Employee Loyalty, Training, and Female Labor Supply

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Abstract

This paper develops and calibrates a game theoretical model of statistical discrimination against women. Using Japanese data, it then quantitatively analyzes the effects of child care subsidies on women's participation in the labor force and gender wage differences. I find that the Japanese female labor market, as it currently stands, is best captured by a pooling equilibrium, in which employers cannot distinguish between women who will leave the firm and women who will stay, thereby allowing for statistical discrimination. I also find that, somewhat surprisingly, a decrease in child-care subsidies could narrow gender wage gaps.

1   Introduction

Gender wage inequality in the labor market has long attracted policy makers' attention. In an attempt to narrow the gender wage gap and achieve employment equity, various kinds of affirmative action policies, such as employment quotas or tax credits, have been implemented all over the world. Indeed, gender wage gaps need to be eradicated if the difference comes from discrimination or social stigma, which leads to productivity inefficiency and welfare loss in the discriminated group. However, if wage gaps mostly reflect job performance and differences in job preference

between men and women, an effort to narrow the gender wage gap could lead to costly, inefficient consequences and worsen social welfare for both men and women.

Taking into account heterogeneity in women's work-life preferences, this paper studies how much the government could influence women's participation in the labor force and gender wage gaps by providing tax credits for working women in the form of child-care subsidies. To do so, I build a game-theoretical model that focuses on statistical discrimination, which is thought to have a significant influence on gender wage inequality. In fact, empirical papers using U.S. data show that statistical discrimination accounts for a persistent wage disparity among gender groups.[2] My model captures the mechanism of statistical discrimination in which a young female worker could receive lower wages than the corresponding male worker because the higher average turnover rates for young women in the fecund period make them less profitable to firms.[3] Using Japanese data, I find that child-care subsidies in Tokyo do not narrow the gender wage gap much, and the overall welfare for young women decreases as the subsidies increase. Such results highlight the importance that narrowing gender wage gaps using child-care subsidies could be costly.

The major contribution of this paper is the finding that decreasing subsidies can lead to an increase in the overall productivity of young women; I find that an increase in the price of the child-care service, which corresponds to a 140% decrease in child-care subsidies, raises the average productivity of female workers in Tokyo's neighboring prefectures. This counterintuitive change occurs because a price increase in child-care services can allow firms to sort women with different work-life preferences into different occupation tracks. Such a complicity of the effect of child-care subsidy suggests that policy makers should exercise caution when implementing new affirmative action policies.

In fact, this finding contrasts with the prevalent claims that affirmative action policies can remove the barrier for minorities and potentially increase productivity. There are many empirical studies that examine how child care subsidies encourage women to continue working after they have children. From the seminal work of Heckman (1974) to the more recent work by Bick (2011), most studies report strong evidence that child care subsidies increase the supply of female labor. Thus, taking statistical discrimination into consideration, this paper draws the contrasting conclusion that subsidies could decrease the supply of female labor in terms of units produced by reducing the amount of investment in women.

Such a novel conclusion comes from the unique feature of my model: unlike the existing literature, I model employee training as a firm's choice and characterize a worker's choice of career path and wage determining mechanisms as equilibrium outcomes of a screening model. That is, the wage is endogenously determined as an equilibrium of a screening model. In my model, employers finance workers' on-the-job training without directly observing intentions to continue working in the same firm. In an attempt to distinguish female workers who will leave the firm from those who will stay with the firm, the employers use long-term wage contracts as a screening device.

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[2]For example, see Light and Ureta (1992); Gayle and Golan (2012).

[3]This type of statistical discrimination was first theoretically illustrated in Barron et al. (1993) and recently explored by Gayle and Golan (2012).

When the screening attempt succeeds, it results in a separating equilibrium, where the employer can discern its workers' intentions to remain with the firm using the wage menus. As a result, workers who intend to continue working receive more investment in their training than workers who have not committed to continue working. In this case, the allocation of resources regarding training investment is as efficient in this scenario as in the economy in which employers know the intentions of all workers. When the screening attempt fails, it results in a pooling equilibrium in which female workers with different employer-employee attachment receive equal investment. This situation is an example of statistical discrimination.

My model suggests that child-care subsidies can bring about a drastic change in labor productivity and worker welfare by altering the type of equilibrium that characterizes the game between worker and firm. The direction of the change, however, is undetermined. I build on this theoretical prediction by applying the model empirically to the Japanese labor market.

Using the Japanese data has several other advantages. First, statistical discrimination in Japan is considered more serious than in most other countries, making a quantitative analysis of statistical discrimination from the data easier, even with measurement errors and all sorts of noise. Second, the Japanese data provides survey questions on whether women plan to continue working at the same firm for the next year and whether they plan to work after giving a birth to the first child. This information allows us to observe the potential productivity of workers that is unobservable to their employers. This kind of survey question is rarely available in other longitudinal data. Third, the Japanese data helps identify the model by providing exogenous variation in women's job quitting behavior. Quitting behaviors of young women are exogenously affected because women's choice to stay or leave the firm depends on the availability of childcare services in Japan. The availability of child care differ across jurisdictions. As will be discussed later in this paper, I argue that such a variation in child care availability is exogenous. Such exogeneity allows me to find women in the data who have the same observable characteristics but different job turnover rates when they become a mother. I carefully select jurisdictions so that, after controlling for observable characteristics such as education, work history, husband's income, and occupation, women in different jurisdiction are comparable. In doing so, I attribute the differences in earnings across jurisdictions to the differences in labor force attachment.

The Japanese labor market can be captured by a relatively parsimonious, simple model of statistical discrimination, which allows us to focus on the interaction between a firm's employee investment decisions, workers' labor force participation around the time of child-birth, and statistical discrimination. In doing so, I can avoid the technical difficulties of handling skill depreciation due to spells out of the labor force. Yet, despite my focus on this particular instance of statistical discrimination, the model built in this paper is rich enough to match with observed features of the Japanese labor market well. Although the empirical analysis is specifically tailored to the current Japanese labor market, the model implications provided in this paper are applicable to a general analysis of statistical discrimination against workers' weak labor force attachment.

In this paper, the term employer-employee attachment and labor force attachment are used interchangeable since most women who quit their job following childbirth also withdraw from the labor force in Japan. Given that women's quitting behavior is concentrated around the event

of childbirth, intention to continue working following childbirth (labor force intention, hereafter) plays an important role in career and lifestyle planning in Japan. Its importance can be seen from the fact that the Japanese panel data ask women such questions. Once women choose a career path, they stick to a specific firm, and switching jobs is not common. With a very low labor mobility in Japan, this paper does not distinguish the difference between returns to job tenure and labor market experience as in other literature such as Topel (1993) and Audrey Light (1995). Also, note that women who self-select into the non-career track are revealing their weaker attachment to the labour force. The focus of this analysis is on women who select into the career track. Even for those who select into the career track, there is a substantial male-female wage gap after several years of employment. The regression analysis takes job course choice into account and analyze gender wage gap within and across career tracks.

Related Literature

This paper adds to the literature by estimating the effect of child-care subsidies on gender wage gaps in the Japanese labor market taking statistical discrimination into consideration. The topic of interest here builds upon the theory of statistical discrimination, pioneered by Arrow (1973) and Phelps (1972). In contrast to taste-based discrimination (Becker (1964)), statistical discrimination is a rational behavior that could result in persistent inequality between groups (Lundberg and Startz (1983); Coate and Loury (1993)). Statistical discrimination and its policy implications have been studied extensively in the theoretical literature, but few studies empirically quantify the contribution of statistical discrimination to observed gender wage gaps.[4] Indeed, many experimental papers have contributed to our understanding of statistical discrimination by providing results from a laboratory or field environment designed to generate random assignment. List (2004), Bertrand and Mullainathan (2004), Carlsson and Rooth (2007), and Oreopoulos (2011), to name a few, have all produced influential studies. However, these experimental papers focus on statistical discrimination in hiring decisions, not wage determinants.

Altonji and Pierret (2001), Moro (2003) and Gayle and Golan (2012) are among the few empirical papers that estimate how much statistical discrimination accounts for wage gaps. Altonji and Pierret (2001) tackle the issue of identification by assuming that wage is correlated with average productivity between groups categorized by observed characteristics (e.g., gender, race, education) in the early stages of employment. Moro (2003) provides a general framework to estimate a structural model where multiple equilibria could coexist. In his application, Moro estimates the changes in the Black-White wage gap in the U.S. These studies aim to estimate the extent of statistical discrimination in wage gaps but do not evaluate the effect of public policies. My paper contributes to the strand of the empirical literature on statistical discrimination by providing policy evaluation. This paper also complements the literature by addressing the underestimation of statistical discrimination. The underestimation occurs when the model lacks a self-fulfilling mechanism (Lundberg

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[4]For a comprehensive review on theoretical literature, see Fang and Moro (2010).

