Childbearing Age and the Shadow Mommy Effect on Hiring: A Large-scale Field Experiment*

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Abstract

This study examines the *shadow mommy effect*—discrimination against women of prime childbearing age in the labor market. We sent fabricated CVs to 35,713 genuine job advertisements in the IT, accounting, and HR sectors across four major cities in China, accurately simulating real job-seeking conditions. Our findings reveal that women of prime childbearing age face disadvantages in the job search process, even when their maternal and marital status is not disclosed. The impact of this effect varies by occupation, firm ownership, and location. Our results suggest that employers' decision biases are largely shaped by the intersection of gender and age perceptions. Societal expectations of motherhood intensify concerns about the costs of gendered parental roles, perpetuating the shadow mommy effect.

Keywords: Childbearing age, Gender, Correspondence study, Labor market discrimination

JEL Classification: C93, J16, J71, M51

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1 Introduction

Despite improvements in gender equality, gender gaps remain pronounced in modern societies, especially in the labor market (Bertrand et al., 2010; Blau and Kahn, 2017). Experiences of workplace gender inequality can reduce women's career expectations, potentially reinforcing gender stereotypes (Gibson and Lawrence, 2010; Barbulescu and Bidwell, 2013; Si, 2022). Advancing gender equality and empowering women constitute a core aim of the United Nations' 2030 Agenda for Sustainable Development. Nonetheless, according to the 2024 Global Gender Gap Report, gender parity is projected to be achieved in 134 years at the current rate of progress, while it is expected to take 152 years to bridge the gender gap in economic participation and opportunity (World Economic Forum, 2024).

Recent studies have shown that the unequal distribution of parental responsibilities, commonly referred to as the *child penalty* or *mommy effect*, plays a significant role in perpetuating gender disparities in the labor market (Budig and England, 2001; Correll et al., 2007; Bertrand et al., 2010; Juhn and McCue, 2017; Yu and Kuo, 2017; Kleven et al., 2019a,b; Goldin, 2021; Cortés and Pan, 2023; Zhang et al., 2024). However, what is less recognized is that women affected by the child penalty may extend well beyond actual mothers. Statistical discrimination (Aigner and Cain, 1977) can lead to disadvantages for women who, although not mothers, are perceived as mothers or potential mothers. The implications of intersectionality theory (Crenshaw, 1989, 1991) further underscore the intersection of age and gender with societal expectations of motherhood, leading to biases against women of prime childbearing age. This phenomenon is termed the *shadow mommy effect*.

This paper is consisted of two studies. Study 1 is a large-scale field experiment, while study 2 was an online experiment conducted to causally identify the discrimination for feamles in the labor market due to the possibility of childbearing.

Study 1 is a large-scale field experiment in China conducted to investigate the impact of the shadow mommy effect—discrimination on the basis of *perceived* maternity status—on women's participation in the labor market. Specifically, we examine whether being of prime childbearing age affects women's employment opportunities during the initial stages of the hiring process via a correspondence test. We address the previously understudied discrimination toward perceived maternity within employment opportunities in the labor market (Bertrand and Duflo, 2017). Our analysis reveals how employers' intersectional biases and short-sighted hiring practices sustain immediate discrimination and reinforce long-term structural inequities in the labor market. Recognizing this issue is vital for understanding the persistent gender disparity, as even women who prioritize their careers over fertility may find

their efforts compromised by such discrimination. Furthermore, in light of this discrimination, women might opt for adverse selection by delaying or foregoing childbirth until they achieve career success, ultimately leading to a declining fertility rate in society (Dynan et al., 2022; Gloor et al., 2022).

Study 2 was an online experiment in which subjects,who played the role of employer, were given information about female and male job candidates, and they were asked to choose which job candidate they would choose to hire. Differed with the field experiment, we manipulated the marriage status, which allowed us to address a potential identification concern that one may have for the field experiment.

Despite being an emerging market that impacts a large population and yet remains understudied, China is the focus of this study for three main reasons. First, emerging evidence indicates that increased labor market barriers, stemming from childcare responsibilities and gender-based discrimination, present obstacles to women's active participation in the workforce and their achievement of equal opportunities in urban China (Brussevich et al., 2021; Si, 2022; Zhang et al., 2024). A 2025 survey of Chinese workers revealed that an overwhelming 62.5% of female respondents reported being asked about their marital or parental status during job interviews, in stark contrast to only 18.5% of male respondents who faced similar questioning (Zhaopin, 2025). This contrast likely arises from employers' perception that hiring women who are expected to become mothers could incur costs related to maternity leave, childcare requirements, and family responsibilities (Du, 2023; He et al., 2023; Wang and Chen, 2023; Agarwal et al., 2024; Chen and Tian, 2025; Huang and Fan, 2025; Li and Xiao, 2025). Societal gender norms and disparities in institutionally gendered parental responsibilities can exacerbate such stereotypes and discrimination (Zhang et al., 2024). Hence, the shadow mommy effect occurs if the chances of receiving a callback decrease for female job seekers of prime childbearing age when they are perceived as potential mothers under similar conditions.

Second, the institutional background of the Chinese labor market provides a natural context for exploring the implications of intersectionality theory for perceived maternity discrimination. Intersectionality theory examines how various social identities intersect to create overlapping and interdependent systems of discrimination or disadvantage (Crenshaw, 1989, 1991). Intersectionality highlights that the intersection of identities, such as gender and age, can create specific disadvantages that may not be fully addressed by considering each identity in isolation, regardless of whether each identity is recognized as marginalized (Davis, 2008). As Chinese law prohibits gender-related discrimination in hiring, information regarding marital and parental status is inherently sensitive and is typically not disclosed in a job seeker's resume. However,

a counterintuitive consequence of this regulation is that employers tend to assume that some female jobseekers are likely mothers based solely on limited CV information, namely their age and gender. In line with intersectional perspectives, the interplay of gender and age-based assumptions regarding childbearing potential produces a distinct disadvantage (Gloor et al., 2018, 2022; Zamberlan et al., 2024). Therefore, some employers' concerns about potential costs may lead to statistical discrimination against all women of prime childbearing age, regardless of their actual maternal status (Jessen et al., 2019). This pattern is particularly evident when employers adopt a short-term cost orientation.

Third, the decreasing fertility rate in urban China prompts further investigation into the connections between gender equity in the workplace and societal fertility trends. Gender equity theories of fertility in economics and sociology suggest that gender equality plays a significant role in determining fertility in modern societies (Feyrer et al., 2008; Anderson and Kohler, 2015; Esping-Andersen and Billari, 2015; Goldscheider et al., 2015; Doepke et al., 2023). The previously established negative correlation between fertility and development has shifted to a positive correlation due to socioeconomic advancements, as the compatibility between women's career and family aspirations has become a key factor in fertility decisions (Feyrer et al., 2008; Anderson and Kohler, 2015; Goldscheider et al., 2015; Doepke et al., 2023). Institutional gender inequality is a primary contributor to exceptionally low fertility rates, posing pressing challenges such as population aging for numerous modern societies. China's fertility rate ranks among the world's lowest, alongside South Korea, Singapore, and Japan.[1] As predicted by gender equity theory regarding fertility, employment disadvantages for women may hinder their fertility intentions in modern societies. This suggests a potential negative correlation between labor market discrimination based on perceived motherhood status and fertility rates.

This article contributes to the growing literature on the sources and consequences of gender disparities and inequalities in the labor market and society. First, this study examines the relatively understudied discrimination faced by women of prime childbearing age in real labor market settings, shifting the focus from the extensively documented discrimination against actual mothers (Budig and England, 2001; Correll et al., 2007; Bygren et al., 2017; Yu and Kuo, 2017; Kleven et al., 2019a,b; Cortés and Pan, 2023; Zhang et al., 2024) to biases based on perceived motherhood. By analyzing how employment opportunities may be restricted for all women of prime childbearing age, regardless of maternal status, this study broadens our understanding

[1]The substantial relaxation of the one-child policy since 2013 has had a limited impact on boosting the fertility rate. The blue circle line in Figure A.1 shows births per woman in China from 2011 to 2022. Despite a brief increase following policy relaxation, the fertility rate continues to decline. Additionally, the female labor force participation rate has fallen over this period, as shown by the orange diamond line in Figure A.1. Recent trends in China thus reveal simultaneous declines in both fertility and female labor force participation rates.

of gendered barriers to labor market access. Second, this study illuminates the implications of intersectionality theory for the contemporary labor market, emphasizing how multiple identity axes, such as age and gender, simultaneously interact to shape economic outcomes, despite the possibility that age and gender independently may not produce biased impacts. Our findings indicate that the shadow mommy effect significantly reduces labor market participation among women of prime childbearing age, exacerbating structural inequities. By elucidating the mechanisms underlying this form of discrimination, we provide actionable insights for labor policies aimed at enhancing gender equity. Finally, this study links employment discrimination with declining fertility trends, providing new perspectives on how labor market inequalities intersect with demographic challenges.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and outlines the institutional background. Section 3 details the experimental design of the field experiment, including the preexperiment surveys and implementation of correspondence testing. Section 4 describes the data collected and the empirical models of the field experiment. Section 5 presents the results of the field experiment. Section 6 presents the experimental design and results of the online experiment. The final section discusses the findings and concludes the paper.

2 Related Literature and Institutional Background

2.1 Child Penalty and Gender Disparity in the Workforce

Gender inequality in the workplace is a global phenomenon, with a noticeable disparity persisting in the workforce, even in the most gender-equal societies (Kleven et al., 2019a,b). The child penalty is one of the primary issues contributing to the enduring gender disparities in the labor market (Kleven et al., 2019a,b; Goldin, 2021; Andresen and Nix, 2022; Cortés and Pan, 2023; Zhang et al., 2024). Kleven et al. (2019a) illustrate that women face an average long-term earnings reduction of 20% due to children, a trend observed across six countries with varying policies and norms.

China serves as a representative example of a large emerging economy. The labor force participation rate among women in China is relatively high compared to that in other Asian countries and worldwide. However, since China's market-oriented economic reform, women's labor force participation has declined from 73% in 1990 to 59% in 2020 (Liu et al., 2014; Brussevich et al., 2021). The ratio of women to men in the labor force has also declined over recent decades. This is particularly striking given that women have already surpassed men

in higher education enrollment in China.[2] Several studies have highlighted how childcare responsibilities hinder women's engagement in the labor force, particularly among those with preschool-aged children (Maurer-Fazio et al., 2011; Du and Dong, 2013; Liu et al., 2014; Connelly et al., 2018; Zhang et al., 2024). Recent evidence reveals that fertility policies intended to motivate families to have more children might inadvertently deepen gender inequality in the labor market. Studies by Du (2023), Agarwal et al. (2024), Chen and Tian (2025), and Huang and Fan (2025) indicate that the relaxation of China's one-child policy has adversely impacted female labor force participation and exacerbated the gender wage gap. He et al. (2023) found that the transition from the one-child to the two-child policy adversely affected women's job prospects more than men's. Li and Xiao (2025) demonstrated fertility discrimination against married women in the Chinese labor market following the implementation of the three-child policy.

2.2 Perceived Fertility and the Shadow Mommy Effect

While most studies have explored women's child penalty on the basis of realized fertility, few have recognized that the impact extends beyond actual mothers. Empirical evidence reveals workplace biases against married, childless women, attributable to the "maybe baby" bias, which anticipates imminent pregnancy (Petit, 2007; Gloor et al., 2018; Becker et al., 2019; Gloor et al., 2022; Wang and Chen, 2023; Li and Xiao, 2025). This bias can be seen as a specific instance of the shadow mommy effect, which broadens discriminatory practices to encompass all women of prime childbearing age, regardless of their current maternal status or intentions to have children. This bias can be readily triggered by minimal information, with age and gender serving as significant demographic factors, in alignment with an intersectionality perspective (Gloor et al., 2022; Delacruz and Speer, 2023; Zamberlan et al., 2024).

Our study advances existing research by pinpointing the shadow mommy effect on labor demand in China's job market through simulations of the job-seeking process. Online labor marketplaces play a pivotal role in hiring and employment and have become the predominant channel for job seekers and recruiters in China. Starting in 2019, employers were legally prohibited from inquiring about a female applicant's marital and parental status or from using these factors as a basis for hiring decisions (Kuhn and Shen, 2023). Consequently, online job boards offer standardized resume templates that omit information about marital and parental status, allowing job seekers to complete them. However, this practice may unintentionally incentivize

[2] According to Education Statistics for 2020, the proportion of female students in undergraduate programs was 50.96%, whereas it was 52.53% in master's programs. The data were retrieved from the Ministry of Education of the People's Republic of China at http://www.moe.gov.cn/jyb_sjzl/moe_560/2020/quanguo/202108/t20210831_556360.html.

employers to broadly discriminate against all women perceived as current or prospective mothers. Given that employers cannot directly determine female applicants' marital and maternal status from their resumes, intersectionality theory suggests that they may interpret women of prime childbearing age as potentially bearing impending or current fertility-related responsibilities. This perception could lead to statistical discrimination against all women of prime childbearing age. Employers may view hiring women in this age group as potentially imposing additional costs on business operations, driven by concerns over maternity leave, childcare needs, and possible disruptions to work schedules (Jessen et al., 2019; Gloor et al., 2022; Cortés and Pan, 2023; He et al., 2023; Li and Xiao, 2025).

During the time of our study, the duration of paid maternity leave in China ranged from approximately 128 to 178 days, varying by province. Therefore, employers may perceive hiring female employees who take paid maternity leave as financially burdensome, as the public social security system does not fully cover their salaries, requiring employers to supplement the remaining amount during the leave period (Li and Xiao, 2025). Furthermore, an additional cost is incurred in arranging temporary replacements to fulfill the duties of employees on maternity leave. Consequently, employers situated in cities with elevated labor costs and those with heightened cost sensitivity may have a reduced likelihood of hiring female employees of prime childbearing age.

This bias could be aggravated by the significant difference in parental responsibilities between women and men (Zhang et al., 2024). Compared with the duration of maternity leave, the duration of paternity leave is relatively brief, usually ranging from approximately 10 to 30 days; furthermore, paternity leave is voluntary. In accordance with traditional gender norms, females in most Chinese families bear the primary responsibility for childcare, while males contribute less (Maurer-Fazio et al., 2011; Du and Dong, 2013; Connelly et al., 2018). Hence, concerns may emerge about the possible reduction in productivity among women of prime childbearing age who are concurrently engaged as caregivers for their young children. In essence, when there is a greater difference in how parental status affects women and men, women of prime childbearing age are more likely to face discrimination in the job market.

