follows marriage. It overlooks marrying to access the pill for career purposes. It also abstracts from intra-household bargaining dynamics, which can influence work and family decisions. Finally, the model does not consider the possibility of divorce, even though the U.S. divorce rate surged between 1970 and 1990. Despite these limitations, the model effectively illustrates how the pill reduces the cost of delaying marriage to invest in a career. It also shows that although men generally gain and women as a whole benefit from the pill, those in the third group may face worse partner matches.

The indirect effect of the pill, while outside the scope of the model, manifests through a social multiplier effect where contraception availability delays marriage. This delay allows for better matches and more substantial career investments. As more individuals delay marriage, the market becomes 'thicker,' enhancing match quality and career opportunities. Furthermore, improved marriage matches can lower the divorce rate, showing a long-term benefit of later marriages facilitated by the pill.

The model predicts that the introduction of the pill should lead to significant societal changes. First, more women should enter the workforce, as reliable contraception reduces career costs from unintended pregnancies. Second, the age at first marriage should increase, as the pill allows women to delay marriage. Third, the age at first birth should increase, reflecting a longer period of investment before starting a family. These changes are not distinguishable from each another, with increased professional careers, delayed marriage, and postponed childbirth reinforcing each other. These predictions underscore the transformative impact of the pill on women's career and life choices.

4.3 Econometric Evidence for the Power of the Pill

4.3.1 Laws and Age at First Marriage

To study the impact of laws on the age at first marriage, Goldin and Katz (2002) use the 1980 *Census of Population* dataset and a difference-in-differences (DiD) approach with two-way fixed effects (state of birth α_s and year of birth δ_y):

$$M_{isy} = \alpha_s + \delta_y + P_{sy}\gamma + X_{isy}\beta + A_{sy}\pi + \epsilon_{isy},$$

where M_{isy} equals 1 if an individual i was married before age 23. The key independent variable P_{sy} equals 1 if the individual's state of birth had a nonrestrictive birth control law for minors at age 18. X_{isy} includes race dummies and A_{sy} equals 1 if abortion was legal in the individual's state at age 18.

Results show that nonrestrictive birth control laws for minors reduce the likelihood of women marrying before age 23 by 2 p.p. Both access to birth control and abortion legalization similarly reduce early marriage. However, adjusting for state linear time trends is crucial. This adjustment accounts for the potential endogeneity of birth control laws to state-specific trends in feminist views and attitudes toward women's careers. With state linear time trends, the impact of birth control laws is reinforced, while the effect of abortion legalization becomes insignificant.

4.3.2 Pill and Career

The analysis of the pill's impact on women's careers uses data from 20 age groups (30-49) across three Census years (1970, 1980, 1990), resulting in 60 observations for U.S.-born college graduate women from the 1921-1960 cohorts. The key estimating equation is:

$$Y_{at} = \alpha_a + \delta_t + P_{at}\gamma + A_{at}\pi + X_{at}\beta + \epsilon_{at},$$

where Y_{at} is the share of age group a with a career or marital status outcome in year t, α_a and δ_t are age and census year fixed effects, P_{at} captures access to or usage of birth control for the cohort as young women, A_{at} reflects access to abortion for the cohort, and X_{at} includes demographic controls. This framework isolates the effects of access to birth control and abortion on the career and marital outcomes of women over different cohorts.

Results show that the pill usage alone accounts for a substantial portion of the increase in the share of professional occupations, highlighting its role in enhancing women's career opportunities during this period.[15] Pill access was most effective for professions requiring substantial up-front investments, and boosted the number of college women pursuing careers as lawyers and doctors. These results underscore the pivotal role of pill access in facilitating women's entry into high-investment professional careers.

Results also indicate that changes in abortion rates had a similar effect on women's careers as the pill, but the pill had a broader impact as college women relied on it for safe, reliable contraception. Access to the pill increased the share of women who never married and significantly reduced the share of currently divorced.[16] Although the divorce rate surged from 1970 to 1990, the rise slowed for cohorts with greater pill access, suggesting that the pill improved marriage quality by enabling later, better matches.