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and Startz (1983); Coate and Loury (1993)).[5] In my model, the self-fulfilling mechanism happens when female workers who are discouraged because they have little opportunity in the labor market select a career path associated with low wage growth and low investment.

In a broader context, this paper contributes to a strand of literature that considers women's lifetime labor supply using a dynamic model. The empirical literature on dynamic female labor supply can be classified into two groups in terms of the main objective: the studies that aim to understand the mechanism behind the observations and the studies that aim to evaluate an established policy by estimating the effect of welfare. The seminal works in the first group includes Altug and Miller (1998) and Gayle and Golan (2012). Gayle and Golan (2012) analyze the changes in the U.S. labor market over the last four decades. Among their important findings is that the major driving forces behind the decline in the gender earnings gap is the increase in women's labor market experience. They also found that statistical discrimination accounts for a large fraction of the observed gender earnings gap and its decline. The caveat of their estimation approach is that they use intertemporal Euler conditions as the estimation moments, which assume that the distribution of individuals' lifetime wealth does not change. Because new policies would be expected to alter the distribution of wealth, their method would not be appropriate for conducting a policy evaluation.

The seminal work in the second group of studies, the main objective of which is policy evaluation, includes Keane and Wolpin (2010) and Eckstein and Lifshitz (2011). These papers build a comprehensive dynamic discrete choice (DDC) model, which does not require a stationary distribution of wealth. These papers incorporate all the major choices women make over their lifecycle, such as education, participation in the labor market, marriage, and fertility. However, their focus is the dynamics in the labor supply side and they do not model the labor demand side. Unlike the existing literature of dynamic female labor supply, I explicitly model the labor demand side by allowing firms to choose the amount of investment and to offer a long-term wage contract. Thus, my work adds to the second branch of the policy evaluation literature on female labor supply by considering firms' strategic responses to labor supply and characterizing an equilibrium wage determinant mechanism.

In my model, long-term wage contracts are an empirical illustration of a screening model, first studied by Rothschild and Stiglitz (1976) and Wilson (1977) in the context of the insurance market. By incorporating a screening model, I can characterize a dynamic wage contract as an equilibrium outcome.

The equilibrium wage contracts derived from my model fall into a category of "deferred payment," also known as back-loaded compensation. As discussed in the pioneering works of Lazear and Rosen (1981) and Lazear (1981), the deferred payment system reduces the cost of replacing employees and prevents workers from shirking because it provides workers with a strong incentive

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[5]For instance, suppose all workers are equally productive but somehow employers wrongfully predict that some minority groups are less productive on average and provide them with fewer opportunities in the work-place. Such an incorrect prediction could actually end up becoming true when workers in the minority group, foreseeing the poor return from working decrease the return of their work-related skill investment and make less investment in their work-related skills when compared to the rest of workers who do not belong to discriminated-against minority groups. Thus, discrimination could lead to self-reinforcing feedback loops, a phenomenon known as a self-fulfilling prophecy.

to stay with the firm for the promised future compensation as long as the promise is credible.[6] Such a deferred payment mechanism is further developed and explored by recent theoretical literature in the context of the job search model (Burdett and Coles, 2003; Burdett and Coles, 2010; Menzio and Shi, 2010; Tsuyuhara, 2015; Lentz, 2015) and empirically explored by Lamadon (2014).

Unlike these studies, my model has a occupation screening mechanism that can sort out workers with different intentions to continue working, which serves as an additional driving force for the deferred payment system. As a consequence, my model predicts a steeper wage profile for workers with stronger labor force attachment in a separating equilibrium than the case without unobserved heterogeneity in labor force attachment. Thus, my paper complements the job search literature by analyzing how wages are determined when statistical discrimination against weaker labor force attachment exists.

My empirical application of the model of statistical discrimination with dynamic wage contracts also helps us understand the underlying mechanisms in the Japanese labor market. The Japanese labor market has distinctive features in its patterns of labor mobility, promotion, training, and the distribution of earnings. In order to explain the differences between the Japanese labor market and that of other countries, many studies provide a model that captures the Japanese labor market. Seminal papers include Aoki (1988), Hashimoto (1979), Okuno-Fujiwara (1987; 1989), Hashimoto and Raisian (1992), Abe (1994), Owan (2004), and Morita (2005). This paper, which focuses on the Japanese female labor market, complements these studies by incorporating the dual job course system as a screening mechanism.

The rest of this paper is organized as follows. Section 2 documents stylized facts of the Japanese labor market and child care shortages. Based on these observed features, Section 3 formulates a structural model and then analyzes optimal wage schemes and productivity efficiency under the information problem. Section 4 describes the data sets. Section 5 lays out an identification strategy and estimates the model parameters using calibration. Section 6 presents the estimation results. Section 7 conducts a set of counterfactual analyses to calculate potential efficiency and to evaluate the effect of child-care subsidies on inefficiency. Finally, Section 8 concludes by discussing the efficiency of child care subsidies.

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[6]Thus, the model implications are related to the growing literature on efficiency wage models. Effi- ciency wage models have one or more of the following characteristics: 1) compensation levels and rules af- fect the types of workers who are attracted to, and retained by, the firm – normally referred to as the sort- ing effect of wages; 2) compensation rules create incentives for workers to behave in ways that in- crease firm profits; 3) wages affect the nutrition and health of workers and thus higher wages directly in- crease productivity (these 'nutrition' models are most applicable in poor countries). (Weiss, Andrew. "ef- fi- ciency wages." The New Palgrave Dictionary of Economics. Second Edition. Eds. Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan, 2008. The New Palgrave Dictionary of Economics On- line. Palgrave Macmillan. 23 April 2013 <http://www.dictionaryofeconomics.com/article?id=pde2008_E000245> doi:10.1057/9780230226203.0452) My model allows firms to commit to long-term wage contracts and has the first and second characteristics listed above.

2 Institutional Background

2.1 Indirect Evidence for Statistical Discrimination

There are five major reasons why statistical discrimination is thought to be more serious in Japan. First, Japanese firms finance employee training to a large extent.[7] Hiring new workers is more costly in Japan than in other countries. According to the 2010 survey by SANRO Research Institute Inc., the cost of employee training before employment is, on average, 43,798 Japanese yen per employee (approximately 437 USD), and the average cost of on-the-job training is 165,191 Japanese yen (1,651 USD).[8]

Second, male workers, on average, stay in the same firm longer than female workers. Among female workers, the labor supply patterns are dichotomous in that some women leave the labor market and never return while others continue to work as long as male workers. In Japan, more than half of women leave the labor market at the time of marriage or motherhood, while most men work without interruption until the legal retirement age of 65. As of 2008, the average job tenure in Japan is 13.1 years for men and 8.6 years for women.[9] The tenure of Japanese men is the longest among OECD countries while that of Japanese women is just above the OECD average for women. The voluntary separation rate per year for full-time Japanese workers is 10.9% for men and 24.6% for women.[10]

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[7]I argue that Japanese firms finance employee investment as described in the literature on the Japanese labor market. The training and employment relations in Japan are well documented in Hashimoto (1979). See Aoki (1988) for general discussions on firm-sponsored training programs. We can justify firms' employee investment by assuming that human capital is occupation-specific and that the labor market has frictions and workers cannot change a job without incurring costs. Alternatively, we can assume that human capital is firm-specific. A great deal of empirical literature takes the stance that the majority of human capital is general and useful at all firms or at least at jobs in the same occupation (occupation-specific), thereby modeling investment as a worker's choice (Sanders and Taber (2012)). In contrast, the low labor mobility in Japan was often explained by the hypothesis that Japanese firms make more intensive investment in firm-specific human capital than other countries (e.g. Hashimoto (1979)).

[8]This survey asked 230 randomly picked companies how much they spend on their newly-hired employees. Among the most common kinds of training are 1) fostering workers' business attitudes (95.4%); 2) developing workers' communication skills, including, but not limited to, presentation, information exchange, and counseling skills (89.0%); and 3) teaching employees company operations and philosophy (87.7%). On-the-job training for white-collar and professional careers can last from half of one year to two years. The training period is especially lengthy in large firms, where, during the training periods, employees are assigned to different sectors of the company in order to learn how the company operates. In fact, the survey by SANRO Research Institute Inc. reports that, in large firms with an employee size of more than 3,000, the cost of on-the-job training per employee amounts to as much as 252,036 Japanese yen (2,520 USD). Given the great costs for employee training, Japanese firms, concerned about investment loss, must lower employee turnover.