3 Experimental Design

3.1 Cities Included in the Field Experiment

The experiment was conducted in four prominent metropolises often referred to as first-tier cities in China: Beijing, Shanghai, Guangzhou, and Shenzhen. Marked by rapid urbanization,

technological innovation, and vibrant business ecosystems, these four megacities collectively represent China's foremost urban centers. With their similar levels of economic development, they offer a rich array of employment opportunities across diverse industries and enterprises, serving as hubs for a significant portion of the country's workforce.[3]

Beijing and Shanghai provide maternity leaves of 128 to 158 days, whereas Guangzhou and Shenzhen provide leaves of 178 days. Paternity leave spans 10 days in Shanghai and 15 days in the remaining three cities. Despite the short duration, the use of paternity leave is not widespread. In a recent survey conducted by the Beijing Federation of Trade Unions, the findings revealed that 41.78% of the surveyed employees had never utilized paternity leave, and 39% of the respondents were uncertain about the availability of paternity leave within their respective units. Despite knowing about paternity leave, 64.53% of employees choose not to take it, fearing its impact on their careers.[4]

3.2 Preexperimental Survey

To gain more insight into the key experimental elements relevant to correspondence testing, specifically, the conventional prime childbearing age for women in the focal cities, we conducted preexperimental online surveys targeting full-time workers in each of the four megacities between December 2020 and January 2021. There were 73 questions on the questionnaire, which explored people's viewpoints regarding gender discrimination in the workplace and certain demographic information.[5] As shown in Table B.1, 572 questionnaires were retrieved, with an even distribution across genders and cities.

3.2.1 Age Categories

Since marital and parental status are typically omitted from CVs in the Chinese job market, being of prime childbearing age signals a perceived likelihood of parenthood. To identify the perceived prime childbearing age, survey participants were asked what they believed was the typical age at which parents had their first child. According to the survey data depicted in Figure 1, the age group most likely to be perceived as having their first child consists of those aged 27–29, an age range commonly regarded as the onset of childbearing according to the participants' responses. We further integrated these data with findings from the 2020 National

[3]The study was confined to four cities rather than being nationwide, owing to the diversity in China's development levels, economic disparities, and social norms. As the country's most progressive regions, these four cities theoretically offer women a wider array of career opportunities for self-fulfillment than other cities in China do. This setting allows us to scrutinize issues related to labor demand, such as discrimination, without the complicating influence of diverse labor supply concerns.

[4]Source: http://www.news.cn/legal/2022-04/25/c_1128592428.htm.

[5]The full set of survey questions is available in Appendix C.1.

Census, which indicated that the average age of first marriage for women is 28 years and for men is 29 years.[6] As a result, we determined that the most likely age for women to have their first child was 29 years. Moreover, according to the fertility rates reported in the 2020 national census, the average number of births per woman was 0.8 in Beijing, 0.7 in Shanghai, and 1.2 in Guangdong Province, where Guangzhou and Shenzhen are located, implying that having only one child remains prevalent in Chinese families, despite the relaxation of the one-child policy.

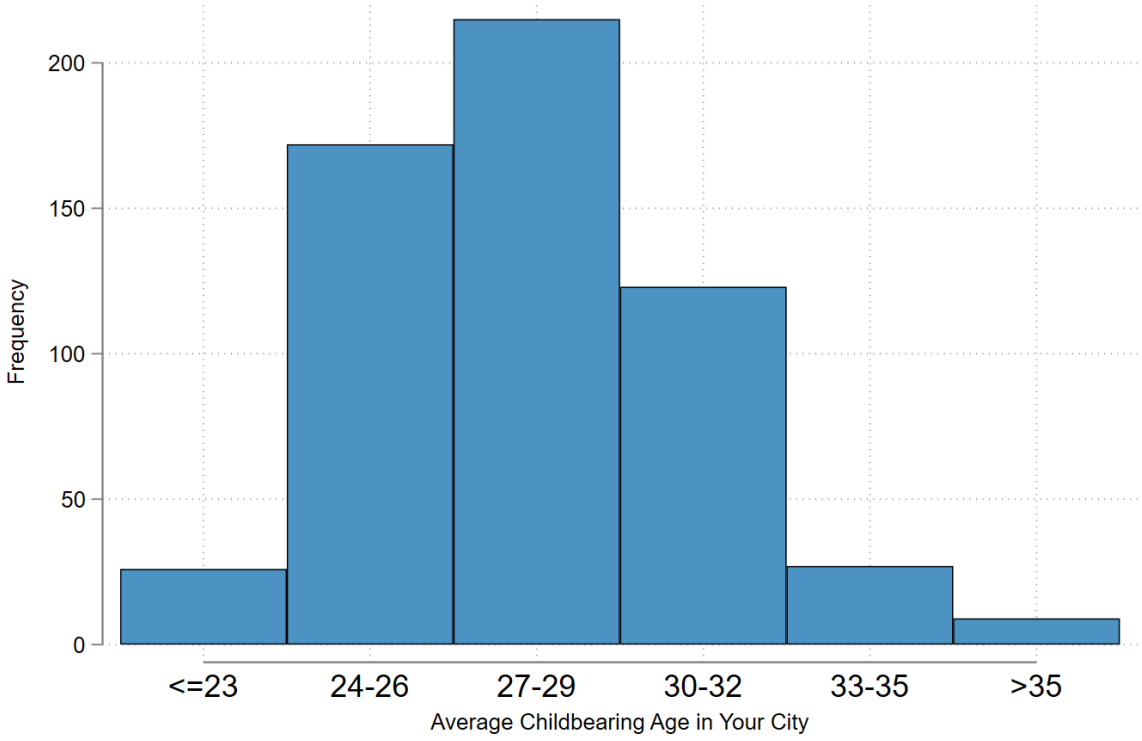


Figure 1: The conventional age for first-time parenthood

Note: Data obtained from the preexperiment survey conducted by the authors. The related question is as follows: "Please estimate the average age at which people have their first child in your city".

All the job applicants in our experiment possessed a bachelor's degree. It is common in China for people to graduate from a university with a bachelor's degree at age 22. The prefertility age was set at 24 years, not only because most people in the four cities do not have their first child before this age but also because it is likely that individuals will enter the job market after gaining two years of work experience following graduation. The late fertility age was 34 years, since it is commonly believed that most individuals have already welcomed their first child by this age, as shown in Figure 1. Additionally, in China, ageism at work can begin as early as 35, which is sometimes referred to as the "age-35 phenomenon" (Leng and He, 2021;

[6]Nonmarital births are uncommon in China, with most couples choosing to have children after marriage.

Huang and Zhang, 2021). Hence, we limited our experiment to individuals younger than 35 years to mitigate the potential confounding effect of age discrimination.[7]

3.2.2 Occupation Categories

The level and direction of gender discrimination can vary across occupations due to gender stereotyping (Weichselbaumer, 2004; Riach and Rich, 2006; Booth and Leigh, 2010; Carlsson, 2011; Zamberlan et al., 2024). The current experiment, therefore, focused on a female-dominated field of occupation, a male-dominated field of occupation, and a mixed-gender occupation. Our survey collected information on gender stereotyping in several occupations that were recruited through online job postings, as shown in Table B.2. Given the information presented, we selected accounting (ACC) as a female-dominated field, information technology (IT) as a male-dominated field, and human resources (HR) as a mixed field. These choices were based on the substantial number of job openings available on the market in these three professions.

3.2.3 Perspectives on Child Penalty by City

Despite providing information to guide the experiment, the preexperiment survey was useful for gaining insight into people's perspectives on the child penalty at work. Specifically, survey participants were asked to express their views on whether motherhood has a detrimental effect on women's careers and whether fatherhood has a similar effect on men's careers. Their responses were recorded on a scale ranging from 0 (strongly disagree) to 10 (strongly agree). As depicted in Figure 2, individuals in each city tend to agree that motherhood has a negative effect on women's careers, as the average rating exceeds 5 in each city, as illustrated by the pink circle line. In contrast, the average level of agreement about fatherhood harming men's careers is less than 5 in each city, as plotted by the blue square line, indicating that most people do not agree with this statement. Accordingly, the gray triangle line illustrates the disparity between the average levels of these two statements, which can be interpreted as the "child penalty" (the adverse effect on an individual's career attributed to motherhood compared with fatherhood) perceived by respondents. Beijing presented the highest "inferred child penalty", followed by Shanghai, Guangzhou, and Shenzhen.

[7] We chose discrete age categories over a continuous age range to differentiate between the pre-prime, prime, and late-prime childbearing phases. This decision was driven by practical constraints during online job applications, as the internet real-name system in China necessitates managing a finite number of fictitious job candidates. Thus, each job candidate's account was tied to a distinct mobile number, which in turn was linked to a unique citizen identification number. Given a limited number of applicant profiles, we randomized job applications at the employer level, leveraging the high volume of job postings on the recruitment website for our field experiment. The comprehensive procedures outlining how we conducted the experiment are provided below.

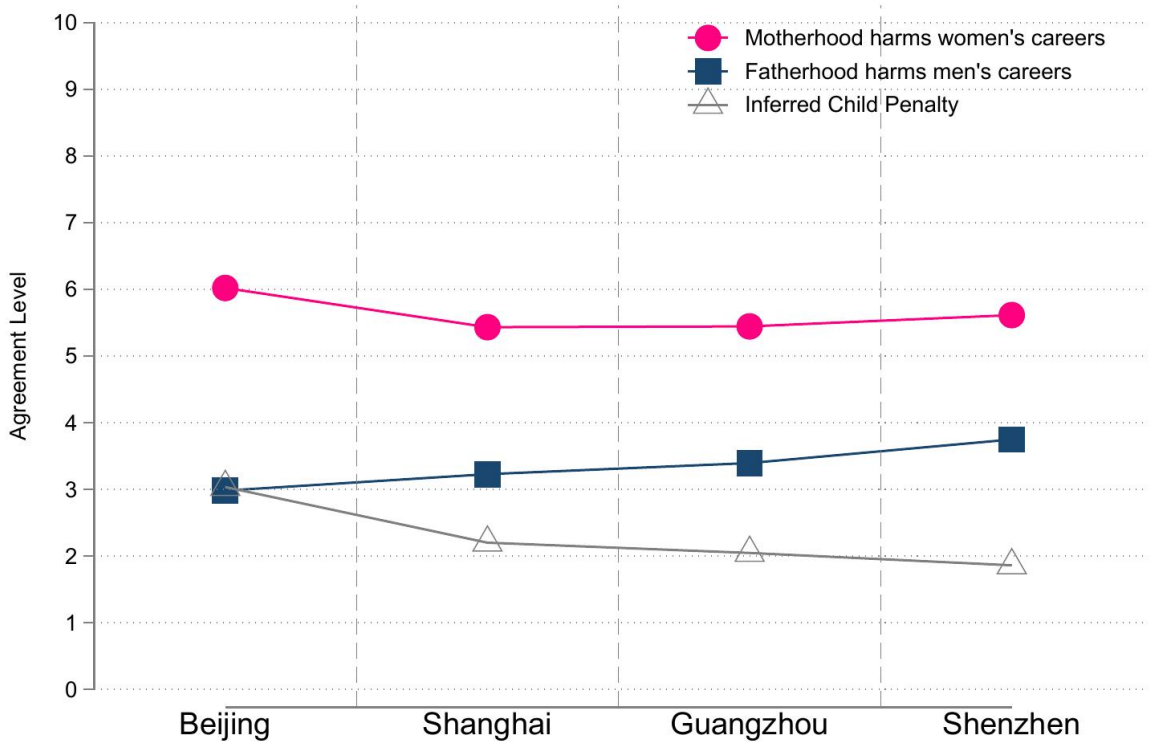


Figure 2: Respondents' perspectives on parental impact in organizations

Note: Data obtained from the preexperiment survey conducted by the authors. The related questions are as follows: "Do you agree with the statement that having a child negatively affects a woman's/man's career?" The responses were collected via a scale ranging from 0 (strongly disagree) to 10 (strongly agree).

3.3 Correspondence Testing

The correspondence test was conducted on one of China's largest, leading recruitment websites, 51job.com. Job applicants must register an account on the website using their mobile number, which is linked to their citizen identification number, before they may apply for jobs online. The website provides a standard resume template for job candidates, including name, gender, age, date of birth, educational background, work experience, job intentions, salary expectations, skills, professional certificates, and contact information. In each of the three fields we targeted, we generated resumes for female and male candidates aged 24, 29, and 34 years. Thus, 18 modules of fictitious resumes were generated.

3.3.1 Signaling Potential Maternal Status: Women of Prime Childbearing Age

Drawing on intersectionality theory, our primary focus group consisted of 29-year-old female job applicants, perceived as likely to be having their first child, and 34-year-old female applicants, perceived as being in the early stages of motherhood. The comparison group

included 24-year-old women and men aged 24, 29, and 34. Gender information was generally included in the resumes. Additionally, we developed different feminine and masculine given names whose gender identities were verified in the preexperiment surveys, combining them with the most common Chinese surnames. These names were randomly assigned to applicants according to their gender.

3.3.2 Other Characteristics of Fictitious Resumes

All the applicants were described as holding a bachelor's degree from Chang'an University in a field relevant to their intended profession. Chang'an University is a key national university located in Xi'an, the capital of Shaanxi Province, far from the four experimental cities. We selected this university not only because most employers consider it a fair school but also because we wanted to avoid any preference of local employers for local universities. The applicants' previous work experience was carefully fabricated to match their age and specialty. The applicants' skills, project experience, professional certifications, and salary expectations for the next job were also aligned with their previous work experience and seniority. As is common in social recruitment, all applicants were described as currently employed and looking for new opportunities. They were also described as currently residing and working in Wuhan, the capital city of Hubei Province, which is approximately the same distance from each of the four experimental cities. All the applicants claimed to be able to move to a new city for interviews and a new job.

Each applicant's contact information was unique and included her or his mobile number and email address. A photograph of the applicant was not included in the resume as it is customarily optional and because facial attractiveness may influence interview callbacks (Maurer-Fazio and Lei, 2015; Deng et al., 2020). Appendix C presents an example of a fictitious resume.