4.4 Conclusion

The contraceptive pill had a profound impact on young women's careers and marriage rates in the 1970s. Its ease-of-use, female-controlled nature, coupled with low health risks and minimal discomfort, made it a supply-driven explanation for women's changes. The pill lowered the cost of remaining unmarried while investing in careers, increasing the age at first marriage and enhancing women's professional opportunities. Its introduction coincided with a period of high college graduation rates among U.S. women, enabling them to fully benefit from these changes. The pill's unique characteristics and timely availability promoted lasting social change, fundamentally altering the landscape of women's opportunities and choices.

5   Orchestrating Impartiality

Gender bias in hiring has been alleged in many professions, but it is extremely hard to prove. A change in symphony orchestra recruitment offers a unique test case. The inno-

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[15]The analysis quantifies the pill's impact on women's professional occupations with an estimated $\hat{\gamma}$ of 0.048. As pill usage rose from 0% in pre-1940 cohorts to 35% in mid-1950s cohorts, the estimates suggest a 1.7-p.p. ($0.048 \times 35 = 1.68$) increase in the share of professional occupations (excluding teachers and nurses) out of an overall 5 p.p. increase for these age groups from 1970 to 1990.

[16]Abortion legalization had similar but smaller effects on these two proportions.

Figure 5: Blind vs. Non-Blind Auditions

A: Non-Blind Audition

B: Blind Audition

Note: Panel A: Carnegie Hall (New York). Panel B: Saint Louis Symphony Orchestra

vative change involves transitioning from traditional auditions to 'blind' auditions (see Figure 5). This shift provides a transparent and exogenous source of variation to assess the impact of recruitment practices on gender bias.

For years, the most prestigious US orchestras relied on non-blind auditions, handpicking members, which allowed for potential discrimination. Initially, concerns centered on nepotism, with orchestras filled with the conductor's connections. However, bias against women further complicated fair recruitment. Zubin Mehta, conductor of the Los Angeles Philharmonic, told the *New York Times* on April 11, 1971: "I just don't think women should be in an orchestra. They become men. Men treat them as equals; they even change their pants in front of them. I think it's terrible!" This view reflected the low number of women in U.S. orchestras at the time.

In a seminal paper, Goldin and Rouse (2000) investigated the impact of blind auditions in symphony orchestras. Some orchestras began using screens to conceal performers' identities during auditions, providing a unique opportunity to assess their effectiveness in reducing bias. By analyzing a large sample of orchestras, they examined whether blind auditions could eliminate discrimination against women and increase female representation. They found that using screens significantly increased the chances of women advancing through selection rounds and winning in the final round.

5.1 Context and Data

The Audition Process — Goldin and Rouse (2000) study gender representation in top-

tier and second-tier orchestras.[17] A typical orchestra consists of approximately 100 musicians, with standardized roles and responsibilities. This consistency in orchestral structure allows for a uniform comparison across orchestras and time. From 1940 to 1990, the share of women increased dramatically. Notably, the New York Philharmonic (NYPhil) saw an increase in women from nearly 0% for decades to 35% by 1990. This rise is impressive given the low attrition rates, with top orchestras averaging 4 new hires per year and others about 6. Since the early 1980s, women have accounted for about 35% of new hires at the Boston Symphony Orchestra (BSO) and Chicago, and about 50% at the NYPhil, up from less than 10% before 1970. These changes mark a significant shift in gender representation within these prestigious orchestras.

The audition process is designed to identify the most talented musicians while ensuring impartiality. Initially, orchestras advertise auditions, and applicants submit resumes and tapes. Candidates are then selected for the audition process, which involves at most 3 rounds: preliminary, semi-final, and final. Almost all preliminary rounds are now blind to avoid bias, with some orchestras using carpets to muffle footsteps that might reveal gender. Only the personnel manager knows the identity of the candidates to maintain anonymity. The semi-final round is sometimes not blind, while the final round, usually not blind, includes the presence of the music director. The committee advances all who are deemed qualified, with no limit on the number of musicians in each round. Although the final round usually results in a hire, there are instances when it does not.