[9]The difference in the average tenure, 4.5 years, was the largest figure among developed countries in 2008, exceeding the second largest gender gap, observed in Ireland, by 1.5 years. The average of the gender gap among other OECD countries—excluding the U.S.—is 1.05 years. (Source: OECD) For reference, the median job tenure in the U.S. is 4.4 years for men and 4.1 years for women as of 2010. (Source: Bureau of Labor Statistics)

[10]I calculate the separation rates as the number of workers (called regular workers in the survey) who left the job within one year divided by the number of workers who worked at the beginning of the year, using the data from the Survey on Employment Trends.

Third, while the majority of Japanese women work when single (See Table 6 in the appendix), female workers display large heterogeneity in their work-life preferences following childbirth. According to the Annual National Survey of Lifestyle Preferences (NSLP) in 1998 and 2008, about 20% of married women wanted to continue working, 25% wished to permanently leave the labor market at marriage or childbirth, and more than 50% wished to leave the labor market temporarily and return when their children grew older.

Fourth, the data features show that employers do not directly observe workers' labor force intentions. I argue that women's attitudes toward labor force participation at an early career stage are really unknowable to an employer. Many women follow a typical career path of obtaining higher education, entering the labor market after college graduation, and choosing a career with good prospects; however, some of these women have stronger preferences toward staying at home after their first child birth and leave the labor force. Despite their heterogeneous work-life preferences, the JPSC data shows that female Japanese workers are highly educated and work similar hours and receive similar wages (See Table 7 in the Appendix).

Last, evidence for statistical discrimination against female workers is also found in gender earnings differences over the life cycle. I conducted regression analysis using the sample of women who initially plan to stay at the same firm and men in Japanese panel data.[11] I found that an interaction term of gender and tenure is positive in the fixed-effects wage regressions, which implies that the effect of gender on wage becomes smaller as workers stay in the firm longer (For results, see Table 8 in the Appendix). This decrease in the gender wage gap over the lifecycle is puzzling. One explanation is that firms decide to postpone investment in female workers in their fecund periods, during which the employer learns about the worker's tendency to quit, or that overall quit rates among female workers drop as pregnancy rates decline. As for male workers, firms do not have to wait to invest because men's career orientation varies much less than that of women.[12]

Given the diversity in work-life and work-family preferences among young female workers, if a woman's labor force intentions are unobservable to her employers, a larger heterogeneity within a group could lead to more inefficiency due to statistical discrimination. If employers cannot observe an individual's quitting intentions, they may use information on average quit rates by gender to maximize their profits. This practice is an example of statistical discrimination. Together, these findings reinforce the hypothesis that statistical discrimination exists and affects the gender earnings gap to a significant extent.

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[11]I controlled for possible changes in productivity by including dummy variables for events that trigger productivity changes (i.e. childcare leave, layoff, etc.). The basic econometric specification is a fixed-effects regression of log wage on years of schooling and gender, willingness to continue to work, and father's education. The coefficients on these explanatory variables are allowed to vary with employment spell and residence in an urban area.

[12]A narrowing gender wage gap over age is also found by Gayle and Golan (2012) in the U.S. data, which motivated them to build a model of firms' investment in employees. They found that the gender wage difference decreases when looking at full-time workers who work without interruption.

2.2 The Dual Job Course System as a Screening Mechanism

With the exception of Moro (2003) and Gayle and Golan (2012), few empirical papers analyze how workers are sorted into occupations and how wages associated with occupation are determined. However, many theoretical studies illustrate the importance of occupation and task screening.[13] Faced with female workers with hard-to-observe labor force intentions, Japanese firms behave as economic theory predicts: firms commonly adopt an occupation sorting mechanism, which is known as the dual job course system.[14] During the 1993-2008 period studied in this paper, there are two distinct career paths: *Sogo-shoku* (career course) and *Ippan-shoku* (non-career course).[15] These two courses are characterized by differences in wage growth, the difficulty of tasks, opportunities for promotion, and the chance of job transfer. While career courses are associated with a large growth in wage, better opportunities for promotion, and more demanding tasks, non-career courses are associated with little wage growth, little promotion, and relatively easy tasks. At the beginning of the job application process, workers select one of these two courses. After choosing, workers are rarely allowed to switch courses. The non-career course, which assigns workers to tasks that do not require specialized skills, attract almost no male workers and consist predominantly of female workers who plan to leave the labor market upon marriage or motherhood.

This job course system can be seen as a real-life example of the screening mechanism first studied by Rothschild and Stiglitz (1976) and Wilson (1977). Using this career course system, firms attempt to distinguish workers who will only work for short periods in order to treat them differently without legal accusation.[16]

2.3 Exogenous Variation in Women's Quitting Behavior

Quantifying statistical discrimination through wage compensation is particularly challenging. For example, it is difficult to tell whether wage correlates to an easily observable worker character-

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[13]For example, see Spence (1973), Miyazaki (1977), Coate and Loury (1993), and Moro and Norman (2004).

[14]The dual job course system in Japan is documented by Carney and G. O'Kelly (1987), for example.

[15]The third course is "*Chiiki Sogo-shoku*", which is regarded as *sogo-shoku* without job relocation or *Ippan-shoku* with a chance of promotion and was introduced in the mid-2000s. Since the third course is not as commonly offered as the other two courses, I consider this third course as *Ippan-shoku* and do not distinguish the two in the empirical work. In fact, some large companies such as Sompo-Japan abolished *Ippan-shoku* and re-label their existing *Ippan-shoku* as *Chiiki Sogo-shoku* in 2014 (Source: Nihon Keizai News Article January 24, 2015; http://www.nikkei.com/article/DGXMZO82245480S5A120C1TY5000/). However, the actual chance of promotion did not change substantially after the name change.

[16]As a matter of fact, the history of these courses indicates that the non-career course is actually designed for women who are weakly attached to the labor force. The year in which the course system was introduced, 1986, was the year that Japan enacted the first equality act prohibiting gender discrimination (Equal Employment Opportunity Law). Since then, 10-15% of Japanese firms offer courses that predetermine a worker's career path. This system is prevalent among firms that hire a large proportion of women. Thus, Japanese firms, which were barred from explicitly discriminating against workers based on gender, use this screening mechanism in order to minimize investment loss from the turnover of female employees, effectively discriminating against female employees, but in an implicit manner.

istic, because uninformed firms use the observable trait to discriminate or because the variable is associated with unobserved productivity.[17]

I argue that the shortage of public child care services in Japan helps identify the causal effect of statistical discrimination because it provides exogenous variation in women's quitting behaviors.[18] Following the long-lasting stagnation of the Japanese economy, family incomes have decreased, and more women have sought to work after childbirth.[19] Since more than 80% of families in Japan are nuclear families consisting of two adults and their children, the rise in maternal employment has drastically increased the demand for child care services. However, the supply of public child care has increased slowly, causing an excess demand for child care. As of 2011, the total occupancy rate of child care facilities exceeds 100% with as many as 25,556 children on waiting lists (See Figure 4 in the Appendix).

The child-care shortage is attributed to the government's regulation of the child-care market. Although the private sector also offers child care services, it generally charges more than twice to four times as much as public child care due to expensive labor costs and the government regulating the quality of child care. In order to maintain the quality of child-care services, the Japanese government subsidizes only providers that obtain accreditation.[20]

This shortage of affordable child care is so severe that a number of women have to quit their jobs despite their willingness to continue working in order to take care of their children. According

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[17]Due to the existence of omitted variables, the commonly used empirical method of Blinder (1973) and Oaxaca (1973) results in biased estimates of statistical discrimination.

[18]Hereafter, child care is interpreted as caring for and supervising children from 0 to 3 years of age, mainly to facilitate maternal employment in both the public and private sectors. Child-care services for pre-school children aged 4 to 6 are not discussed because the accreditation system is different from the system of services for younger children. The criteria to obtain accreditation is much lower for pre-schools and kindergartens.