3.3.3 Experimental Procedure

The experiment and data collection took place between March and June 2021, the peak period for social recruitment. We collated all job vacancy advertisements for IT, accounting, and HR positions from 51job.com, posted within the preceding 30 days, via a web-scraping program. We kept full-time positions in Beijing, Shanghai, Guangzhou, and Shenzhen that required a bachelor's degree. We excluded positions with a posted monthly salary exceeding 40 thousand CNY to exclude high-end positions. We then randomly divided all positions within each field (IT, accounting, and HR) into six groups based on all available job posting

information, including firm details, job requirements, and expected salary, ensuring that each group was balanced across all characteristics on average. Finally, we submitted one application for each of the six resume types (two genders across three age categories) to every vacancy within each group in each field—IT, accounting, and HR. Each job position within a single firm received only one application from our experiment. In total, 35,713 job applications were successfully submitted. Figure B.1 presents a schematic diagram of the job application process used in our correspondence tests across occupational fields.

With randomization at the employer level, this procedure was appropriate given the limited number of job candidate accounts; it also reduced the likelihood of employers identifying fictitious applicants and minimized disruption to their operations. Moreover, the stable unit treatment value assumption is unlikely to be violated, as can occur in paired designs, potentially leading to biased results (Phillips, 2019).

Positive responses from employers were captured as callbacks in our experiment, which were carefully tracked via mobile phones, text messages, emails, and messages from the 51job.com inbox. Contact is normally not made if the employer is not interested. An interview is usually the next step after a callback. In our experiment, the majority of callbacks occurred within a week. Six research assistants, three males and three females who mimicked the six applicants in each occupation, assisted with responding to and recording the callbacks. In response to a callback, our research assistants promptly informed the employer that the applicant was no longer available for the position, thus enabling them to move on to a different job candidate.

4 Data, Variables, and Empirical Models

4.1 Summary Statistics for the Experimental Sample

4.1.1 Application Characteristics

Table 1 presents summary statistics for the experimental sample and the variables used in the analysis. The sample has an equal distribution across genders, age levels, and occupations. Each job advertisement to which we responded received an average of approximately 150 applications, signifying intense competition on the labor supply side. As further illustrated by the upper plot in Figure A.2, the accounting field was the most competitive, followed by the HR and IT fields.

Approximately 33% of our applicants possess work experience that aligns perfectly with the expectations of the positions. A dummy variable was defined for those applications with

Table 1: Summary Statistics

Variables	Mean	Standard Deviation	Min	Max
Application Characteristics:				
Female Applicant	0.50	0.50	0	1
Male Applicant	0.50	0.50	0	1
Applicant Age: 24	0.34	0.47	0	1
Applicant Age: 29	0.33	0.47	0	1
Applicant Age: 34	0.33	0.47	0	1
Applicant's experience: Good match	0.33	0.47	0	1
Applicant's expected salary matched	0.44	0.50	0	1
Information Technology (IT)	0.35	0.48	0	1
Accounting (ACC)	0.35	0.48	0	1
Human Resources (HR)	0.30	0.46	0	1
No. of applicants per advertised position	150.68	198.68	1	2449
City Dummies:				
Beijing	0.12	0.33	0	1
Shanghai	0.38	0.49	0	1
Guangzhou	0.22	0.41	0	1
Shenzhen	0.28	0.45	0	1
Firm Characteristics:				
Listed company	0.08	0.27	0	1
State-owned enterprise	0.07	0.26	0	1
Foreign company	0.19	0.39	0	1
Private enterprise	0.64	0.48	0	1
Non-listed company	0.02	0.12	0	1
Type unknown	0.00	0.02	0	1
Large-size (No.of employees≥1000)	0.19	0.39	0	1
Medium-size (150≤No.of employees<1000)	0.39	0.49	0	1
Small-size (No.of employees<150)	0.40	0.49	0	1
Size unknown	0.02	0.13	0	1

Notes: Total number of observations: N = 35713. The data were collected by the authors between March and June 2021.

well-matched experience. Approximately 44% of our applicants had salary expectations that matched the proposed salaries for the positions. A dummy variable was used to indicate a salary match.

4.1.2 City and Firm Characteristics

As shown in Table 1, the percentages of jobs applied for in Beijing, Shanghai, Guangzhou, and Shenzhen were 12%, 38%, 22%, and 28%, respectively. The job distributions in IT, accounting, and HR within each city are remarkably consistent, as depicted in the lower plot of Figure A.2. Our job applications were submitted to various firms with diverse characteristics, such as varying ownership structures and sizes, including state-owned enterprises, foreign-invested enterprises, listed companies, nonlisted companies, private companies, and companies of different sizes.

Considering that randomization occurs at the employer level in our experimental procedure, we conduct a balancing test of characteristics relevant to firm attributes in job postings. As illustrated in Figure A.3, the small and statistically insignificant estimated coefficients suggest that there is no selection effect where women or women of prime childbearing age categories are associated with any specific characteristics of job postings. This ensures that the randomness is verified and that there is no selection effect on our key variables of interest.

4.2 Empirical Models and Variables

4.2.1 Baseline Analysis

We conduct a baseline analysis to examine the effects of gender and age on callback rates, following intersectionality theory, which considers the interaction of overlapping social identities. The linear probability model takes the following form:

$$Callback_{ij} = \alpha_j + \phi(Gender \times Age)_i + X_i'\gamma + \epsilon_{ij}, \tag{1}$$

where the dependent variable $Callback_{ij}$ is an indicator for applicant i receiving a callback for a job vacancy in city j. $Gender_i$ and Age_i represent the gender and age category dummies, respectively. Hence, Equation (1) contains six combinations of gender and age groups.

The vector of application characteristics X includes indicators for whether the applicant's work experience matches the requirements for the advertised position, whether the applicant's expected salary matches that of the advertised salary, the logarithm of the number of applications received for the advertised position, the work experience expected for the position, and

the field of the position (IT, accounting, or HR). In addition, we control for the characteristics of the company posting the position, such as its type, size, and industry. Fixed effects for the month of job posting and the month of application submission are also included. The set of city fixed effects α_j absorbs time-invariant city characteristics. Standard errors are clustered at the applicant level to account for any arbitrary correlation in the error term, ϵ_{ij}.

4.2.2 Main Specification

To investigate the impact of being of prime childbearing age on female applicants, we use the following linear probability model Equation (2) and estimate the probability of receiving a callback for job applicant i applying for a job in city j. The specification is as follows:

$$\begin{aligned} Callback_{ij} = \alpha_j + \beta_1(Female \times Age29)_i + \beta_2(Female \times Age34)_i + \beta_3 Female_i \\ + \beta_4 Age29_i + \beta_5 Age34_i + X_i'\gamma + \epsilon_{ij}, \end{aligned} \tag{2}$$

The variable $Female_i$ indicates whether applicant i is a woman. $Age29_i$ represents whether applicant i is 29 years old, an age commonly associated with peak childbearing and potential motherhood. Similarly, $Age34_i$ indicates whether applicant i is 34 years old, an age often perceived as being in the early stages of motherhood.

Equation (2) is the principal empirical model for examining the impact of women's prime childbearing age on job opportunities. One of the key variables of interest in Equation (2) is the interaction term $Female \times Age29$, where the coefficient of interest, β_1, captures the distinct effect of a 29-year-old female applicant on the callback rate. Additionally, the interaction term $Female \times Age34$, with its coefficient β_2, quantifies the explicit impact of being 34 years old on the callback rate for female applicants. β_3, β_4, and β_5 represent the callback rates for female applicants aged 24, male applicants aged 29, and male applicants aged 34, respectively, relative to the reference group of male applicants aged 24. The other variables in Equation (2) have the same meanings as those described in Equation (1).

5 Results

5.1 Raw Callback Rates

Table 2 summarizes the means of the raw callback rates and the number of job applications by gender. The unconditional probability of receiving a callback among females is 1.60%, whereas that among males is 1.34%. Considering that the average number of applications

received for a single position was 150, competition from the labor supply side appears to have been fierce. The callback rate for female applicants in the 24- and 34-year-old age groups is greater than that for male applicants (2.26% vs. 1.60% and 1.06% vs. 0.61%), whereas among applicants in the 29-year-old age group, female applicants have a lower callback rate (1.48% vs. 1.80%). This is the initial sign of "maybe baby" bias, indicating that women at age 29 are at a relative disadvantage in the employment market. Compared with their male counterparts, female applicants receive fewer callbacks in IT (1.06% vs. 1.74%) but receive more callbacks in accounting (1.40% vs. 0.83%) and HR (2.47% vs. 1.47%). Compared with male applicants, female applicants are less likely to receive callbacks for jobs in Beijing (1.12% vs. 1.43%). The callback rate was greater in Shanghai (1.58% vs. 1.33%), Guangzhou (1.56% vs. 1.29%), and Shenzhen (1.88% vs. 1.36%). Women's higher callback rates in accounting and HR contribute to the overall higher callback rates for female applicants.

Table 2: Raw Callback Rates

	Female Applicants		Male Applicants	
	Callback Rate (in %)	No. of Observations	Callback Rate (in %)	No. of Observations
All	1.60	17916	1.34	17797
Age 24	2.26	6016	1.60	5991
Age 29	1.48	5942	1.80	5941
Age 34	1.06	5958	0.61	5865
IT	1.06	6324	1.74	6315
ACC	1.40	6214	0.83	6170
HR	2.47	5378	1.47	5312
Beijing	1.12	2148	1.43	2168
Shanghai	1.58	6843	1.33	6825
Guangzhou	1.56	3917	1.29	3797
Shenzhen	1.88	5008	1.36	5007

Notes: The variable "callback" indicates whether an applicant is invited to an interview during the experiment.

Moreover, we use ordinary least squares (OLS) to estimate Equation (1) and visualize the key estimated coefficient ϕ for each gender and age group in Figure 3. The pink triangle markers represent the estimated coefficients of the female dummy interacting with each age category, whereas the gray round markers represent the estimated coefficients of the male dummy interacting with each age category. The estimates for females and males in each age category are necessarily symmetric. Figure 3 depicts the estimated coefficients of ϕ for the whole sample and for each occupational field (IT, accounting, and HR), integrating them for comparative visualization. For the entire sample, the prime childbearing age of 29 years clearly has a negative effect on female applicants receiving callbacks from employers, whereas it has a positive effect on male applicants. This negative impact is statistically significant

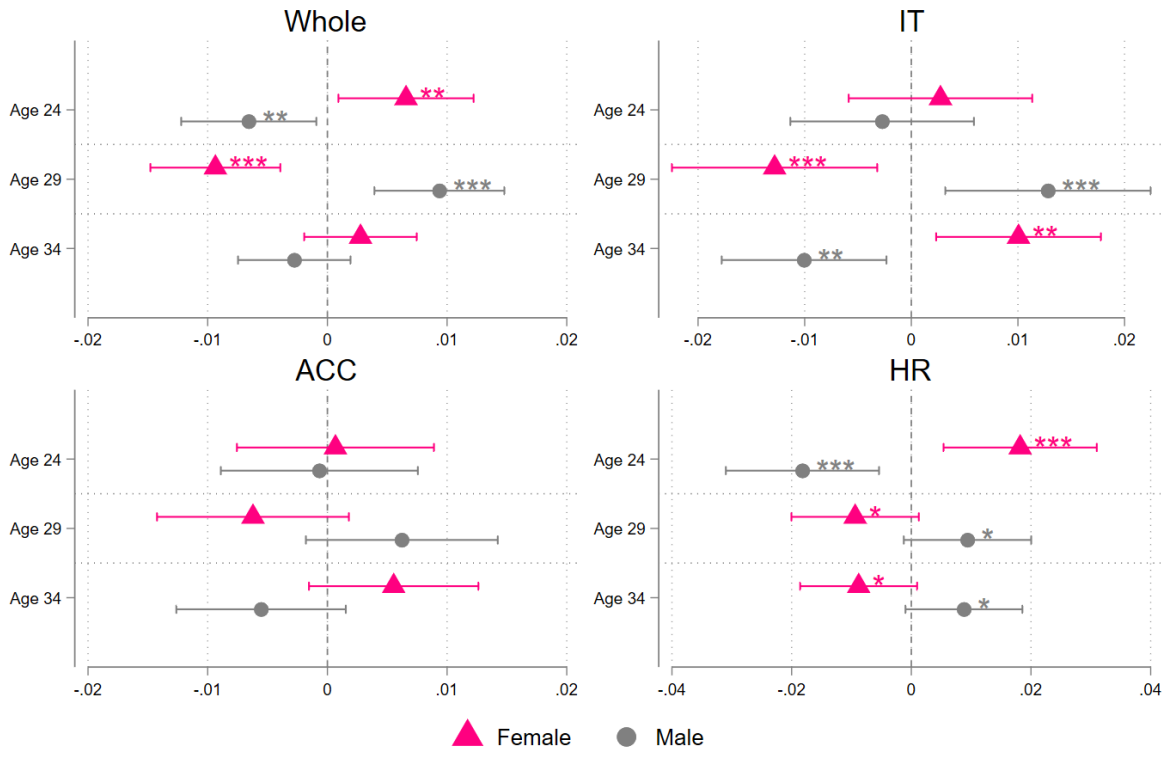


Figure 3: Callback Rates by Gender

Note: The graph displays the results of a baseline analysis on the callback rates for different age groups in each gender. The dependent variable is an indicator variable for whether the applicant is invited to an interview. The plots depict the estimated coefficients of the key variable of interest, namely, the interaction term between gender and age dummies in each regression. The pink triangle markers represent the estimated coefficients of the female dummy interacting with each age category, whereas the gray round markers represent the estimated coefficients of the male dummy interacting with each age category. The 95% confidence intervals are illustrated by the horizontal bars and their caps. The size of the p value is labeled $^{*}p < 0.1$; $^{**}p < 0.05$; and $^{***}p < 0.01$.

and driven primarily by job applicants in IT and HR. Female job applicants aged 34 also face statistically significant disadvantages in HR. For jobs in accounting, female applicants experience a comparative disadvantage in receiving callbacks at age 29, although the estimate is not statistically significant. There are also diverse patterns within different fields. For example, 34-year-old male applicants face disadvantages in IT, whereas 24-year-old female applicants are favored in HR. Nevertheless, the pattern of female applicants at age 29 remains notably consistent across all fields.