Data — The study uses two data sets to analyze the impact of blind auditions on gender representation in orchestras. The first data set, comprising 7,065 individuals across 588 audition rounds, focuses on audition outcomes. The second, consisting of 1,128 new orchestra members hired between 1970 and 1996, examines personnel rosters. These comprehensive data sets provide a robust basis for assessing changes in hiring practices and their effects on gender diversity in orchestras.

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[17]Top Tier (the "Big Five"): Boston Symphony Orchestra, Chicago Symphony Orchestra, Cleveland Symphony Orchestra, New York Philharmonic, Philadelphia Orchestra. Second Tier: Los Angeles Symphony Orchestra, San Francisco Philharmonic, Detroit Symphony Orchestra, Pittsburgh Symphony Orchestra.

5.2   The Detective Work

The detective should consider whether the increase in hiring of women results from the introduction of audition screens, or from other factors. Possible confounding factors include a reduced societal bias against women and a larger pool of talented female applicants coming out of music schools. Goldin and Rouse (2000) carefully build their argument, methodically answering key initial questions before jumping to econometrics and the identification strategy.

Is Blind Really Blind?   Can trained musicians discern female candidates by their playing style? This is highly unlikely, which helps challenge prejudices and gender stereotypes held by famous conductors, such as "women have smaller techniques than men" or "the more women (in an orchestra), the worse the sound" (Goldin and Rouse, 2000).

Is the Adoption of Blind Auditions Endogenous?   A key question is whether the adoption of blind auditions is endogenous to the number of female musicians in the orchestra. If so, it would mean that the increased female representation is due to a prior willingness to attract more women, not the screen itself. Probit estimates show actually that a higher proportion of female members in an orchestra increases the likelihood of adopting blind auditions. However, the effect is small and not statistically significant. In addition, the results indicate that greater staff stability in terms of tenure significantly increases the likelihood of adopting blind auditions. These findings suggest that while gender composition may influence adoption, staff stability plays a more significant role.

Does Self-Selection Matter?   Selection is always an issue in the job market. The introduction of blind auditions may alter the applicant pool. Surprisingly, the raw data show that women fare *worse* in blind auditions than in non-blind ones across all rounds. This unexpected suggests underlying factors, such as the need to control for "ability." Lower-ability female musicians might be more inclined to apply when auditions are blind, expecting that the screen might mitigate gender bias. This self-selection could lower average ability among female applicants in blind auditions, thereby affecting their overall success rates. Controlling for individual ability and other factors is crucial to accurately assess the impact of blind auditions.

Controlling for ability by focusing on musicians who auditioned both with and with-

out a screen reveals that women's success rates are almost always higher in blind auditions.[18] Overall, women's success rates increase by 14.8 p.p. in blind auditions, making their success 1.6 times higher than in non-blind auditions.

After answering these initial questions, Goldin and Rouse (2000) clearly specify their identification strategy and the sources of variation.

Does the Screen Affect the Likelihood of Advancing? They identify the effect of blind auditions on the probability of being advanced or hired through the following DiD:

$$P_{ijtr} = \alpha + \beta Female_i + \gamma Blind_{jtr} + \delta(Female_i \times Blind_{jtr}) + X_{it}\delta_1 + Z_{jtr}\delta_2 + \epsilon_{ijtr}, \quad (7)$$

where P_{ijtr} represents the probability that individual i is advanced or hired from an audition at orchestra j, in year t, from round r. The variable $Female_i$ is an indicator that equals 1 if the musician is female, and $Blind_{jtr}$ is an indicator that equals 1 if a screen is used during the audition. The model also includes X_{it}, which captures individual factors, and Z_{jtr}, which accounts for orchestral factors. The interaction term $Female_i \times Blind_{jtr}$ is key as it allows the estimation of the differential impact of blind auditions on female musicians.