[19]For the past decades, becoming a homemaker has been a popular option for a married woman in Japan. Even among female college graduates, more than half of the full-time workers quit at marriage or motherhood and 70% of them do not work again as full-time workers. These low labor force participation rates are partly attributed to Japanese public policies. Over the past several decades, Japanese society has tried to keep women at home in the belief that it would improve family life and help women have more children, all while supporting traditional values. Japan has provided the lowest child-care subsidies proportional to GDP among OECD countries. In addition to the lack of support for child care, the government started subsidizing households with members who earn less than 1,030,000 yen (approximately $10,000) per year. Thus, the government actively made the option of becoming a housewife attractive while making labor market participation expensive for women with children. Thus, household specialization increased through the post-war economic development in Japan partly because the government pushed women into more domestic lifestyles and away from professional lives. Since then, however, the economic climate has changed significantly.

[20]To obtain accreditation, a child care facility must satisfy the following criteria: 1) the capacity is larger than 60 (To obtain subsidies for small sized child care services, the capacity can be as small as 20.); 2) the space per child is larger than 3.3 square meters or 35.5 square feet; 3) the local government collects pre-fixed fees; 4) applications must go through the local government; and 5) the provider must operate for fewer than 11 hours per day. Without subsidies, child care facilities satisfying all the above conditions would be very costly. Although private child care could offer high quality services and set prices freely, these services generally charge two to four times the price of public child care. Since the average cost of private child care amounts to more than half the average monthly salary for young female workers, very few households can afford such child care services. Moreover, the government requires that all child care services taking care of six or more children register in the government database. The government monitors the quality of these child care services in order to eliminate poor child-rearing environments. Thus, private child care services struggle to compete, in either price or quality, with public services.

to the Annual National Survey by the Ministry of Labor, Health and Welfare, 15-20% of women leave the labor market at their first childbirth every year. Conditional on continuing to work, 70-83% of women take child care leave, and this proportion has increased over the past decade. More than 97% of workers who take child care leave are women. Conditional on taking child care leave, 8- 11% of women do not return to the work place, which is partly attributed to the recent shortage of child care services.

3   Model

I introduce a model of firms' investment in their employees with a dynamic screening mechanism that will be estimated in the empirical section. The type of statistical discrimination studied here is similar to the model explored in Barron et al. (1993). I incorporate firms' investment choices and screening mechanisms into their model. The screening mechanism captures the dual job course system introduced in the previous section. I illustrate equilibrium wage determination and market failure associated with information asymmetries.

Suppose women have a different evaluation of their options of not working in the labor market. Such an evaluation, which reflects their home productivity and/or work preference, affects the probability that they will leave the labor market. A firm does not observe a woman's outside option when making investment decisions. Concerned about employee turnover, firm offer long-term contracts to defer payments. I characterize this situation as a two-period screening model in a competitive labor market. I describe the model setup, firms' investment problems, workers' labor supply problems, and the timing of the game. I also define the equilibrium and characterize the equilibrium with respect to wages, investment allocation, and labor supply.

3.1   Model Setup

Consider a two period competitive labor market with firms facing a unit mass of homogeneous male workers and two types of female workers N and C, with the proportions of n_N and n_C respectively. Each of the workers lives for two periods, which correspond to a woman's single young-adulthood and child-rearing years. Throughout the paper, there is no borrowing or saving. Unlike standard empirical labor supply literature, I assume that all human capital is firm-specific so as to give firms an incentive for employee investment.[21] Workers work for firms and receive wages. Firms hire

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[21]The theoretical rationale behind who makes investment choices is spelled out in human capital theory (Becker (1964)). According to the human capital theory, general human capital should be paid for by workers and firm-specific human capital should be paid for by firms in a general setting with a competitive, frictionless labor market. Admittedly, firm-specific human capital is a strong assumption, imposed to theoretically justify firms' employee investments in my model. In fact, my paper provides descriptive evidence for firms' investment in employees, but it does not provide evidence for firm-specific human capital. However, the firm-specific human capital assumption is not a necessary condition for my model and can be replaced by others; for instance, another way to justify firms' investment is to assume high mobility costs associated with switching firms, just as Gayle and Golan (2012) did.

workers and generate profits from production. The interactive investment decisions of the firm and its workers are analyzed as the pure strategy equilibrium of a game.

All men have the same outside option θ_M. Women with different types differ in their second-period outside options θ_i with $\theta_N > \theta_C$. Hereafter, I refer to type N as the non-career type woman and type C as the career type woman. Although value θ is time-invariant, the outside option is shifted by ε, a shock that is realized at the time of marriage. Assume that $\varepsilon^i \sim N(0, \sigma_\varepsilon^2)$. Let $G(\varepsilon)$ denote the CDF of stochastic term ε^i and $g(\varepsilon)$ as its PDF.

A worker has no outside option in the first period, and thus both men and women work.[22] In the beginning of the first period, workers privately learn if they are career type or non-career type. After workers learn their types, the firms offer them long-term contracts, which consist of wages for the two periods (w_t, $t \in \{1, 2\}$). Firms commit to wage contracts once offered. In addition to wage contracts, the firms decide how much human capital (on-the-job training) to provide for each worker. Workers choose a wage contract and a firm in the first period, then decide their second-period labor force participation based on their realized outside option. While employers cannot observe whether a female worker is a career type or a non-career type, they perfectly observe a worker's ability.

3.2 Workers' Problems

The objective of workers is to maximize their lifetime discounted utility. Their flow utility depends on consumption c. Let $\beta \in (0, 1)$ denote the common subjective discount factor[23] and $\mathbb{E}(\cdot)$ be the expectation conditional on the information available at the time of decision making. While male workers face uncertainty in the marriage market only, female workers face both the risk of staying single despite their willingness to get married and the risk of not being able to work due to the child-care shortage.

Knowing their inherent outside option θ, workers choose a wage contract in the first period. By construction, all workers would work in the first period. At the beginning of the second period, an individual receives a marriage offer with a known probability p_m. If a worker is married, $m = 1$; if a worker is single, $m = 0$. I assume that every individual who receives a marriage offer gets married. A married worker consumes all of his or her partner's income. For simplification, assume that workers know the distribution of their spouses' income. I also assume that all married workers have a child for whom they need to care. Having a child costs a female worker c if she works but costs a male worker nothing. The number of small children is assumed to be one.[24]

After observing all realization, a worker chooses their labor force participation in the second period. If he or she chooses to work, $d = 1$, and if not, $d = 0$. The decision on how to participate in the labor force during the second period depends on whether the second-period wage is higher than his or her outside option, $\theta + \varepsilon$. Keep in mind that ε is a shock that is realized at the beginning

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[22]Such an assumption is reasonable to make since more than 90% of new graduates work in Japan (Source: Survey on Employment Structure by Ministry of Health, Labor and Welfare).

[23]$\beta \equiv 1/(1+r)$ where r is the market interest rate.

[24]The mean of the number of children at age 35 conditional on being married by age 35 is 1.5.

of the second period. With $\theta_N > \theta_C$, the non-career type workers are more likely to leave the labor force in the second period and consume their outside value.

Given a contract (w_t, $t \in \{1,2\}$), the utility maximization problem for a worker is specified as

$$\max_{d,w_1,w_2} V(w_1,w_2) = \log(x_1) + \beta \mathbb{E}\log(x_2)$$

$$\text{s.t. } x_1 = w_1$$

$$x_2 = dw_2 + m(y_2 + (1-d)(\theta + \varepsilon) - cI(i \neq M))$$

$$d = \mathbf{1}_{\{w_2 - c \geq \theta + \varepsilon\}}.$$

where Ω_j is a set of state variables.

The objective function can be rewritten as

$$V = \max_{\psi} [\log w_1 + \beta((1-p_m)\log c(\Omega_1) + p_m(1-p_w)\mathbb{E}\log c(\Omega_2) + p_m p_w \log c(\Omega_3))]$$

where p_w is the probability that worker i will work in the second period.

For the purpose of this paper, I simplify the marriage market in that I assume every woman who receives a marriage offer gets married. Compared to their work-life preference, women's family-life preferences have much less heterogeneity.[25]

3.3 Firms' Problem

The objective of firms is to maximize the difference between revenue and wages. At the beginning of the first period, firms propose long-term wage contracts. After seeing the types of contracts they have been offered, workers choose a firm and a contract. Based on the contracts workers choose, firms infer the quit rate of each worker and then make an investment decision.