5.2 The Impact of Childbearing Age on Female Applicants

To test and quantify the impact of prime childbearing age on callbacks for female applicants, we use OLS regression to estimate Equation (2). The results are presented in Table 3 for the full

sample in Column (1) and for each field of occupation in Columns (2)-(4).[8]

Table 3: Impact of Childbearing Age on Callback Probability for Female Applicants

Dependent Variable:	Callback (yes=1; no=0)			
	Whole	IT	ACC	HR
	(1)	(2)	(3)	(4)
Female × Age 29	−0.011***	−0.010*	−0.005	−0.018**
	(0.003)	(0.006)	(0.005)	(0.007)
Female × Age 34	−0.003	0.005	0.003	−0.018***
	(0.003)	(0.005)	(0.004)	(0.007)
Female	0.007***	−0.005	0.006*	0.022***
	(0.002)	(0.004)	(0.004)	(0.006)
Age 29	0.001	0.011**	−0.001	−0.010*
	(0.003)	(0.005)	(0.004)	(0.006)
Age 34	−0.007***	−0.006*	−0.009**	−0.009*
	(0.002)	(0.004)	(0.003)	(0.006)
Working Experience Matched	0.008***	0.005*	0.006**	0.015***
	(0.002)	(0.003)	(0.002)	(0.004)
Expected Salary Matched	−0.000	−0.001	−0.002	−0.001
	(0.002)	(0.003)	(0.003)	(0.005)
Shanghai	0.004*	−0.001	0.005*	0.009**
	(0.002)	(0.004)	(0.003)	(0.004)
Guangzhou	0.000	−0.003	−0.001	0.006
	(0.002)	(0.004)	(0.003)	(0.005)
Shenzhen	0.003	−0.003	0.006**	0.009*
	(0.002)	(0.004)	(0.003)	(0.005)
Log No. Applicants	−0.004***	−0.003*	−0.002**	−0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Mean of Dep. Variable	0.015	0.014	0.011	0.020
Firm Characteristics	Yes	Yes	Yes	Yes
Observations	35713	12639	12384	10690

Notes: The dependent variable indicates variable for whether the applicant is invited to participate in an interview. The key variable of interest is whether the applicant is a woman of childbearing age (29 years of age). The set of covariates includes dummies for the applicant's age, whether her or his work experience matches the requirements of the advertised position, whether her or his expected salary matches the advertised salary, and the cities where the position is advertised; the logarithm of the number of applications received for the advertised position; and work experience expected for the advertised position. The firm's characteristics, including type, size, and industry, are controlled for. Fixed effects for the month of the job posting and the month of the application submission are also included. The model in Column (1) also controls for the field (IT, ACC, or HR). Robust standard errors in parentheses are clustered at the applicant level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

As shown in Column (1), being a female candidate at age 29 is associated with a 1.1 percentage point decrease in the probability of receiving a callback, a result that is statistically significant at the 1% level. Being 34 years old is associated with a decrease in the likelihood of a female candidate receiving a callback, although the estimate is statistically insignificant. Compared with male applicants aged 24, female applicants aged 24 are more likely, and male applicants aged 34 are less likely, to receive callbacks by 0.7 percentage points, respectively. As expected, having matched working experience increases an applicant's probability of receiving callbacks, whereas intense competition decreases it.

[8]The results remain robust to the Heckman-Siegelman critique (Heckman and Siegelman, 1993). We have applied the method proposed by Neumark (2012) to conduct a robustness check, with the detailed analysis presented in Appendix D.

Column (2) displays the results for the IT industry. Being 29 years old is associated with a decrease in the likelihood of female applicants receiving a positive response by 1.0 percentage points, which is statistically significant at the 10% level. By comparison, male applicants in the same age group are 1.1 percentage points more likely to receive a callback than those in the younger age group. Column (3) presents the results for the accounting field. Being 29 years old is associated with a slight, yet statistically insignificant, reduction of 0.5 percentage points in the likelihood of female applicants receiving a callback. The results for HR jobs are presented in Column (4). Both age 29 and age 34 negatively and significantly affect female applicants' chances of receiving callbacks from employers, with a decrease of 1.8 percentage points.

Overall, consistent with the findings depicted in Figure 3, it is apparent that being of prime childbearing age negatively impacts women's prospects in the job market, despite their maternity status being undisclosed. Women in this demographic group are particularly susceptible to discrimination within the IT and HR sectors. This indicates possible statistical discrimination against women of prime childbearing age, a phenomenon that could be termed the *shadow mommy effect*. In particular, women aged 29 are more disadvantaged than those aged 34 in terms of childbearing age in the hiring market. The findings indicate that the prospect of becoming a mother is subject to more discrimination than being perceived as already a mother in the early stages of motherhood. The likely reason is that pregnancy can lead to additional costs for employers due to maternity leave and associated factors, which indicates "maybe baby" bias (Gloor et al., 2018; Jessen et al., 2019; Gloor et al., 2022; Wang and Chen, 2023; Li and Xiao, 2025).

Moreover, our results indicate that employers' preference for hiring 24-year-old women over 29-year-old women may reflect an inability to foresee that younger women will shortly enter prime childbearing age. This trend suggests that some firms prioritize immediate maternity-related costs over a forward-looking hiring strategy. Employers' short-sighted hiring practices likely stem from elevated turnover rates in the Chinese labor market. Empirical data reveal that the average tenure of Chinese employees spans roughly 22 months, with younger workers, especially those under 23, remaining employed for as few as seven months (Hiller, 2018; Dani, 2020). This duration significantly differs from Western counterparts, where European employees typically remain with employers for over 10 years on average (Hiller, 2018). Age significantly influences tenure, with workers under 23 staying in their first job for only seven months, those aged 23 to 28 for approximately 19 months, and those aged 29 to 38 for about 3.5 years (Liu, 2018). Given these patterns, employers may view younger women as a lower-risk investment, assuming they will leave before maternity-related costs become a concern. Conse-

quently, employers' focus on short-term gains appears to overlook the long-term implications of workforce instability in a rapidly shifting demographic landscape.

However, the extent of the shadow mommy effect varies across occupational fields. Specifically, discrimination appears to be more pronounced in the IT sector, which has a predominantly male workforce, and in the HR sector, which has a more balanced gender composition, than in the accounting sector, where female workers outnumber male workers. This suggests that the impact of childbearing age on female applicants differs depending on the gender composition within occupations. The findings suggest that greater inclusivity within occupational fields tends to mitigate discrimination against women of prime childbearing age.

5.3 Heterogeneous Effects

To gain further insights into the underlying mechanisms, we conduct subsample analyses to explore heterogeneous effects.

5.3.1 Subsample Analysis by Firm Ownership

The ownership of a firm's structure creates distinct organizational characteristics and practices, which could lead to varied hiring preferences. For example, Zhou et al. (2013) demonstrated that various company types exhibit differing gender preferences during the hiring process. Thus, we conduct a subsample analysis based on the different types of firm ownership to explore the mediating and moderating effects of factors related to firm ownership on the shadow mommy effect.

First, we divide the total sample into state-owned enterprises (SOEs) and nonstate-owned enterprises (NSOEs). SOEs constitute a significant segment of the Chinese economy. According to World Bank estimates, the share of SOEs in China's GDP ranges from 23% to 28%, and their portion of total employment spans from 5% to 16% (Zhang, 2019). We estimate Equation (2) and plot $\widehat{\beta_1}$ and $\widehat{\beta_2}$, which are the estimated coefficients of the key variables of interest, $Female \times Age29$ and $Female \times Age34$, in Figure 4. The blue triangle markers represent estimated coefficients for the full sample, the orange square markers represent estimated coefficients for the IT field, the green diamond markers represent estimated coefficients for the accounting field, and the red circle markers represent estimated coefficients for the HR field. The upper-left plot in Figure 4 displays the estimates for SOEs, whereas the upper-right plot shows the results for NSOEs.

As shown, for jobs in SOEs, there is no statistically significant negative association between being a woman of prime childbearing age and callback rates. However, among NSOE jobs,

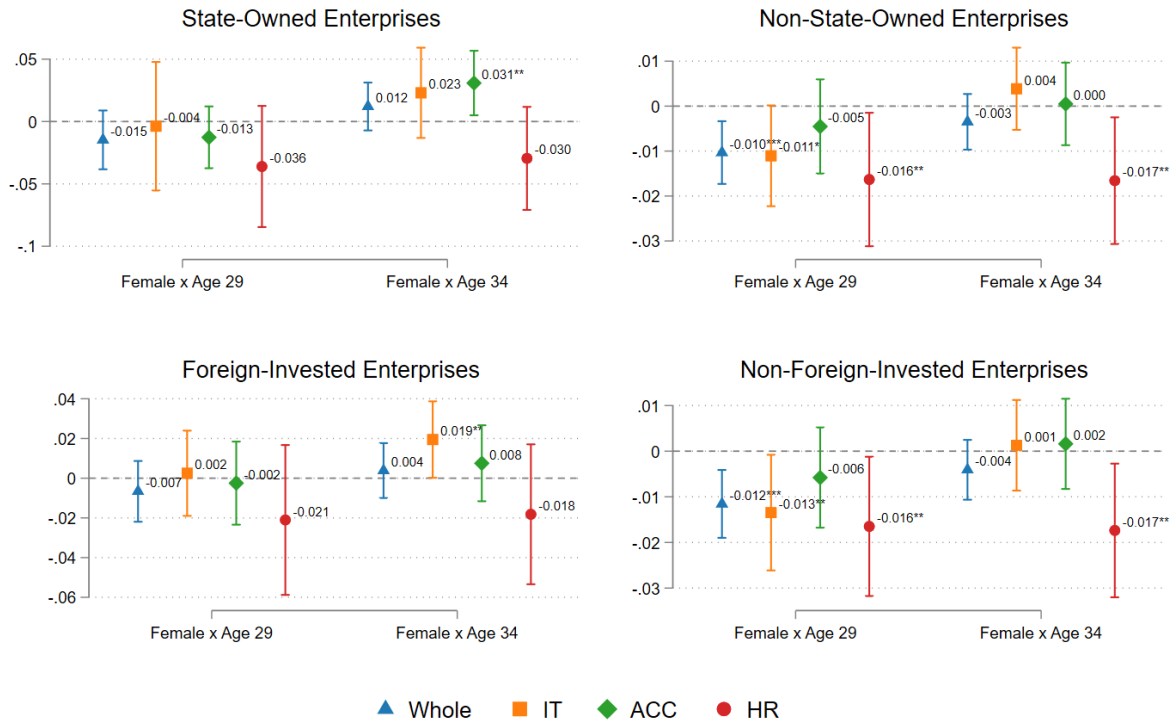


Figure 4: Impact of Age of Childbearing Age on Female Applicants by Firm Ownership

Note: The graph presents the results of a subsample analysis in which the positions advertised were with SOEs, NSOEs, FIEs, and NFIEs. The dependent variable is an indicator variable for whether the applicant is invited to an interview. The plots show the estimated coefficients of the key variables of interest: whether the applicant is a woman of prime childbearing age (29 years of age) and whether the applicant is a woman of late childbearing age (34 years of age). The corresponding regression estimates are labeled. The blue triangle markers represent estimated coefficients for the full sample, the orange square markers represent estimated coefficients for the IT field, the green diamond markers represent estimated coefficients for the accounting field, and the red circle markers represent estimated coefficients for the HR field. The 95% confidence intervals are illustrated by the vertical bars and their caps. The size of the p value is labeled $^{*}p < 0.1$; $^{**}p < 0.05$; and $^{***}p < 0.01$.

being 29 years old reduces women's callback rate by 1.0 percentage points, which is statistically significant at the 1% level. For IT positions, being 29 years old significantly decreases a woman's callback rate by 1.1 percentage points; similarly, for HR positions, being 29 and 34 years old significantly lowers a woman's callback rate by 1.6 and 1.7 percentage points, respectively. A comparison of the estimates with those of the main results in Table 3 reveals that the magnitude of the estimated coefficients is quantitatively similar, which indicates that the main results are driven primarily by jobs in NSOEs.

Owing to government support and subsidies, SOEs are generally less cost sensitive than private companies are (Lin et al., 2020). Therefore, the potential costs related to childbearing for women, which NSOEs are more sensitive to, could be a key mediating factor underlying the statistical discrimination against women of prime childbearing age (Jessen et al., 2019). Additionally, Qian and Yang (2023) found that Chinese companies with state ownership are more oriented toward public interests, which contributes to stronger environmental, social, and governance (ESG) performance than their non-state-owned counterparts. Gender equality is intricately woven into all aspects of the ESG framework, acting as a key driver in advancing ESG commitments (iSAW, 2022). As SOEs demonstrate stronger ESG performance than NSOEs, this orientation could help mitigate the shadow mommy effect.

Moreover, we divide the total sample into foreign-invested enterprises (FIEs) and nonforeign-invested enterprises (NFIEs) and estimate Equation (2) for each subsample and by field. The lower plots in Figure 4 display coefficient plots for each subsample of FIEs and NFIEs. As shown by the lower-left plot, the estimates indicate that there is no statistically significant evidence of discrimination against female applicants of prime childbearing age who apply for positions in FIEs across all three fields. However, the lower-right plot indicates that for positions within NFIEs, being 29 years old reduces the callback rate for female applicants by 1.2 percentage points. This reduction is significantly influenced by employment in the IT and HR sectors. Furthermore, being 34 years old correlates with a lower callback rate for female applicants in HR roles. Once more, the magnitudes of the estimated coefficients closely align with the point estimates in the main results from Table 3, underscoring that positions in NFIEs shape the primary effects.

Although ESG principles are gaining prominence in China, their adoption remains relatively nascent compared to Western practices (Liu et al., 2023). Consequently, FIEs are more likely to exhibit advanced ESG practices, placing greater emphasis on gender equity. Tang and Zhang (2021) found that foreign affiliates from countries with a stronger focus on gender equality tend to employ a higher proportion of women and appoint more female managers in China. The

finding that FIEs do not discriminate against potential mothers aligns with Tang and Zhang (2021). Strong ESG practices within these companies may help mitigate the potential shadow mommy effect.