The study refines the DiD model by incorporating individual fixed effects (η_i) to control for individual ability. This approach identifies the impact of blind auditions by focusing on musicians who auditioned both with and without a screen. This is feasible because 42% of candidates in the sample participated in more than one round, 6% competed both with and without a screen, and 24% competed in more than one audition. The individual fixed effects strategy thus leverages repeated observations of the same individuals to isolate the impact of blind auditions more precisely.

The findings reveal that blind auditions significantly impact women's advancement in orchestras. The screen increases the likelihood of a woman advancing to the next round, with the coefficient of interest (δ) of the interaction between "Female" and "Blind" being positive. Specifically, for preliminaries without a semifinal, blind auditions increase the likelihood of a woman being selected by about 11 p.p. For finals, the chances of winning increase by approximately 33 p.p. with a screen. However, blind auditions have no effect

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[18]For example, in preliminary rounds without semifinals, 19.3% of women in non-blind auditions advance compared to 22.5% of men, whereas in blind auditions, 28.6% of women advance compared to 20.2% of men. This suggests that women increase their own success rate by 9.3 p.p. in blind semi-final auditions.

in preliminaries with a semifinal and have a *negative* impact in the semifinal. This un-expected negative effect could be due to the staggered nature of the screen adoption. In the 1990s, the approach used by Goldin and Rouse (2000) was the standard for estimating DiD models (Angrist and Krueger, 1999).[19] This approach suits the canonical case with two time periods, "pre" and "post", and two groups, "treatment" and "control." How-ever, it is not appropriate when treatment occurs at different times. Screens were adopted by orchestras at different times, mostly from the early 1970s to the late 1980s. Using the canonical model with staggered adoption can lead to unexpected negative estimates due to a mix of "clean" comparisons between treated and not-yet-treated units as well as "for-bidden" comparisons between units who are both already-treated (see Goodman-Bacon (2021); de Chaisemartin and D'Haultfœuille (2022); Roth et al. (2023). The issue arises when the treatment effect for always-treated units increases over time, causing forbidden comparisons to potentially lead to negative estimates. Adopting the modern staggered DiD approach is required when treatment effects are heterogeneous.

Do Orchestras Using Screens Discriminate Less Against Women? Much of detective work in economics involves addressing potential biases and confounding factors that could influence the results. A concern is whether orchestras using screens are inherently less discriminatory against women than those that do not. Additionally, other valid con-cerns include whether the observed improvement in women's performance over time is due to women switching from non-blind to blind auditions, and if their performance growth rate is faster than men's. To investigate this, several individual time-varying covariates are included, revealing little effect on the estimated impact of the screen for women. Another potential concern is that individuals hired at their first audition might be more capable musicians than those auditioning multiple times. However, only a very small number of musicians win an audition in any given year, mitigating this concern. In addition, the accuracy of determining the sex of participants based on their first names is questioned. While this could lead to attenuation bias, it is not a significant issue in this study.

Finally, Goldin and Rouse (2000) address whether orchestras adopting screens are in-herently less discriminatory by incorporating orchestra fixed effects (η_j). This approach

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[19]DiD has roots in the 19th century when used to understand cholera transmission via contaminated water (Snow, 1855). It became popular among applied economists following (Card, 1990).For excellent re-views of the design-based revolution and causal identification following the Nobel Prize of Joshua Angrist, David Card, and Guido Imbens, see Girard and Guyonvarch (2023) and Goux and Maurin (2023).