The investment problem is a modified version of the Ben-Porath (1967) model, in which the investment cost is captured by the opportunity cost of training. A worker is endowed with one unit of time in each period with the initial human capital H_1. Workers' productivity in the first period is $(1-I)H_1$, where I represents the amount of time invested in human capital. The second-period human capital thus becomes $h(I)$ with $h(0) = H_1$. To avoid a trivial case, I restrict our attention to

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[25]In the JPSC survey data, 87% women at age 25 answered that they want to get married some day, while 10% answered they want to eventually get married, while 10% answered they do not necessarily want to get married. Conditional on a desire to get married, 90% of women at age 25 answered their desired age of marriage is 30 or younger and 98% answered 35 or younger. I ignore the small fraction of women who divorced in the data, which accounts for 0.19% of the whole population (Data Source: Annual National Survey 2010 by Ministry of Health, Labour and Welfare).

a set of parameters where any amount of investment is profitable if the worker does not quit. Also, I assume there is a unique maximum for the investment problem.

A contract ψ can be fully characterized by two period wages, $\psi = (w_1, w_2)$. Since there are two types of female workers (career type and non-career type), according to the revelation principle, firms firms propose at most two contracts ψ_N and ψ_C in an attempt to screen female workers. Let q_ψ stand for the average quit rate of the workers who choose the contract ψ. The firm's objective is therefore written as

$$E[\pi(I, \psi)] = \max_{\psi_i, I} \sum_{i \in N, C} n^i \{(1 - I)H_1 - w_1 + \beta(1 - q_\psi)(h(I) - w_2)\}$$

3.4   Endogenous Quit Rates and the Effects of Child-Care Subsidies

A worker's labor force attachment is characterized by the quit rate, which consists of endogenous and exogenous components. On the one hand, the quit rate is endogenous because the relative importance of the workers' outside options compared to their wage offers from a firm affects the probability that they will leave the firm in the second period. That is, the quit rate is a function of the outside option and wage. On the other hand, the quit rate is affected by exogenous variation in the availability and cost of child care. As documented in Section 2, the government strictly regulates the child care market in Japan, leading to child care shortages across the country. Since the costs of public child care are determined by the local government, there is considerable variation in costs across prefectures. Taking these variations into consideration, I consider the supply of child care to be exogenous since women in different prefectures will have different labor force intentions depending on the local accessibility to child care. Thus, the marginal effect of child care subsidies, different in each prefecture, is denoted by j.

Child care services can also affect a woman's labor supply decision in that both the net wage payment a woman receives and the chance of limiting the probability of working with a small child impact a woman's decision to continue working during the second period. The cost of working with a child for a female worker is the price of public child care in prefecture j, denoted as c_j, and zero for male workers;

$$c = \begin{cases} c_j & \text{for female workers} \\ 0 & \text{for male workers} \end{cases}$$

The net financial gain of working in the labor market is $w_2 - c_j$ for a women who has a small child and lives in prefecture j and w_2 for all man. This specification reflects the reality of Japanese women who has no other options but public child care to look after her child while she works.

The child-care shortage in Japan can also affect a woman's decision to continue working during the second period. I assume that the probability of working in the second period, pw, can be expressed as the joint probability of a female worker being able to find a child-care service, p_j, and the probability that her option of staying in the labor market exceeds the option of staying at home.

$$
p_w = \begin{cases} p_j \Pr\left(w_2 - c_j \geq \theta + \varepsilon\right) & \text{for female workers} \\[2em] \Pr\left(w_2 \geq \theta + \varepsilon\right) & \text{for male workers} \end{cases}
$$

when worker i lives in prefecture j. The quit rate of a worker with θ in the second period is defined as:

$$
q(\theta, w_2) = \Pr(w_2 - c_j \leq \theta + \varepsilon) + p_j \Pr(w_2 - c_j > \theta + \varepsilon)
$$

3.5   The Timing of the Game

As previously mentioned, the first and second periods roughly correspond to the individual's early ages and later ages, respectively. The timing of the game is defined as follows:

Period 1: Young Workers

1. Each firm may simultaneously announce any finite number of contracts.

2. Workers choose a contract.

3. After observing a worker's contract choice, firms decide how much to invest in worker i.

4. Workers produce output, receive the first-period wage, and consume.

Period 2: Old Workers

1. Workers may receive a marriage offer associated with a random shock to their home productivity.

2. If workers stay in the firm, they produce output and receive the second-period wage. Otherwise, they obtain the value of outside option.

3. Workers consume.

3.6 Equilibrium Wage

The game structure is essentially a screening model under perfectly competitive assumptions. However, an equilibrium may not exist for a standard screening model.[26] I use the Wilson equilibrium to circumvent this problem. Wilson (1977) considers the structure of the screening game by introducing an "anticipatory equilibrium" to the Nash equilibrium concept: in Wilson's concept, an expectation rule is imposed such that each firm assumes that any unprofitable policy will be immediately withdrawn. Wilson shows that the anticipatory equilibrium concept leads to a pooling equilibrium in which utility is maximized subject to a zero-profit condition.[27] Given the game structure, the equilibrium is defined below.

Definition 1. – Equilibrium Wage Contracts with Screening

The equilibrium under asymmetric information is a set of wage contracts $\psi = (w_1, w_2)$ and the associated investment level $I(\psi)$ such that it solves the firm's problem of maximizing profits and firms make zero profit.

Note that owing to the competitive labor market assumption, a firm's profit-maximization problem is equivalent to its revenue-maximization problem, subject to workers' participation constraints. Furthermore, the set of choices is reduced to a single element because the second-period wage determines the average quit rate, which in turn pins down the optimal investment level. Finally, the zero-profit condition determines the equilibrium first-period wage.

The problem of this screening model would become:

$$\max_{\psi} \sum_{i \in N,C} n^i \left\{ (1 - I(\psi))h_1 + \beta(1 - q(\psi))h_2(I(\psi)) \right\}$$

$$\text{s.t. (Zero Profit): } E[\pi(\psi)] \leq 0$$

$$\text{(IC): } V^i(\psi_i) \geq V^i(\psi_j).$$

Then, the equilibrium is defined as a pair of contracts that meet the following conditions:

(E1) Payoff Maximization: Workers choose the contracts that maximize their lifetime discounted utility.

(E2) Profit Maximization: Firms maximize their profits.

(E3) Incentive Compatibility (IC): Each type of worker will not choose the contracts offered to the other type.

(E4) Participation constraints: Workers would participate in this game (i.e. firms earn non-positive profit).

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[26]If there is any equilibrium, only a separating equilibrium survives, and thus a pooling equilibrium does not exist. There are many ways to circumvent the non-existence problem. One way is to change the structure of the game. For example, we can assume there exists a small fraction of unhealthy firms which disappear in the second period.

[27]For a comprehensive discussion and literature review, see Riley (2001).

3.7 Allocation Inefficiency

The resulting equilibrium outcomes can be classified into three categories: first-best outcomes, second-best separating outcomes, and pooling outcomes.[28] The equilibrium types are defined below.

Definition 2. — Type of Equilibrium
Without uncertainty, the competitive equilibrium is defined as
i) a first-best equilibrium if it achieves the same outcome as the first-best equilibrium.
ii) a second-best separating equilibrium if the first-best contracts are not incentive compatible but workers with different labor force intentions choose different wage contracts.
iii) a pooling equilibrium if workers with different labor force intentions choose the same contracts.

The equilibrium is defined as a first-best outcome if, in terms of resource allocation and individuals' welfare, it achieves the same outcome as the situation with symmetric information. In a second-best separating equilibrium, the welfare of workers with lower outside options decreases. This decrease is due to the career-type woman choosing an incentive-compatible contract, which

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[28]Given the model structure, the economy achieves a separating equilibrium or a pooling equilibrium, depending on the model parameters. Note that the first-best equilibrium wages can be rewritten as:

$$
\psi^* = \{(w_1, w_2) : U'(w_1^*) \left(\underbrace{-H_1 \frac{\partial I^*}{\partial w_2}}_{\Delta \text{training}} + \beta \left(-1 + \underbrace{p_m g(w_2^* - \theta_i) h(I^*)}_{\Delta \text{output from } \Delta \Pr(\text{work})} + \underbrace{(1 - q_\theta(w_2^*)) \frac{\partial h(I^*)}{\partial w_2}}_{\Delta \text{productivity from } \Delta \text{human capital}} \right) \right)
$$

$$
+ \beta \left(\underbrace{(1 - q_\theta(w_2^*)) \frac{\partial U(w_2^*)}{\partial w_2}}_{\Delta U_2 \text{ from } \Delta w_2} + \underbrace{p_m g(w_2^* - \theta_i) U(w_2^*)}_{\Delta U_2 \text{ from } \Delta \Pr(\text{work})} \right) = 0 \}
\tag{1}
$$

Equation 1 shows that the loss from the worker's first-period utility associated with a small increment in the second-period wage should be equal to the gain from the second-period utility. The first term shows the change in the first-period utility brought about by a decrease in the first-period productivity and a change in the first-period payment. The second term consists of an increase in future payments and an increase in the probability of continuing to work. However, this outcome cannot be achieved if the first-best equilibrium wages are not incentive compatible.