5.3.2 Subsample Analysis by City

To explore the situation in different cities, we conduct a subsample analysis by city. We estimate Equation (2) for each city and by field. Coefficient plots for $\widehat{\beta_1}$ and $\widehat{\beta_2}$, which represent the estimated coefficients of the key variables of interest, $Female \times Age29$ and $Female \times Age34$, are depicted in Figure 5. For jobs in Beijing, being 29 years old significantly decreases the callback rate for women by 1.9 percentage points. The impact is evident, with a 3.5 percentage point reduction for jobs in IT and a 2.2 percentage point reduction for jobs in accounting. In Shanghai, being aged 29 significantly lowers women's callback rates by 1.5 percentage points. The adverse impact is primarily observed in positions within HR, where being aged 29 reduces female applicants' callback rates by 4.1 percentage points. Additionally, women at age 34 experience similar negative effects. However, in Guangzhou, there is no evidence of discrimination against women of prime childbearing age, as the estimates for the key variable of interest are small and insignificant. Similarly, there is no statistically significant evidence in Shenzhen that being of prime childbearing age decreases the callback rate for female applicants. Overall, the shadow mommy effect, indicating discrimination on the basis of perceived maternal status, is most pronounced in Beijing and Shanghai but is not evident in Guangzhou and Shenzhen.

There could be several reasons why the shadow mommy effect is heterogeneous across cities. One likely reason could be labor costs. Women must take maternity and childcare leaves during the initial stages of motherhood. For employers, this entails finding temporary employees to perform their duties during such absences. Thus, the higher the labor costs in a city are, the more expensive it is for employers to hire temporary workers. Figure A.4 depicts the average annual salaries in Beijing, Shanghai, Guangzhou, and Shenzhen from 2017 to 2021. As observed, Beijing has the highest average salary, closely trailed by Shanghai, with both surpassing the average salaries in Guangzhou and Shenzhen. This indicates that labor costs in Beijing and Shanghai are notably higher than in Guangzhou and Shenzhen. Therefore, employers in Beijing and Shanghai might be less inclined to hire women in their prime childbearing years because of the potentially higher additional costs they may incur, especially when they are more sensitive to costs. This aligns with Jessen et al. (2019)'s findings in Germany, which suggest that costs play a significant role in driving discrimination against

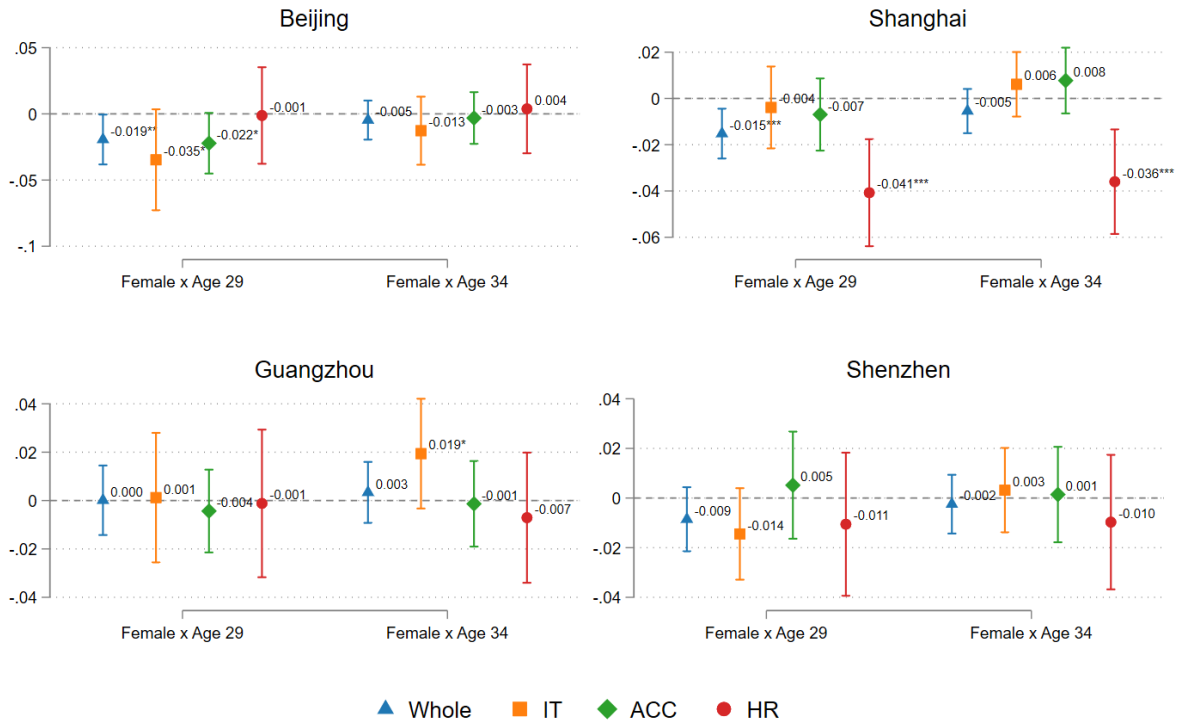


Figure 5: Impact of Age at Childbearing Age on Female Applicants by City

Note: The graph presents the results of a subsample analysis in which the advertised positions are located in Beijing, Shanghai, Guangzhou, and Shenzhen. The dependent variable is an indicator variable for whether the applicant is invited to an interview. The plots show the estimated coefficients of the key variables of interest: whether the applicant is a woman of prime childbearing age (29 years of age) and whether the applicant is a woman of late childbearing age (34 years of age). The corresponding regression estimates are labeled. The blue triangle markers represent estimated coefficients for the full sample, the orange square markers represent estimated coefficients for the IT field, the green diamond markers represent estimated coefficients for the accounting field, and the red circle markers represent estimated coefficients for the HR field. The 95% confidence intervals are illustrated by the vertical bars and their caps. The size of the p value is labeled $^{*}p < 0.1$; $^{**}p < 0.05$; and $^{***}p < 0.01$.

women with potential maternal status.

Additionally, differences in parental responsibilities related to the traditional homemaker-breadwinner norm may work in concert with the level of the child penalty in different cities (Kleven et al., 2019a; Andresen and Nix, 2022; Doepke et al., 2023; Zhang et al., 2024). As revealed by the preexperimental survey, people generally agree more strongly that motherhood negatively impacts a woman's career than does the perception that fatherhood affects a man's career. As depicted in Figure 2, the agreement that motherhood harms women's careers is most pronounced in Beijing. Conversely, the consensus that fatherhood has a detrimental effect on men's careers diminishes from Shenzhen, Guangzhou, Shanghai, to Beijing. Since the child penalty reflects the effects of parenthood on women relative to men, this pattern implies that the child penalty is more severe in Beijing and Shanghai than in Guangzhou and Shenzhen, which is consistent with the results from the correspondence test. Furthermore, this may imply that the gendered institution of the homemaker-breadwinner norm is stronger in cities with a larger child penalty. In summary, discrimination against perceived maternity status could be fostered by the substantial disparity in how parental status impacts the careers of women and men. This discrepancy likely arises from traditional differences in parental responsibilities, rooted in the gendered institution of the homemaker-breadwinner norm.

Moreover, given recent research emphasizing the vital role of childcare in female labor force participation in China (Zhou et al., 2022), we explore potential differences in childcare support among these four cities that may contribute to varying outcomes. Because of the scarcity of public childcare facilities and limited childcare services on the market, it is common in China for grandparents to play a significant role in raising children, especially those younger than three (Ji et al., 2020; Wang et al., 2021; Meng et al., 2023).[9] Deng et al. (2023) and Meng et al. (2023) reported that the accessibility of grandparental childcare could mitigate discrimination by companies against women with children and decrease the motherhood penalty in China. Therefore, we examine differences in the availability of grandparental childcare among Beijing, Shanghai, Guangzhou, and Shenzhen. We gather data on the amount of time grandparents spend caring for their grandchildren from the China Health and Retirement Longitudinal Study (CHARLS).[10] According to the CHARLS data from 2018, grandparents in Beijing spend 673.6 annual hours caring for their grandchildren, whereas in Shanghai, this figure is 1102.6 hours. In Guangzhou, this figure is 2320.1 hours, whereas in Shenzhen, it is 2072.8 hours. Indeed, it is evident that grandparents in Guangzhou and Shenzhen invest significantly more

[9] In China, the minimum age for kindergarten enrollment is typically three years.

[10] The CHARLS is a nationally representative sample of Chinese residents aged 45 and above and is designed to support scientific research on elderly individuals (Zhao et al., 2014).

time caring for their grandchildren than do grandparents in Beijing and Shanghai. Consistent with prior research, our findings on the presence of the shadow mommy effect in Beijing and Shanghai suggest that adequate childcare support may mitigate labor market discrimination against perceived maternal status.

Furthermore, recent findings on gender equity and fertility reveal a negative correlation between labor market gender discrimination and fertility rates in urban areas, highlighting the broader link between fertility and development at the macro level (Adserà, 2004, 2005; Da Rocha and Fuster, 2006; Myrskylä et al., 2009; Nakagaki, 2018). Greater discrimination against women of prime childbearing age signifies a more challenging balance between family and career for women in society. In situations where a balance between career and family is manageable, women are able to pursue professional careers while raising children, leading to increased fertility rates and higher levels of female workforce engagement. Conversely, when career and family aspirations clash, the number of working women decreases, accompanied by a decrease in childbirth rates (Goldin, 2021; Doepke et al., 2023). According to the Municipal Bureau of Statistics, in 2021, approximately 6.35 children were born per 1,000 regular residents in Beijing, 4.67 children were born per 1,000 regular residents in Shanghai, 11.82 children were born per 1,000 regular residents in Guangzhou, and 10.37 children were born per 1,000 regular residents in Shenzhen. The city-level fertility rate is clearly higher in Guangzhou and Shenzhen but notably lower in Beijing and Shanghai, where we observe a noticeable shadow mommy effect. This finding confirms a negative correlation between labor market discrimination against women of prime childbearing age and city fertility rates. These results align with Kim et al. (2019), who report that workplace gender discrimination in South Korea is linked to lower rates of pregnancy planning and childbirth.

6 Study 2: Survey Experiment

6.1 Experimental Design

We conducted an online survey experiment to *causally* identify the effect of childbearing on women's probability of being interviewed for the job applied. In the survey experiment, we have nine treatments by age groups (Age 24, Age 29, and Age 34) and occupations (ACC, IT, HR). Within each age group in Age 24 and Age 29 treatments, we had four conditions (not mentioning marriage status, married, married and mentioned that there is a possibility of providing 150 days of maternity leave, married and with an one year old children). In the Age 34 treatment, we had one more condition condition (C5) that the candidate has a children of

six years old. In each condition, we provided descriptions of female and male job candidates, and subjects were asked to pick one to hire, as if they were the employer. All conditions were randomized.

An Example (for Age 29): Subjects were shown the following: "Suppose you are an employer looking for an employee for an Accounting (HR (Human Resource), IT (Information Technology) position in your company. There are two candidates, one female and one male. The two candidates are identical in age, education, work experience and other aspects."

Then, they were shown all the four conditions (C1-C4) in randomized order, with the same description of the background information being displayed each time. The four conditions (in treatments Age 24, 29, 34) were:

C1. Candidate 1: Female, 24 (29, 34) years old.
Candidate 2: Male, 24 (29, 34) years old.

C2. Candidate 1: Female, 24 (29, 34) years old, married.
Candidate 2: Male, 24 (29, 34) years old, married.

C3. Candidate 1: Female, 24 (29, 34) years old, married, with the possibility of having 150 days of maternity leave.
Candidate 2: Male, 24 (29, 34) years old, married.

C4. Candidate 1: Female, 24 (29, 34) years old, married, with an one year old child.
Candidate 2: Male, 24 (29, 34) years old, married, with an one year old child.

C5. (for Age 34 only) Candidate 1: Female, 34 years old, married, with a six year old child.
Candidate 2: Male, 34 years old, married, with a six year old child.

The online survey experiment allowed us to test two main hypotheses. First, there is discrimination against female in the job market due to childbearing possibility even when the marriage status was not mention. This will be tested using condition C1 and we expect to observe the probability of female being hired to be lowest in Age 29. Second, when the possibility of childbearing is made more salient, there is stronger discrimination against female in the job market.

After completing the hiring tasks described above, Subjects participated in guessing tasks on the percentage of subjects choosing to hire the female candidate in each of the conditions they participated. The guesses were incentivized (subjects were told that 1% of the participants would be drawn for payment), with reward of RMB 2 if the guess was withing 5% of the actual percentage.

In total, 1800 subjects in Beijing, Shanghai, Guangzhou, and Shenzhen participated in the online survey, with 200 subjects for each treatment. Each subject participated in only one treatment. The online survey was conducted in Credamo which is a major survey platform in China. Subjects received a participation fee of RMB 2, in addition to the payment from the guessing tasks. We also elicited subjects' demographic information.

6.2 Experimental Results

6.2.1 Proportion Chosen to Hire Female

Our first result for the survey is that there was a clear evidence of discrimination against females due to the possibility of childbearing. Table 4 reports the proportion of subjects chosen to hire female in each of the conditions and ages (pooling the three occupations). The average was 0.57 for C1, where the possibility of childbearing was the least salient. The proportion (0.50) was lower in C2, and substantially lower in C3 (0.15) (where the possibility of 150 days of maternality leave was salient). The proportion observed in C4 (0.38) captures employers' concern about females responsibility of taking care of young children (1 year old), and subject concern was lower when the childdren gets older (6 years old), as shown in C5. These comparisons were statistically significant at 1% level based on the two-sample test of proportions.

Condition C1 was closest to our field experiment where no explicit marriage status was mentioned. In the survey experiment, we observed a consistent pattern as with the field experiment that the probability of hiring female was lowest in Age 29. In fact, in C1, the proportion of hiring female in Age 29 was significantly lower than Age 24, with p-value equals 0.03 under two-sample test of proportions. The proportion hiring female in Age 29 was lower than under Age 34, while it was not statistically significant. In the other conditions, the possibility childbearing was made salient, and thus subjects needed not using age to infer the childbearing probability, and hence the differences between ages on hiring probability were smaller.

Taken together, both hypotheses 1 and 2 were supported. In relationship to the field experiment, study 2 shows that the presence of discrimination against females in the labor market even when their marriage status were not disclosed. Comparing the results between conditions C1 to C5, we causally identified the effect of childbrearing on discrimination against females in the labor market.

Table 5 reports the proportion chosen to hire females under each occupations, and ages. Similar patterns on hiring decision in C1, and across the conditions were observed as in the

pooled analysis reported above.[11] The result also suggests that in each occupation the difference between Age 29 and Age 24 and Age 34 were lower when marriage status (and childbearing possibility) were explicitly disclosed.