focuses on individuals who auditioned for a particular orchestra both before and after screen adoption. However, this within identification comes from a much smaller sample. Only three orchestras adopted a screen during the study period. The estimates are less precise than other specifications that exploit between variation, i.e., orchestras which did not change their hiring process during the study period. Nevertheless, three interesting results emerge. First, orchestra fixed effects do not affect the magnitude of the results, suggesting that orchestras using screens are not inherently less discriminatory. Second, without individual fixed effects, women fare worse with the screen. As noted above, this could be due to selection bias, with blind auditions attracting more women, including weaker candidates. Third, adding individual fixed effects shows that women benefit from blind auditions, indicating that individual ability and selection matter. However, a major concern is that the key interaction effects of $Female_i \times Blind_{jtr}$ are not statistically significant in this smaller sample, leading the authors to conclude:

> "Even though our sample size is large, we identify the coefficients of interest from a much smaller sample. Some of our coefficients of interest, therefore, do not pass standard tests of statistical significance [...]. The weight of the evidence, however, is what we find most persuasive and what we have emphasized. The point estimates, moreover, are almost all economically significant."

5.3   Conclusion

To sum up, the audition process in orchestras began changing in the 1970s with the increasing use of physical screens to conceal candidates' identities and ensure impartiality. Based on their estimates, the rise in the proportion of female musicians among new hires can be attributed to three main factors: the blind audition process itself (33%); greater acceptance of female musicians or decrease in prejudice (33%); and the increased proportion of female candidates (34%).

There is much to praise about this paper. The idea of testing for gender discrimination in hiring is highly original. The quantity and quality of data gathered are impressive given the period considered and the date of publication. The paper is meticulously crafted and very transparent about its source of variation and identification, setting a high standard for applied work. Their transparent presentation of results is remarkable, without hiding unfavorable findings, such as the semifinal estimate that contradicts the

general result. Their dedication to craft ideal empirical strategies means some coefficients do not pass standard tests of statistical significance, as they identify key coefficients from a smaller subset of data. Are we convinced by 'the weight of the evidence'? That's the question! Expanding the data set or replicating the results in different countries would further validate the findings.[20]

6 Conclusions and Recommendations

6.1 Key Questions, Themes and Findings

This overview explores key questions and themes central to Goldin's analysis of labor market differences between men and women: education, experience, labor force participation, earnings, and social norms. Methodological questions include: What would a great detective do? How do you find data and evidence? How do you determine relevance before formulating hypotheses? What is the right theory? Analytical questions include: Does economic progress promote gender equality? What percentage of women are in the labor force? What factors increase the participation of (married) women? What is the role of temporal flexibility? What has been the impact of the contraceptive pill? And how do hiring practices affect gender diversity?

This review highlights key findings from Goldin's work on gender. First, women's LFP follows follows a U-shaped pattern: initially high in low-income agricultural societies, declining with rising incomes and changing norms, and rising again with improved education and market wages.

Second, education significantly impacts gender equality. Historically, female secondary school enrollment in the U.S. was higher than male enrollment, and since 1950, female college enrollment has also surpassed males, narrowing the gender earnings gap.

Third, policy and social changes, such as the birth control pill and blind auditions for orchestras, have significantly improved women's professional opportunities by enabling career investments and reducing hiring bias.

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[20]The project PRODIGE, led by Hélène Perivier, aims to measure biases in recruitment procedures and assess the effectiveness of blind auditions in France. Preliminary results from 13 orchestras show that 47% of applicants are women, with gender differences across instruments. Of the 325 observed competitions, some did not result in recruitment, and among the 285 individuals recruited, 44% were women. Further results are awaited.

Fourth, the Quiet Revolution in the late 20th century saw a consistent increase in women's workforce participation driven by increased education, career planning, and work-life balance, narrowing the gender pay gap.

Fifth, the Great Convergence describes the narrowing gender differences in education, labor force participation, and occupational roles. The path to gender equality lies in changing the way work is organized and compensated, and in the role of work flexibility.