As illustrated in Equation 1, uncertainty plays an important role in wage growth in my model. My model contains three sources of uncertainty: the availability of a marriage offer, the accessibility of child care, and women's realization of their outside options. With an information problem, uncertainty increases the likelihood of pooling consequences by reducing the set of incentive-compatible wage schemes. When uncertainty increases an option value of investment, incentive compatibility for housewife types is more likely to bind. The opposite case may also happen: as uncertainty rises, incentive compatibility of career-type women could be more likely to bind when the benefits from choosing a steep wage profile exceed its costs. In other words, uncertainty in the marriage market (there is a positive chance that they cannot get a marriage offer) would increase an option value of market-related skill investment; a larger probability of not getting married makes steeper wage profiles more attractive to workers with ex-ante high outside options. In contrast, uncertainty in the labor market (the presence of shocks to the outside option and a chance that they have to leave the labor force with no child care service available) decrease the option value of investment; a larger probability of not being able to work makes female workers with lower outside options prefer to choose flatter wage contracts because they are not sure whether they would stay and receive the second-period wage. This makes deferred payment harder to be accepted.

leads to lower levels of utility than the case without an information problem in order to reveal their type. In a pooling equilibrium, all workers receive an equal amount of investment, but workers with higher outside options leave the firm. Therefore, firms lose profits from those who quit, reducing the payment to workers who stay. There are two kinds of pooling outcomes. The first case of a pooling equilibrium is where workers with lower outside options stay. The second case of a pooling equilibrium is where no workers stay with the firm.[29]

The model is set up such that the economy could achieve either a separating outcome or a pooling outcome, depending on market productivity compared to workers' outside options. In fact, a pooling equilibrium may exist because workers constrained from borrowing prefer a flat wage profile in order to smooth their consumption over time. That is, workers who can receive more investment and more compensation by choosing a steeper wage profile would rather not do so when their utility gain is smaller than the utility loss from having lower first-period consumption. Thus, without imposing strong assumptions, the model describes an environment where, despite firms' best screening efforts, women who plan to continue working choose the same investment level as those who plan to quit their job at childbirth.

If the society is in a pooling equilibrium, investment allocation is not as efficient as the case in which employers observe workers' labor force intentions. Efficiency could drastically increase if a pooling equilibrium turns into a separating equilibrium. One possible way to alter the type of equilibrium and create a separating equilibrium is to render tax credits for working women. For example, child care tax credits would increase the relative attractiveness of a work option for a mother with a small child.

4   Data

I use three kinds of data sets: the Japanese Panel Survey of Consumers (JPSC), the Japanese census, and the aggregate data on child care services provided by Zenhoren (The Institute for Research on Child care).

4.1   Household-Level Panel Data

The main data set in this study is the 1993-2008 JPSC data, offered by the Institute for Research on Household Economics. The currently available data contains individuals divided into four age cohorts: Cohort A (born between 1958 - 1969), Cohort B (born between 1970- 1973), Cohort C (born between 1974-1979), and Cohort D (born between 1980-1984).[30]

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[29]Note that under a linear utility assumption, wage contracts that exhibit the property of "deferred payment" can screen workers perfectly without changing individuals' welfare. That is, the economy always achieves separating outcomes. In contrast, with the concave utility function, the equilibrium types depend on the parameter values.

[30]The survey started in 1993 with a cohort of 1,500 women aged 24 to 34 chosen from across Japan; it has been conducted annually since then and a cohort of young adult women have been added to the data every 3 to 5 years. As of 2008, the most recent wave of the survey, the oldest cohort is 49 years old.

The JPSC contains extensive data on each household member, including the prefecture in which a family lives, which can inform us about the accessibility of child care for individual women. This key variable provides exogenous variation in women's quitting behavior around the time of child birth. The data also includes detailed information on other labor supply determinants such as a woman's education, her husband's income, household assets, remittance, and her mother's labor force participation when the woman was a child.

The JPSC data also contains information on individual labor force intentions. This information allows us to observe the potential productivity of workers that is unobservable to their employers. Since the survey ceased asking about labor force intentions in its later iterations, this information about labor force intentions is available only for the first two cohorts. For this reason, I focus on female college graduates in Cohorts A and B.

4.2 Prefecture-level Public Child-Care Data

In addition to the household panel data, I use data on child care services provided by Zenhoren (The Institute for Research on Child care),[31] which contains information on the costs and availability of child care by each prefecture and municipality. To conduct a counterfactual analysis, identifying the unbiased effect of child care is important. Although data on child care expenses and usage for each household are available in the JPSC data, I only observe the accepted prices of child care, which would potentially bias the estimation results. Therefore, instead of the actual expenses, I use a variation in the availability and cost of public child care across municipalities. To identify the causal effect of statistical discrimination, I use variation in the accessibility of accredited child care as an instrumental variable for women's quit rates.

As discussed above, there are large differences in the cost of public child care between prefectures in Japan. The monthly cost of accredited child care in Tokyo, for example, is set at 37,200 Japanese yen, which is a fixed cost for a household with an income between 3,375,000 and 3,931,666 Japanese yen ($\approx$ \$33,750 to $\approx$ \$39,316 USD). For households with these same income ranges, the monthly cost of child care is 54,830 in Chiba, 53,500 in Kanagawa, and 46,800 in Saitama. Since the average total monthly income for these households is 3,500 to 4,500 USD, the relative magnitude of child care expenses is large. Based on the difference in child care costs, women in Tokyo are categorized into one group and women in Tokyo's neighboring prefectures (Kanagawa, Chiba, and Saitama) are put into another group. [32]

I use the extent of the child care shortages as an instrument in order to identify the effect that high average job quit rates have on women's earnings. To measure the extent of child care shortages, I construct a child care accessibility index. This index is defined as the number of children who are in child care divided by the number of children on waiting lists plus the number

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[31]The official name of the institute is Zenkoku Hoiku Dantai Renrakukai. The website is found at: http://hoiku-zenhoren.org/

[32]I combine the prefectures with similar characteristics to avoid the sample size becoming too small.

of children who are in child care. I confirm that the child care accessibility index strongly correlates with women's average quit rates.[33]

I also argue that the instrument (child care accessibility) does not affect women's compensation through any channel other than the women's average quit rates. The major concerns about the validity of exclusion restriction are that child care accessibility in a residential area may affect a woman's choice of where to live. However, not many women move to find better access to child care. According to the JPSC data,[34] women were not aware of child care shortages at the time they decided on their residential area. Moreover, even after they became aware of these shortages, they did not move to seek better accessibility to child care. Therefore, I use child care accessibility as an exogenous source that affects quitting rates in order to identify the degree of statistical discrimination.

4.3 Census Data

One problem with the JPSC data is that the only data on men comes from women's responses about their husbands. Since married men are not representative of the reference population of Japanese men, I use the Japanese national census rather than the JPSC data to analyze the labor market outcomes for men. The data for men's monthly salaries is obtained from the Basic Survey on Wage Structure, conducted annually by the Ministry of Health, Labor and Welfare. Both the JPSC and the census have statistics on monthly salaries, or the amount paid every month (excluding bonuses). However, as is often the case with statistics on earnings, monthly salaries are not consistently defined between the JPSC data and the census. In fact, these two sources of data ask questions about salaries in a slightly different manner. The questions in the government data are posed to a restricted group of workers defined as "ordinary workers," who work full-time in the first firm.[35]

4.4 Sample Universe

I compare women and men with similar characteristics with respect to the investment decisions of the employing firms. Since male workers are most comparable to single, childless female workers, I limit our sample universe to women in the data aged 29 and under who are single and work full-time in their first firm.[36] Among the women who graduated with a four-year college degree, more than half of them work in the first firm between age 24 and 29.

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[33] All the F-statistics in the first stage of the IV exceed the Stock and Yogo (2005) 10% critical value. The regression results show that those women who live without a parent are 59% more likely to participate in the labor force when the child-care access index is higher by 1.

[34] Asai et al. (2015) document the little effects of child-care accessibility on mothers' relocation.