Table 4: Proportion Chosen to Hire Female

	C1	C2	C3	C4	C5
Pool	0.57	0.50	0.15	0.38	0.54
Age 24	0.60	0.50	0.16	0.41	-
Age 29	0.54	0.48	0.15	0.38	-
Age 34	0.58	0.52	0.16	0.34	0.54

Table 5: Proportion Chosen to Hire Female under Each Occupation

ACC	C1	C2	C3	C4	C5
Age 24	0.71	0.59	0.16	0.43	-
Age 29	0.64	0.56	0.16	0.46	-
Age 34	0.75	0.71	0.18	0.42	0.69
IT	C1	C2	C3	C4	C5
Age 24	0.44	0.40	0.14	0.31	-
Age 29	0.41	0.36	0.13	0.33	-
Age 34	0.35	0.32	0.14	0.22	0.35
HR	C1	C2	C3	C4	C5
Age 24	0.65	0.51	0.19	0.49	-
Age 29	0.58	0.52	0.16	0.37	-
Age 34	0.63	0.55	0.16	0.39	0.58

Table 6 reports the proportion of employers chosen to hire female job candidate conditional on gender of the employer. It reveals an interesting pattern that lower proportion of males chose to hire females in all conditions. The observed proportions were significantly different from 0.5 (if subjects were making random choice) at 1% level, under Binomial probability test. In fact, for female employers, they were significantly more likely to hire females in C1 and C2, while when the childbearing possibility were salient, they were also more likely to hire males. Taken together with the result in the field experiment, this suggests that the main source of discrimination was from male employers, and for female employers, they exhibited discrimination only when the childbearing responsibility was salient.

[11] The results on guesses are reported in the online appendix.

Table 6: Proportion Chosen to Hire Female by Gender of Employer

	Male	Female	Mean Difference	p-value
C1	0.38	0.69	-0.3	0.00***
C2	0.32	0.61	-0.28	0.00***
C3	0.06	0.21	-0.14	0.00***
C4	0.46	0.24	-0.22	0.00***
C5	0.33	0.65	-0.32	0.00***

7 Discussion and Conclusion

In this work, we perform a large-scale correspondence test (Study 1) to investigate the impact of being of prime childbearing age on women's employment opportunities. Our experiment is conducted in four major Chinese cities—Beijing, Shanghai, Guangzhou, and Shenzhen—and uses one of the largest online job boards to simulate real job-seeking conditions. The target professions are the male-dominated field of IT, the female-dominated field of accounting, and the mixed-gender field of HR. The age and gender of the applicants are systematically varied, and we tracked interview callbacks.

Our findings reveal the presence of labor market discrimination against women of prime childbearing age. Biased decisions seem to occur at the intersection of gender and age, highlighting the shadow mommy effect, where discrimination persists even when maternity and marital status remain undisclosed. This discrimination is particularly pronounced in the IT and HR sectors. The heterogeneous analyses reveal that the shadow mommy effect is primarily observed in hirings within NSOEs and NFIEs, with the most pronounced effects found in Beijing and Shanghai. Our findings suggest that employers' apprehensions regarding the potential costs related to gendered parental responsibility disparities serve as the primary mediators of the shadow mommy effect. However, creating an inclusive environment for women, implementing robust ESG practices within organizations, and providing additional childcare support can help mitigate discrimination against women of prime childbearing age. Our findings further suggest that some employers demonstrate shortsightedness by focusing on immediate costs, a pattern consistent with the brief tenure periods typical in the current Chinese labor market.

Study 2 shows that there was discrimination against females even when their marriage status was not disclosed, a result consistent with Study 1. The study also causally shows that when the childbearing possibility was more salient, there was a higher degree of discrimination against females.

This study contributes to the literature on gender disparities by examining the often-

overlooked discrimination against women of prime childbearing age on the basis of perceived motherhood. Unlike prior research that focused on actual mothers, our work highlights how this bias affects all women in this demographic, revealing a broader, pervasive issue in the labor market. By applying intersectionality theory, we demonstrate how the intersection of gender and age intensifies employment disadvantages, leading to what we term the *shadow mommy effect*. This effect significantly impedes gender equity and is linked to declining fertility rates, offering new insights into the interplay between labor market inequalities and broader societal trends. Our findings suggest that employers and policymakers should adopt practices that promote gender equality in the labor market, benefiting society overall. These practices include fostering an inclusive environment for female employees, implementing strong ESG policies, encouraging paternity leave to balance the child penalty, and expanding public childcare support.

Our field experiment has several limitations. First, our experimental design captures discrimination only at the initial hiring stage, leaving subsequent stages unexplored. Second, our experiment focused on a single general job recruitment website, excluding specialized platforms and headhunters. Finally, the evidence does not enable us to identify the causal factors underlying varying levels of discrimination against women of prime childbearing age across cities. Future research could leverage exogenous shocks or employ advanced research designs to establish causal relationships in these contexts.

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Appendix A Supplementary Figures and Tables

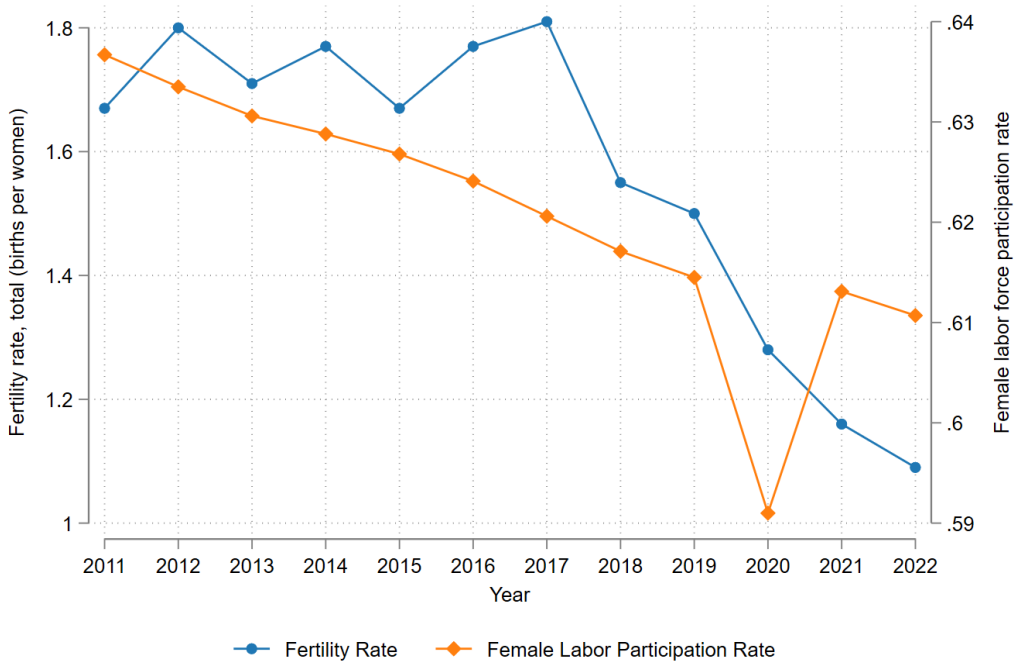


Figure A.1: Fertility trends and female labor participation in China (2011–2022)

Note: The blue circle line illustrates China's total fertility rate, measured as children per woman, from 2011–2022. The orange diamond line represents the labor force participation rate among females aged 15 and above in China during the same period. Data source: The World Bank.

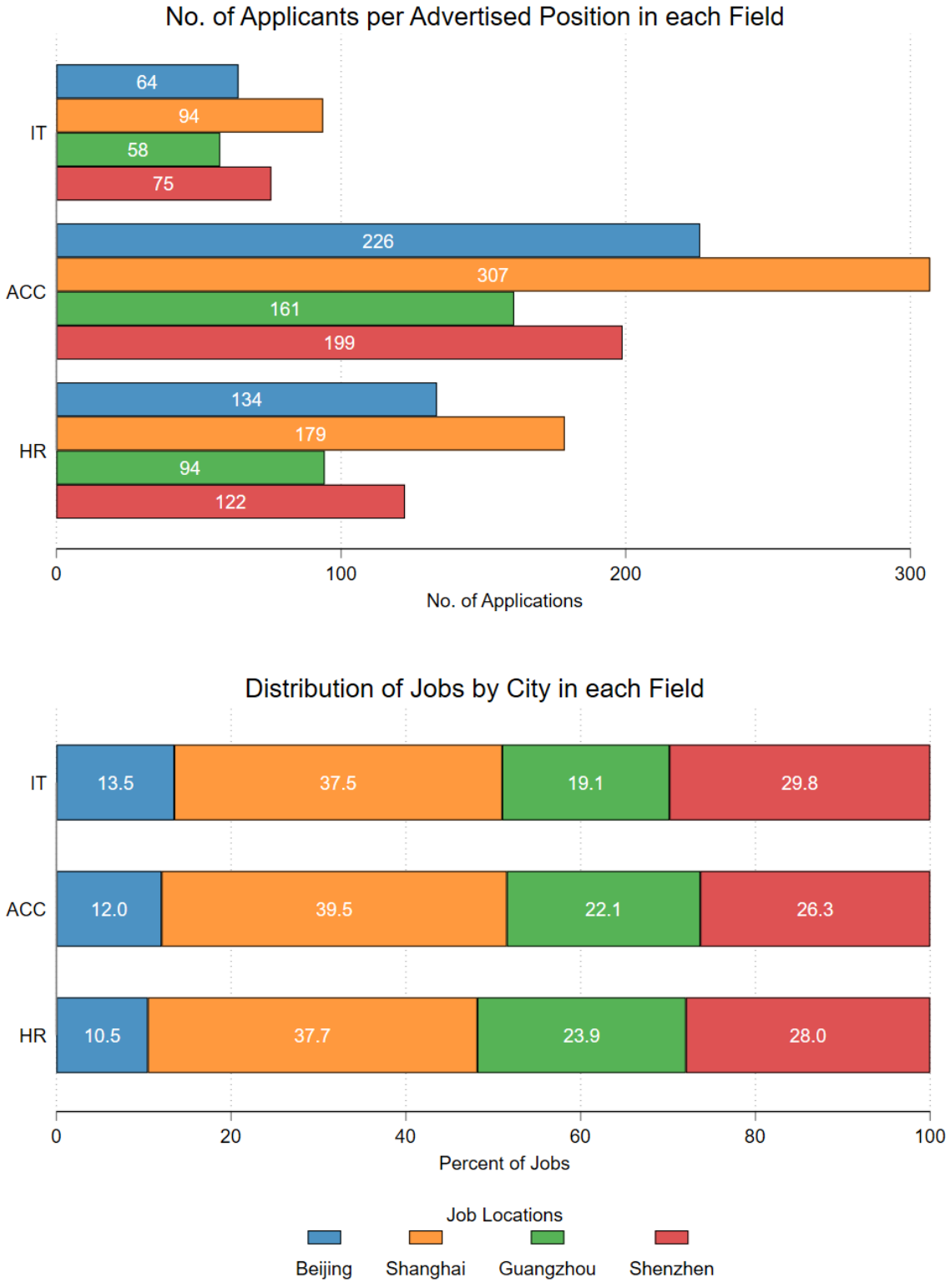


Figure A.2: Job Posting Characteristics across Fields and Cities

Note: The data were collected by the authors between March and June 2021.

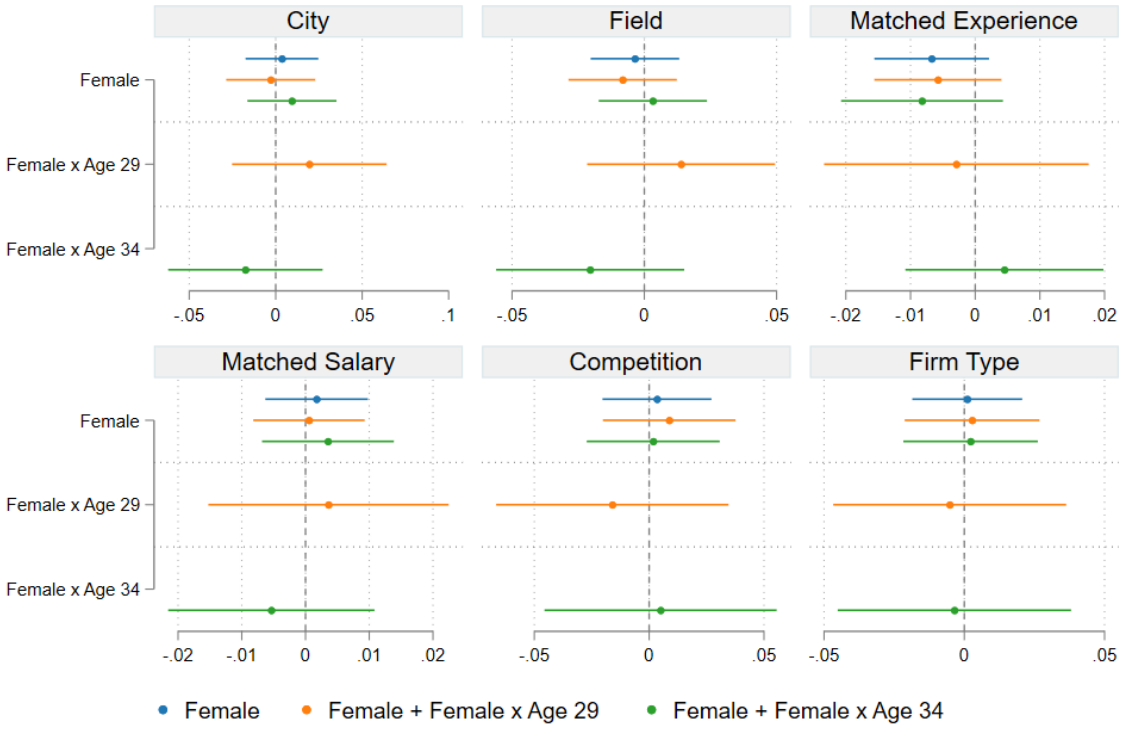


Figure A.3: Balancing Test

Note: The graph illustrates the estimated coefficients of the balancing tests. The blue markers plot the estimated coefficients of each characteristic of the job postings (the city in which the position is advertised, the field of the advertised positions, whether the applicant's working experience is a good match for the requirements of the advertised position, whether the applicant's expected salary is in line with the advertised salary, the logarithm of the number of applications received for the advertised position, and the type of firm that advertised the position) on the female dummy. The orange markers plot the estimated coefficients of each job posting characteristic on both the female dummy variable and the interaction term of the female and age 29 dummies. The green markers plot the estimated coefficients of each job posting characteristic on both the female dummy variable and the interaction term of the female and age 34 dummies. The horizontal spikes represent the 95% CIs.