6.2 Policy Recommendations

Universal and Targeted Solutions — What policy recommendations can we draw from these findings? Goldin (2021) emphasizes that "there is no simple solution, no one-size-fits-all policy." Goldin argues that universal remedies designed to promote equity may end up reinforcing inequities.[21] For example, Antecol et al. (2018) show that the universal stopping of the tenure clock for all assistant professors after childbirth tends to benefit new fathers and to disadvantage new mothers. Men use the extra time to work and publish, while women do not.

Other examples exist, but this does not imply that all universal and gender blind remedies will fail. "Knowing the issues can move us in the right direction" Goldin (2021). De Sousa and Niederle (2022) show an example of a targeted remedy that reduces gender inequalities. In the male-dominated world of chess, where women represent only about 10% of all internationally rated players, the 1990 quota for women in the French Club Chess Championship provides a unique case study. This affirmative action quota had three positive outcomes: improved performance among selected women, significant spillover and trickle-down effects with more and better qualified women players, and no adverse effects on French male players. Partial removal of the quota and international comparisons confirm that these results are unique to France. This study highlights how similar policies could be implemented in other settings.

Couple Equity and the COVID-19 — Alleviating career penalties for women may require equal participation from both partners in domestic production and family care. Exploring targeted policies that promote equitable sharing of these responsibilities is essential, though challenging to design and implement. During the COVID-19 economic

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[21]See her interview with David Figlio in the Family Action Network.

downturn, such policies were suggested to mitigate gender inequalities Alon et al. (2020). The pandemic highlighted the fragility of women's employment gains, particularly affecting sectors with high female employment, like healthcare and education. It also exacerbated the burden of unpaid domestic work, with women disproportionately handling childcare, home-schooling, and household tasks due to lockdowns and school closures. These developments have led to a temporary withdrawal of women from the labor market and threaten to reverse decades of progress in gender equality.

However, historical evidence supports the idea that crises and failures can lead to changes that could be beneficial in the long run. For example, World War II significantly increased female labor force participation, and these changes persisted even after the war (Acemoglu et al., 2004; Goldin and Olivetti, 2013). Alon et al. (2020) suggest that the COVID-19 crisis could promote long-term gender equality by accelerating the adoption of flexible work arrangements and increasing fathers' involvement in childcare, thereby challenging existing social norms.

Firm and Industry Changes — Employers can address gender disparities by supporting work-life balance and offering flexible work arrangements. Goldin (2014) suggests that the gender pay gap may shrink if firms eliminate disproportionate rewards for long hours. In the pharmacy industry, technological advancements and the decline of independent pharmacies have reduced the penalty for part-time work and narrowed the gender pay gap.

6.3   Recommendation for Young Researchers

Let me conclude with some recommendations for young researchers, inspired by Goldin (1998) and my understanding of her research.

First, pick a subject you are passionate about, as it will consume your thoughts day and night. Trendy topics might guarantee publication, but true intellectual stamina comes from a genuine desire to answer your questions.

Second, if you work on an empirical subject,"you must get to know your data." By personally handling and cleaning the data, Goldin uncovered important details that she might otherwise have missed. Familiarize yourself thoroughly with your data, looking for outliers and examining its properties before applying advanced techniques.

Third, Goldin approaches her work by critically evaluating every idea, theory, and empirical method as if she were her own worst enemy. This rigorous self-assessment helps uncover flaws and ultimately strengthens your research. This self-critical approach prepares her for external scrutiny from sharp critics.

Fourth, Goldin observes that some economic research appears to be flawlessly executed and elegantly written, leading us to believe that the authors are inherently superior. While this may be partly true, such researchers also work diligently on both content and writing. Goldin stresses the importance of revising repeatedly. Even the most admired work is not perfect in its first draft. Continuous rewriting greatly improves the quality of writing.

Fifth, Goldin tells her students that taking a course is a gift. Many students see classes as time-consuming, but most researchers have put in many hours in their classes, many hours to produce one hour of lecture. Isn't that a gift?

Finally, Claudia Goldin is a role model for many women, researchers, students, and ... me.

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