[35] In Japan, this specific term "ordinary workers or regular workers" refers to the workers who continue to work full-time in the same firm since the beginning of their work career in order to distinguish from workers who have ever changed a firm. The names come from the fact that labor mobility is extremely low and most of full-time workers stay in their first firm for their whole life in Japan, at least until recently. I construct the monthly salary data for female using the JPSC data so that the measurement of earnings is comparable between men and women.

[36] The sample excludes college dropouts, who consist of 1.7% of the observation.

My sample universe is young men and women who work full-time in their first firm at some point in the survey period from 1993 to 2008.[37] The JPSC data contains 2,813 women in Cohorts A and B aged 29 and under at the time of their first appearance in the data. The sample size decreases as I focus on full-time workers. Among observed workers, 1,891 of them (67.2%) are in the labor force, and 1,264 of them (44.9%) work full-time. Among full-time female workers, 81.9% are single, making the sample size 1,035. When I further restrict the sample to women who work in their first firm, the number of female individuals in the sample is reduced to 633. I observe these women for two six-year periods.

4.5   Main Variables

I created variables for women's labor force intentions based on survey questions in the JPSC data. There are several questions that ask workers about their career plans. One of the questions asked all women in the sample whether they want to continue working at their current job, switch their job for one with fewer hours, or stop working when they have a child. The question is asked three times throughout the survey (in 1994, 1997 and 2000).[38] For those who answered this question two or more times, I find that their answers do not change. That is, female workers do not seem to change their labor force intentions over time. This data feature is consistent with the assumption that women know the deterministic part of their outside option, making it time-invariant.

I classify women who answered the survey when they were single and under the age of 29 into two groups: type N, who answered that they plan to stop working as a full-time worker, and type C, who answered that they plan to continue working full-time. The proportion of workers who plan to continue working is a minority regardless of women's educational attainment. Of four-year female college graduates, 44.1% answered that they plan to continue while 36.3% of women with a two-year college degree or less did so.[39] I find that, of women aged 24 to 29, 57.8% are career-type in the Tokyo area and 43.1% are career-type in the suburb area.

Although the panel data does not contain explicit information about which career course a woman chooses, the data includes a substantial amount of information on task characteristics that allows us to infer what career course she chose. Using these job characteristics, I classify full-time jobs into two groups. For a job to be considered as a career course, the annual growth rate of its corresponding monthly salary must be larger than 5,000 Japanese yen ($\approx$ 50 U.S. dollars), and I assume the job requires more than one month of training for a newly-hired worker. In addition, I exclude jobs chosen by the workers because they require no overtime work or have no chance of job transfer from the group of career jobs. As a result, 52.1% of female full-time workers are considered to have career jobs when they are first observed in the panel data; the remaining 47.9% have non-career jobs.

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[37]Workers on leave are also excluded from the sample.

[38]1,433 women answered this question once, 898 twice, and 312 three times.

[39]To the survey question that asked whether they plan to continue to work at childbirth, 370 women answered that they will stop working or switch to a part-time job while 196 women answered that they will continue to work. That is, 65.4% of women who answered the survey question plan to stop working as a full-time worker upon having a child.

Job courses screen female college graduates with different labor force intentions to some extent, but not perfectly (See Table 9 in the appendix). Based on information about labor force intentions in the JPSC data, I calculate the proportion of women who plan to leave at childbirth in each job course. At age 25, 52% of women in the career course plan to leave, while 70% of women in non-career courses plan to do so. Among those who choose a non-career course, 80.3% plan to leave the labor market or work part time. In contrast, among women who choose a career course, as many as 37.4% plan to leave. Thus, mixed types of workers (in terms of their labor force intentions) are more likely to be observed in career courses despite their screening mechanisms.

The rates of women participating in the labor force between the ages of 30 and 35 are used to match the model with the data. They are different from labor force intentions for various reasons. For instance, some options may not be available: if a woman cannot find a marriage partner, she will continue to work because her outside options remain low; if a woman cannot find affordable child care services, she may leave despite her plan to stay in the labor market; or a woman might change her mind over time as more information unfolds. In the model, wages, *w*, equalize monthly after tax and labor income averages over a six year period. The data shows that, on average, wage profiles in non-career courses start at approximately the same level as wage profiles in career-courses.

5   Calibration

The screening model constructed in Section 3 suggests that the possibility of the separating or the pooling equilibrium occurring depends on the distribution of workers' outside options relative to their market productivity and uncertainty. The model also implies that tax credits for working women can push the economy to a separating equilibrium, increasing efficiency and total welfare.

The empirical section builds on these model predictions and quantifies the counterfactual effect of public policies that change the outside-option distribution of Japanese women. As an example of public policies that are expected to bring about such a shift in distribution, I study child care tax credits for working women. In particular, I calibrate the model to the Japanese data in the spirit of the simulated method of moments, which selects parameters that best match a set of properties for both the actual data and the simulated data from the model. In order to bring the model to the data, I slightly modify the model presented above. Workers are different in ability levels $A_i \in \{0, 1\}$ in addition to outside option θ. Among workers in a career course, the productivity of high-ability workers is greater by Δ units per unit of investment than low-ability workers. Assume the ability of a worker is correlated with home productivity type by the correlation coefficient ρ. When employers make a positive amount of investment in their employee, the worker's human capital in the second period evolves as follows: $h(I) = \gamma I^\alpha H_1 + \Delta I(A = 1)$ where γ, α, and Δ are the parameters to be estimated. Keep in mind that I is the amount of investment and H_1 is the worker's

initial human capital level. In addition, I introduce disutility from working in a career course, denoted by b.[40]

5.1 Solution Algorithm of the Screening Model

The model with long-term contracts for female workers is solved numerically by the following steps.

1. Choose a set of parameters for production technology and women's type distribution.

2. Solve the worker-employer game for the wage contracts in the first-best equilibrium.

   (a) Given a second-period wage, the quit rate conditional on the observables is calculated.

   (b) The quit rate pins down the optimal investment amount.

   (c) From the second-period wage and values from (a) and (b), the first-period wage is obtained from the zero-profit condition.

   (d) Given a feasible wage contract, the corresponding value function for each type is calculated.

   (e) The first-best contracts are the ones that maximize value function for each type.

3. Check if the first-best contracts are incentive compatible.

4. If any incentive-compatible constraint binds, calculate the wage contract in a separating equilibrium for each type of worker.

   (a) If incentive compatibility for the non-career type is binding, find a contract that the career-type woman prefers the most among the contracts that the non-career type woman likes less than their first best contract.

   (b) If incentive compatibility for a career-type woman is binding, find a contract that a non-career type woman prefers the most among the contracts that a career-type woman type likes less than their first best contract.

   (c) If only one of the incentive compatibilities bind, the wage contract for the type whose incentive compatibility binds receives their first-best wage contracts.

5. Calculate pooling equilibrium wage contracts.

   (a) Given a second-period wage, the average quit rate of different types is calculated.

   (b) The average quit rate pins down the optimal investment amount.

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[40]This introduction is made in order to match with the data feature that the starting wages for a career course and a non-career course do not significantly differ. Without disutility from a career course, the model predicts that all female workers end up choosing a career course.

(c) From the second-period wage and values from (a) and (b), the first-period wage is obtained from the zero-profit condition.

(d) Given a feasible wage contract, the corresponding value function for each type is calculated.

(e) The pooling contracts are the ones that maximize value function for each type.

6. If no incentive compatibility binds, let the career-woman type choose a contract among first-best contracts and pooling contracts.

7. If any incentive compatibility binds, let the career-woman type choose a contract among separating wages and pooling wages.

5.2 Moments and Identification

Among the parameters chosen outside of the model are $\{n_{Nj}, p_m, \bar{y}, p_j, c_j\}$ for $j \in \{Tokyo, Suburb\}$. A one-period (six-year) discount rate (β) is 0.7.

The parameters are estimated from the original data with the simulated data by matching wage profiles and the probability of quitting. The moments are calculated conditional on the observed characteristics of workers. The data moments employed in the estimation are as follows:

- Occupational Sorting: the proportion of female individuals who choose each job course by cohort and age.

- Labor Force Participation: the proportion of individuals who work full-time by cohort, age, and gender.

- Earnings Profile: the mean log monthly wage by cohort, job course, age and gender.

I provide an overview of the identification strategy. Some parameters are chosen from outside of the model. The distribution of women's heterogeneous work-life preference (i.e. the proportion of career versus non-career types) is taken from the JPSC survey questions that ask women about their labor force intentions at the time of their first child birth (for details, see the description in Section 4). The probability of receiving a marriage offer is the actual proportion of women who are married by age 35.[41] For female workers, the expected value of their spouse's income is calculated as the average monthly total income of all married men in the JPSC data. The set of parameters chosen outside of the model is summarized in Table 1.