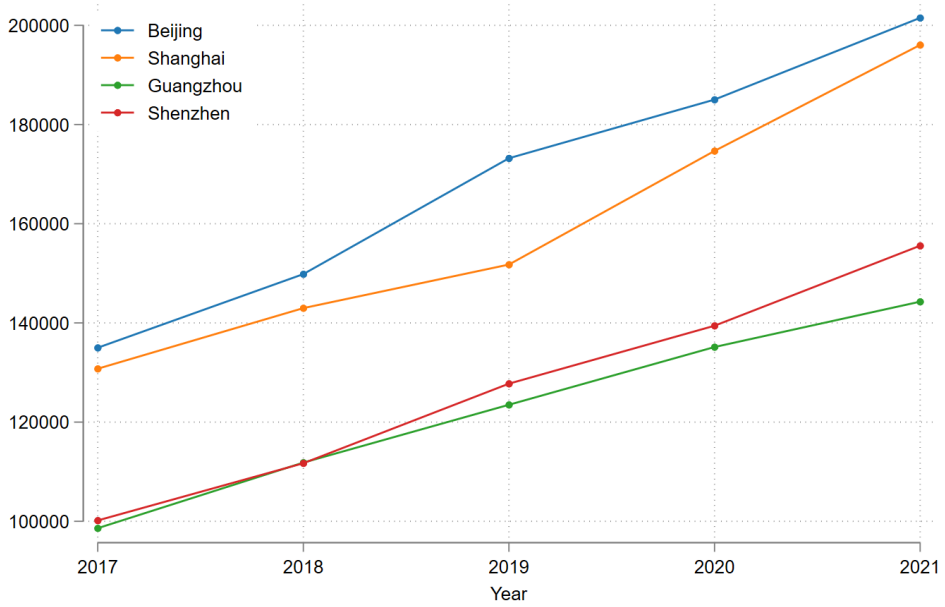


Figure A.4: Average annual salaries of urban employees

Note: Salary averages for employees in each city for the 2017–2021 period measured in Chinese yuan. The data were obtained from the National Bureau of Statistics of China.

Appendix B Online Survey: Guess on Choice of Others

Table 7 reports the results on subjects' guesses on choice of others in hiring female for the pooled data. It can be seen that the magnitudes of the guesses followed a similar U-shape pattern across conditions as in the actual choices, while they tended to underestimate hiring of females in C1, C2, and C4, while overestimating percentage of females being hired in C3. The results conditional on each occupation were reported in Table 8.

Table 7: Average Percentage Guess on Choice of Others to Hire Female

	C1	C2	C3	C4	C5
Age 24	48.47	45.15	25.74	39.77	-
Age 29	46.52	42.17	24.57	39.66	-
Age 34	48.13	46.21	24.85	35.57	46.98

Table 8: Average Percentage Guess on Choice of Others to Hire Female under Each Occupation

ACC	Q1	Q2	Q3	Q4	Q5
Age 24	51.74	49.4	28.62	42.82	-
Age 29	52.3	46.42	25.84	44.56	-
Age 34	54.03	51.04	26.49	37.96	51.58
IT	Q1	Q2	Q3	Q4	Q5
Age 24	44.6	41.99	24.65	35.51	-
Age 29	40.78	37.04	23.2	36.41	-
Age 34	41.15	40.41	24.38	30.39	40.35
HR	Q1	Q2	Q3	Q4	Q5
Age 24	49.06	44.08	23.93	40.97	-
Age 29	46.49	43.06	24.65	37.99	-
Age 34	49.23	47.18	23.67	38.36	49.02

Appendix C Preexperiment Survey

C.1 Survey Questions

Please note that the original survey is in Chinese; what follows is an English translation.

Welcome to this social research questionnaire. The questionnaire contains some subjective judgment questions. After completing the questionnaire, you will receive 3 CNY. It takes approximately 10 minutes to complete the questionnaire. The choices that you make and the personal information that you disclose in this study are both anonymous and absolutely confidential.

Please note that the questionnaire includes numerous attention test questions. If you answer any of the attention tests incorrectly, you will be asked to stop the questionnaire and will not be paid.

1. Please indicate your age: (less than 18/ 18/ 19/.../60/ over 60)
2. Please select your city of residence: Beijing/Shanghai/Guangzhou/Shenzhen
3. Are you currently working full-time now? (Yes/No)

4. Please estimate the average age at which people have their first child in your city:
(Less than 22/ 22/ 23/.../ 34/ 35/ More than 35)

5. Please estimate the average number of children per couple in your city:
(0/ 1/ 2/ 3 or more)

6 –13. Please estimate the masculinity or femininity of the following names:
(on a scale of 0 to 10, where 0 means must be female and 10 means must be male)
Zhou Hengyu; Zhou Mengmeng; Zhou Feiman; Zhou Pengcheng; Zhou Zhilan; Zhou Zhihao; Zhou Junwei; Zhou Jingshu

14 – 23. Please estimate the gender ratios of the following occupations:
(on a scale of 0–10, where 0 means a high percentage of female employees and 10 means a high percentage of male employees)

(a) Information technology
(b) Sales and customer service
(c) Accounting and finance
(d) Chemicals and pharmaceuticals
(e) Media and advertising
(f) Human resources
(g) Consulting and legal services
(h) Training and education
(i) Research
(j) Government

24. This is an attention test question; please select option E.

25 – 34. Please estimate the level of discrimination against female applicants in the following occupations:
(on a scale of 0–10, where 0 represents no discrimination and 10 represents severe discrimination)

(a) Programmer (computer/internet/communication/electronics)
(b) Sales and customer service
(c) Accounting/finance (finance/audit/tax, accounting/finance/banking/insurance)
(d) Chemical engineering (biotech/pharmaceutical/chemical/medical)
(e) Public relations/media (advertising/marketing/media/art)
(f) Human resources/administration/senior management
(g) Consulting/law (consulting/law/education/research)
(h) Training (consulting/law/education/research)
(i) Research (consulting/law/education/research)
(j) Civil servant (government agencies/translation/other)

35 – 44. Please estimate the level of discrimination against male applicants in the following occupations:
(on a scale of 0–10, where 0 represents no discrimination and 10 represents severe discrimination)

(a) Programmer (computer/internet/communication/electronics)
(b) Sales and customer service
(c) Accounting/finance (finance/audit/tax, accounting/finance/banking/insurance)
(d) Chemical engineering (biotech/pharmaceutical/chemical/medical)
(e) Public relations/media (advertising/marketing/media/art)

(f) Human resources/administration/senior management
(g) Consulting/law (consulting/law/education/research)
(h) Training (consulting/law/education/research)
(i) Research (consulting/law/education/research)
(j) Civil servant (government agencies/translation/other)

45. This is an attention test question; please select option B.

46 – 48. To what extent do you think the following types of units will not hire female applicants of childbearing age?
(on a scale of 0–10, where 0 represents "completely unconcerned" and 10 represents "very concerned")

49. To what extent do you think that listed companies will not hire female job seekers of childbearing age?
(on a scale of 0–10, where 0 represents "completely unconcerned" and 10 represents "very concerned")

50. To what extent do you think unlisted companies will not hire female job seekers of childbearing age?
(on a scale of 0–10, where 0 represents "completely unconcerned" and 10 represents "very concerned")

51 – 55. For jobs with the indicated salary level, to what extent do you think that employers tend not to hire a female applicant of childbearing age?
(on a scale of 0–10, where 0 represents "completely unconcerned" and 10 represents "very concerned")

(a) Up to 5000 CNY
(b) 5001 to 10,000 CNY
(c) 10,001 to 30,000 CNY
(d) 30,001 to 50,000 CNY
(e) Above 50,000 CNY

56. According to your own reproductive intentions (without considering the family planning policy), please select the most suitable reproductive plan for you between the ages of 20 and 35:

(a) Do not wish to have children
(b) Wish to have a daughter
(c) Wish to have a son
(d) Wish to have a child, gender does not matter
(e) Wish to have two daughters
(f) Wish to have two sons
(g) Wish to have a daughter and a son
(h) Wish to have two children, gender does not matter
(i) Wish to have three or more children, at least two of whom are daughters
(j) Wish to have three or more children, at least two of whom are sons
(k) Wish to have three or more children, gender does not matter
(l) Uncertain/difficult to answer

57. Please indicate your level of agreement with the statement that "Having a child negatively affects a woman's career"
(on a scale of 0–10, where 0 represents strongly disagree and 10 represents strongly agree).

58. Please indicate your level of agreement with the statement that "Having a child negatively affects a man's career"
(on a scale of 0–10, where 0 represents strongly disagree and 10 represents strongly agree).

59. Please indicate your level of agreement with the statement that "It is better for a mother to go to work after her child begins school"
(on a scale of 0–10, where 0 represents strongly disagree and 10 represents strongly agree).

60. Please indicate your level of agreement with the statement that "During an economic recession, female employees need to be fired first"
(on a scale of 0–10, where 0 represents strongly disagree and 10 represents strongly agree).

61. This is an attention test question; please select option D.

62. Please select your gender: (female; male; do not want to answer)

63. Please select your highest degree:
(junior high school; high school; bachelor's degree; master's degree)

64. How many years have you been employed full time?

65. Please estimate your average monthly income during the past year (including wages, subsidies, investments, part-time jobs, etc.):

(a) Up to 1000 CNY
(b) 1001–3000 CNY
(c) 3001–5000 CNY
(d) 5001–7000 CNY
(e) 7001–10,000 CNY
(f) 10,001–15,000 CNY
(g) 15,001–20,000 CNY
(h) 20,001–30,000 CNY
(i) 30,001–50,000 CNY
(j) 50,001–100,000 CNY
(k) Above 100,000 CNY

66. Please select your marital and parental status:

(a) Unmarried
(b) Married without children
(c) Married with children
(d) Divorced without children
(e) Divorced with children
(f) Widowed without children
(g) Widowed with children

67. Please select the number of daughters that you now have: (0/1/2/3 or more)

68. Please select the number of sons that you now have: (0/1/2/3 or more)

69. Please select the average number of children that your colleagues have: (0/1/2/3 or more)

70. Please select the type that best describes your current work unit:

(a) Government institution
(b) Public institution
(c) Married with children
(d) State-owned enterprise
(e) Foreign-invested enterprise
(f) Joint venture enterprise
(g) Private enterprise
(h) Self-employed
(i) Student
(j) Homemaker
(k) Retiree
(l) Others

71. Please select the category that best describes your current occupation:

(a) Computer/internet/communication/electronics
(b) Sales/customer service
(c) Accounting/finance/banking/insurance
(d) Production/operation/procurement/logistics
(e) Biology/pharmaceutical/chemical/medical
(f) Advertising/marketing/media/art
(g) Construction/real estate
(h) Human resources/administration/senior management
(i) Consulting/law
(j) Education
(k) Research
(l) Service industry
(m) Government institution
(n) Translation
(o) Others

72. Please score the level of gender discrimination that you have experienced during recruitment:
(on a scale of 0–10, where 0 indicates no experience of discrimination and 10 indicates experiencing severe discrimination)

73. Please score the level of gender discrimination that you have experienced at work:
(on a scale of 0–10, where 0 indicates no experience of discrimination and 10 indicates experiencing severe discrimination)

C.2 Supplementary Tables Derived from the Preexperiment Survey

Table B.1: Number of Retrieved Surveys across Cities and Genders

City	Gender			Total
	Female	Male	Prefer not to say	
Beijing	69	62	0	131
Shanghai	76	71	0	147
Guangzhou	94	65	2	161
Shenzhen	71	60	2	133
Total	310	258	4	572

Notes: Data obtained from the preexperiment survey conducted by the authors.

Table B.2: Gender Stereotyping in Various Fields

Field	Mean	S.D.	Median	N
Accounting	2.65	2.65	2	572
Sales and customer service	3.01	2.73	3	572
Media and advertising	3.1	2.62	3	572
Training and education	3.19	2.63	3	572
Human resources (HR)	3.49	2.76	3	572
Government	3.82	2.86	5	572
Consulting and legal services	3.9	2.83	4	572
Research	4.64	2.95	5	572
Information technology (IT)	5.16	2.83	6	572
Chemicals and pharmaceuticals	5.62	2.79	6	572

Notes: The data were obtained from the preexperiment survey conducted by the authors. On a scale of 0 to 10, the smaller the value is, the more female-dominated the field is; the greater the value is, the more male-dominated the field is.

C.3 Supplementary Figure: Overview of Experimental Procedure

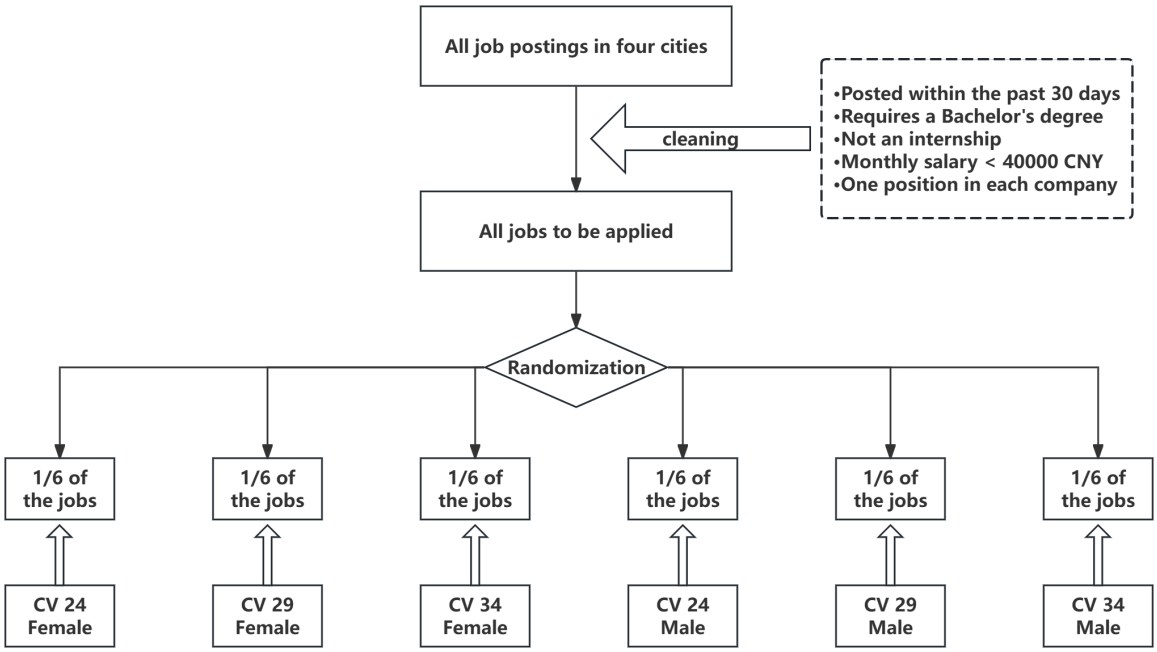


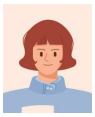
Figure B.1: Schematic Diagram of Job Application Procedures in Each Field

Note: This diagram illustrates the job application process for each field in the correspondence testing experiment.

Appendix D Example of a Fictitious Resume

Here is an original fictitious resume that was used in the experiment. The resume is in Chinese, and an English translation is provided below.

www.51job.com 前程无忧 打印 导出



张芷兰 ID:417659856

13316027434 zhangzlicu@126.com

女 | 29 岁 (1992/03/03) | 现居住武汉 | 7年工作经验

最近工作

职位: 中级前端开发工程师
公司: 九恒星（武汉）信息技术有限公司
行业: 计算机软件

最高学历/学位

专业: 计算机科学与技术
学校: 长安大学
学历/学位: 本科

求职意向

期望薪资: 20-30万 元/年 地点: 广州
职能: Web前端开发
工作类型: 全职

期望薪资: 20-30万 元/年 地点: 上海
职能: Web前端开发
工作类型: 全职

期望薪资: 20-30万 元/年 地点: 北京
职能: Web前端开发
工作类型: 全职

求职状态: 目前正在找工作 到岗时间: 1个月内

工作经验

2018/12-至今 **中级前端开发工程师** | 开发部
九恒星（武汉）信息技术有限公司 [2年3个月]
计算机软件 | 上市公司
工作描述: 1、负责前端日常维护工作;
2、负责Web端功能模块开发及维护工作;
3、负责移动端产品（微信、Android、IOS）的H5开发及维护工作。

2017/3-2018/12 **中级前端开发工程师** | IT部
武汉中科通达高新技术股份有限公司 [1年9个月]
计算机服务(系统、数据服务、维修) | 民营公司
工作描述: 1、负责PC 端与移动产品的HTML 与CSS 页面编写，解决web 端与移动端的适配问题，同时进行代码优化;
2、实现产品UI 和交互方面开发需求，确保产品具有优质的用户体验;
3、了解项目各项要求，配合后台开发人员实现产品前端界面效果与功能。

2014/7-2017/3 **前端开发工程师** | IT部
武汉中科通达高新技术股份有限公司 [2年8个月]
计算机服务(系统、数据服务、维修) | 民营公司
工作描述: 1. 协助项目负责人进行项目的需求分析、技术选型;
2. 基于用户的需求，配合项目负责人制定项目开发计划;
3. 与产品经理和UI 设计师讨论产品设计，根据详细设计进行程序开发、单元测试、开发手册编写，及缺陷修复工作;
4. 负责web 前端页面、移动端内嵌H5 页面开发及前端交 互以及前端性能提升优化.

项目经验

2018/12-2021/1 **流量云平台（移动端）**

所属公司： 九恒星（武汉）信息技术有限公司

项目描述： 流量云平台是一款集供应商管理、产品管理、订单管理，合作伙伴管理，客户管理，账单/报表统计、财务管理，系统权限管理于一体的供应链管理订单平台。

责任描述： 1）使用Vue2.0 全家桶和ElementUI 实现项目的开发；

2）使用lib-flexible实现前端页面能够在不同尺寸屏之间适配。

2017/3-2018/12 **交通管理综合应用平台**

所属公司： 武汉中科通达高新技术股份有限公司

项目描述： 交通管理系统是一款数据可视化的智能化管理的系统。

责任描述： 1. 使用地图对车辆行驶轨迹、行驶位置以及对应终点，实现定位可视化功能；

2. 使用Echarts 对车辆数据数据进行监控统计功能.

技术架构：vue 全家桶+antV

2015/12-2017/3 **运输后台管理系统Vue开发**

所属公司： 武汉中科通达高新技术股份有限公司

项目描述： 本项是为某物流公司开发运输管理平台，实现交易配送提供实时信息数据支撑。主要功能包括了配送车辆管理，承运司机个人信息管理，司机-商户对接管理，配送区域信息管理等。

责任描述： 1. 负责配送车辆管理、司机-商户对接管理等模块的迭代开发与维护；

2. 按质按量完成项目组长分配的开发任务；

3. 将学习到的新技术分享汇报给组员。

技术架构：vue 全家桶+antV

2014/11-2015/8 **公司内部应用平台开发**

所属公司： 武汉中科通达高新技术股份有限公司

项目描述： 该平台具有权限等级区分功能。平台具备用户行为分析功能，并且连通公司财务系统，可自主通过算法计算盈收。

责任描述： 1. 搭建结构框架；

2. 使用vue实现需求功能.

教育经历

2010/9-2014/7 **长安大学**

本科 | 计算机科学与技术

技能特长 （包含IT技能、语言能力、证书、成绩、培训经历）

技能/语言

Web前端 精通

HTML5 熟练

JavaScript 熟练

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CV Translation - Female 29

Zhang Zhilan

- Mobile: 13316027434
- Email: zhangzlicu@126.com
- Gender: Female | Age: 29 (1992/03/03) | Current Residence: Wuhan | Work Experience: 7 years

Most Recent Employment

- Position: Intermediate Front-End Developer
- Company: Jiuhengxing (Wuhan) Information Technology Co., Ltd.
- Industry: Computer Software

Highest Degree/Major

- Major: Computer Science and Technology
- School: Chang'an University
- Degree: Bachelor's Degree

Career Objective

- Expected Salary: 200,000 - 300,000 RMB/year
- Function: Web Front-End Development
- Job Type: Full-time
- Location: Guangzhou, Shanghai, Beijing
- Job Seeking Status: Currently looking for a job
- Availability: Within one month

Work Experience

- Dec 2018-Present **Intermediate Front-End Developer** | Development Department
  - Jiuhengxing (Wuhan) Information Technology Co., Ltd. [2 years 3 months]
  - Computer Software | Public Company
  - Job Description:
    1. Responsible for routine front-end maintenance;
    2. In charge of developing and maintaining web-end functional modules;
    3. Accountable for H5 development and maintenance of mobile products (WeChat, Android, iOS).
- Mar 2017 - Dec 2018 **Intermediate Front-End Developer** | IT Department
  - Wuhan Zhongke Tongda High-Tech Co., Ltd. [1 year 9 months]

    - Computer Services (System, Data Services, Maintenance) | Private Company
    - Job Description:
        1. Tasked with writing HTML and CSS pages for PC and mobile products, addressing web and mobile compatibility issues, and optimizing code;
        2. Implemented UI and interaction development requirements to ensure high-quality user experience;
        3. Understood project requirements and collaborated with backend developers to achieve front-end interface effects and functionalities.
- Jul 2014 - Mar 2017 **Front-End Developer** | IT Department
    - Wuhan Zhongke Tongda High-Tech Co., Ltd. [2 years 8 months]
    - Computer Services (System, Data Services, Maintenance) | Private Company
    - Job Description:
        1. Assisted in project requirement analysis and technical selection;
        2. Based on user requirements, worked with project leaders to formulate development plans;
        3. Discussed product design with product managers and UI designers, developed programs, conducted unit testing, wrote development manuals, and fixed defects;
        4. Responsible for web front-end page development, mobile embedded H5 page development, front-end interaction, and performance optimization.

Project Experience

- Dec 2018 - Jan 2021 **Traffic Cloud Platform (Mobile End) Company**
    - Company: Jiuhengxing (Wuhan) Information Technology Co., Ltd.
    - Project Description: A supply chain management order platform integrating supplier management, product management, order management, partner management, customer management, billing/report statistics, financial management, and system permission management.
    - Responsibility Description:
        1. Utilized Vue 2.0 ecosystem and ElementUI for project development;
        2. Employed lib-flexible for front-end page adaptation across different screen sizes.
- Mar 2017 - Dec 2018 **Comprehensive Application Platform for Traffic Management Company**
    - Company: Wuhan Zhongke Tongda High-Tech Co., Ltd.
    - Project Description: An intelligent management system with data visualization for traffic management.
    - Responsibility Description:
        1. Used maps to visualize vehicle trajectories, positions, and corresponding endpoints;
        2. Applied Echarts for vehicle data monitoring and statistical functions.
    - Technical Architecture: Vue ecosystem + antV
- Dec 2015 - Mar 2017 **Transportation Backend Management System Vue Development Company**

- Company: Wuhan Zhongke Tongda High-Tech Co., Ltd.
- Project Description: Developed a transportation management platform for a logistics company, providing real-time data support for transaction delivery. Main functions included vehicle management, carrier driver information management, driver-merchant interface management, and delivery area information management.
- Responsibility Description:
    1. Responsible for iterative development and maintenance of modules such as vehicle management and driver-merchant interface management;
    2. Completed development tasks assigned by the project leader on time and with quality;
    3. Shared and reported newly learned technologies with team members.
- Technical Architecture: Vue ecosystem + antV

- Nov 2014 - Aug 2015 **Internal Application Platform Development Company**
    - Company: Wuhan Zhongke Tongda High-Tech Co., Ltd.
    - Project Description: The platform featured permission level differentiation, user behavior analysis, and integration with the company's financial system, capable of autonomously calculating revenue through algorithms.
    - Responsibility Description:
        1. Built the structural framework;
        2. Implemented required functionalities using Vue.

Education

- Sep 2010 - Jul 2014 **Chang'an University**
- Degree: Bachelor's in Computer Science and Technology

Skills and Strengths

- Web Front-End - Proficient
- HTML5 - Skilled
- JavaScript - Skilled

Appendix E Impact of the Variance of the Unobservable Determinants of Productivity

Correspondence tests can identify discrimination by employers and overcome the issue of endogeneity due to unobserved individual-level heterogeneity. A caveat with this method, however, is that the variance of the unobservables can bias the measurement of discrimination; this issue is referred to as the Heckman-Siegelman critique (Heckman and Siegelman, 1993). Specifically, the variance of the unobservables may influence the degree of discrimination when employers perceive a group-level difference in the variance of unobserved productivity. The reason is that if the variance varies between groups of applicants, its effect on the callback rate may be incorrectly attributed to discrimination (Heckman, 1998; Carlsson et al., 2014). Neumark (2012) proposed a method for distinguishing between the unbiased estimate of discrimination and the variance of the unobservables. We use the Neumark method to determine whether our estimates of discrimination are robust to the Heckman-Siegelman critique. The method involves two steps. The first step estimates a heteroskedastic probit model. The second step decomposes the marginal effect from the heteroskedastic probit model into two parts: the effect through the level of discrimination, which represents the unbiased estimate of discrimination, and the effect through the variance of the unobservables. Considering that the focus of our research is on childbearing-aged women, we compare childbearing-aged women with other-aged women and with men.

Column (1) of Table D.1 presents the results for childbearing-aged women versus women of other ages. Panel I provides estimates from the standard probit model for comparison with the information shown in Panel II, which provides the marginal effect estimate from the heteroskedastic probit model. Both estimates suggest that childbearing-aged women are significantly less likely than women of other ages to receive a positive employer response. Moreover, the Neumark decomposition shown in Panel III reveals that this adverse effect is largely underestimated. The marginal effect of the level of discrimination is much greater in magnitude and statistically significant. The effect of the variance of the unobserved variables is positive and significant. These results indicate that the relatively low quality of the experimental applicants led to a relative advantage for the applicants from the higher variance group, which in turn led to an underestimate of the extent of discrimination against female applicants of childbearing age.

Table D.1, Column (2), provides a comparison of childbearing-aged women and men. In Panel II, the marginal effect from the heteroskedastic probit model shows that childbearing-aged women are significantly less likely to receive a callback than men are. There is a large

Table D.1: The Neumark Method for Testing the Heckman-Siegelman Critique

Treatment group:	Childbearing-aged Women	
Comparison group:	Other-aged Women	Men
	(1)	(2)
I. Basic probit model (marginal effects)	−0.006***	−0.003
	(0.002)	(0.002)
II. Heteroskedastic probit model (marginal effects)	−0.005***	−0.008***
	(0.002)	(0.003)
III. Decomposition		
Marginal effect through level (unbiased effects)	−0.050***	−0.053***
	(0.005)	(0.004)
Marginal effect through variance	0.045***	0.045***
	(0.004)	(0.005)
Ralative standard deviation of unobserved variables (treatment/comparison)	2.507	2.766
Wald test statistics: null hypothesis that ratio of standard deviations = 1 (p-value)	0.122	0.358
Wald test statistics: null hypothesis that ratio of coefficients are equal (p-value)	0.126	0.579
Number of Observations	17916	23739

Notes: The dependent variable is an indicator variable for whether the applicant is invited to an interview. The set of covariates includes the applicant's gender, age, whether her/his work experience matches the advertised position, whether her/his expected salary matches the advertised salary, the cities in which the position is advertised, the logarithm of the number of applications received for the advertised position, and dummies for the field (IT, ACC, or HR). Fixed effects for the month of the job posting and the month of the application submission are also included. Standard errors are in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

difference in the estimates obtained from the standard probit in Panel I and the heteroskedastic probit model in Panel II, suggesting a perceived difference in the variance of unobservables between groups. Similar to Column (1), the Neumark decomposition of Panel III indicates that the negative impact on childbearing-aged women is statistically significant but is also greatly underestimated.

Overall, according to the Neumark method, we confirm that women of prime childbearing age are discriminated against in the job market. Furthermore, due to the limitations of our experimental design, it is likely that we have underestimated the extent of the discrimination they were subjected to in the real-world conditions.

Appendix F Online Survey Experiment Instruction

The oringal instruction was in Chinese.