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[41]Relatively few women get divorced by age 35. I regarded them as a single when calculating the proportion of married women.

Table 1: Parameters chosen outside of the model

	Non-career Type	Career Type
Tokyo	42.2%	57.8%
Suburb	56.9%	43.1%
Marriage Rates p_m	81.4%	84.8%
Husband's earnings $\bar{y}$	285.1	237.1

The key identification of production function parameters is due to exogenous variation in quit rates across prefectures. As discussed above, the costs of public child-care in Japan are determined by the local government, and thus there is large variation in cost between municipalities. In my model, the probability that worker i leaves the labor force in the second period is given by $q_i = 1 - p_j \Pr \left(w_2 - c_j \leq \theta + \varepsilon \right)$, where p_j is the availability of child care and c_j is the cost of child-care in prefecture j that is exogenously determined. Taking these variables into consideration, I examine the effect of child-care subsidies for Tokyo and its neighboring prefectures separately.

Table 2: The Price of Child-care across Prefecture (Year 1996 – 2000)

Residential Area		Price of Public Child care (c_j)	Child-care Availability
Tokyo		37200	0.81
Suburb	Chiba	54830	0.96
	Saitama	46800	0.89
	Kanagawa	53500	0.85

Note) The price unit is Japanese Yen. The child-care availability index is constructed as the number of children who are in child care divided by the number of children whose mother want to use child care (the summation of the number of children on waiting lists and the number of children who are in child care.

The rest of the parameters are estimated; (i) the parameters in the human capital production function (α, γ, Δ); (ii) the disutility parameters in the utility function (b); (iii) the correlation between ability and the outside option (ρ) ; and (iv) the mean and variance of the outside option for male workers and female workers with different labor force intentions, respectively (θ_M, θ_N, θ_C, σ_M, σ_N, σ_C). Several normalizations are needed because some variables are not observed in the data. For example, I normalize the first-period human capital level to one ($H_1 = 1$), setting one unit equal to 145,000 Japanese Yen ($\approx 1,450$ USD).

The parameters in the production functino are identified as follow. My model characterizes wage equilibrium in relation to occupation (job course) choice and labor force participation decisions made by other workers of the same gender. To be specific, given the quit rates of men, the total earnings for men who work for both periods is equal to the total productivity because of the competitive labor market assumption.

$$(1 - I) + \beta (1 - q_i) h (I) = w_1 + \beta (1 - q_i) w_2.$$

Given female worker's quit rate,

$$(1 - I) + \beta(1 - q(\psi))h(I) = w_1 + \beta(1 - q(\psi))w_2$$

where $q(\psi)$ is the average quit rate of workers who choose contract ψ if the types are pooled, and $q(\psi)$ is equal to the individual's quit rate if the types are separated.

Thus, the observed wage profiles from each gender provides three equations expressed by the three production parameters (i.e. α, γ, Δ) in the human capital function ($h(I)$). Given wages, differences in the observed quit rates mainly determine the value of the outside option for male workers and each type of female worker. As discussed earlier, the variance of shocks to the outside option (σ) is identified by matching the observed wage growth for each gender-type worker.

The extent of work disutility (b) is pinned down by looking at the proportion of female workers who choose a non-career course and the wage levels for each occupation course in the first six-years. If there is no disutility in my model, all female workers would choose a career course in the model simulation unless the starting wages for a non-career course are higher than those for a career course. Given that the starting wages are not significantly different between two occupation courses, positive value of disutility makes some women choose a non-career course.

The correlation between ability and the second-period outside option (ρ) greatly affects the proportion of non-career type workers who choose a career course in the model simulation. The mean (θ) and variance (σ_ε) of workers' outside options for each type of worker are recovered from a mapping of outside options to the optimal wage contracts. The increment in productivity for high ability workers (Δ) and the proportion of high ability workers ($\%A$) is identified using the variance of the second-period wage for each gender and job course. That is, I attribute the variation to ability difference unobserved to researchers as well as measurement errors.

6 Results

The parameter estimates are shown in Table 3. Despite a large difference in the cost of public child care, both Tokyo and its neighboring areas are found to be in a pooling equilibrium. Screening seems to distinguish workers with different labor force intentions to some extent, but not perfectly. The imperfect nature of screening may be because there are only two distinct job courses, which differ not only in wage schemes, but also in hours of work and difficulty.

Table 3: Calibration Results

		parameter	estimate
Demography	% of high ability workers	$\%A$	0.38
	correlation btwn ability and labor force intention	ρ	0.75
Utility	task disutility for the career course	b	1.22
Outside option for men	mean	θ_M	1.04
(Uncertainty)	variance	σ_M	1.13
Outside option for women	mean for Type N	θ_N	1.96
	mean for Type C	θ_C	1.19
(Uncertainty)	variance for Type N	σ_N	1.09
	variance for Type C	σ_C	0.35
Production Function		γ	1.28
		α	1.27
	ability effect	Δ	0.81
Equilibrium in Tokyo Area			pooling
Equilibrium in Suburb Area			pooling

Note : The second best pooling outcome fits the data the best for both areas.

Tables 4 and 5 compare the actual and predicted monthly salaries and overall differences in labor participation rates by cohort, gender and age.

Table 4: Moments by Women's Type and Residential Area

				(Unit: hundred Japanese yen)	
		Non-Career Type		Career Type	
	Residential Area	Actual	Simulated	Actual	Simulated
% Full-time Employment at age 35	Tokyo	28.8	33.4	74.0	88.1
Mean of Monthly Wage at age 24-29	Tokyo	2378.6	2386.0	2600.4	2521.2
Mean of Monthly Wage at age 30-35	Tokyo	2363.3	2643.6	3441.7	3232.8
% Full-time Employment at age 35	Suburb	9.8	29.3	81.9	85.5
Mean of Monthly Wage at age 24-29	Suburb	2419.7	2247.4	2559.6	2398.8
Mean of Monthly Wage at age 30-35	Suburb	3088.0	2424.0	3285.2	3068.4

Note: Employment rates at age 35 are compared to the employment rates at age 25 being set equal to 100%.

Table 5: Moments by Gender

	Female		Male	
	Actual	Predicted	Actual	Predicted
% Full-time Employment at age 35	37.9	42.7	90.9	90.7
% Career Course at age 24-29	50.0	51.3	–	–
% Career Course at age 30-34	66.6	65.7	–	–
Mean of Monthly Wage at age 24-29	2279.4	2312.1	2761.0	2954.0
Mean of Monthly Wage at age 30-34	2721.9	2518.8	3623.0	3251.0

Note 1: Employment rates at age 35 are compared to the employment rates at age 25 being set equal to 100%.

Note 2: The data for the average salary of male college graduates are taken from a national annual survey conducted by the Ministry of Health, Labor and Welfare (2010).

6.1 Discussion

There are two main reasons why a pooling equilibrium exists in my model: workers' borrowing constraints and uncertainty with irreversible features of human capital investment. Borrowing-constrained workers prefer a flat wage profile in order to smooth their consumption over time. That is, workers who can receive more investment and more compensation by choosing a steeper wage profile would rather not do so when their utility gain is smaller than the utility loss from having lower first-period consumption. Thus, without imposing strong assumptions, the model describes an environment in which, despite firms' best screening efforts, women who plan to continue working choose the same level of investment as those women who plan to quit their job at childbirth.

The second reason is more interesting in the perspective of economics. Uncertainty in a framework of finite time horizon adds option value to human capital investment. My model contains three sources of uncertainty: the availability of a marriage offer, the accessibility of child care, and women's realizations of their outside options. When the market sector has less uncertainty than the home sector (or the marriage market), investment in market-related skills has an option value for workers who plan to leave in the second period. That is to say, workers have incentive to receive investment despite their high probability of quitting in order to insure themselves against the risk of not receiving the option to leave the labor market.

Indeed, firms can offer training only to workers who accept a contract in which they promise to pay penalties upon leaving the job. However, such arrangements are not commonly observed in the Japanese labor market. A signaling mechanism is another solution to ameliorate the information problem, but possible signaling devices such as education and hours worked seem too noisy to convey labor force intentions: I ran logit regressions of employee turnover on various indicators and find that neither education nor overtime work predicts worker turnover rates. These findings are not surprising considering that many women go to college for purposes other than work-related investment and the number of hours worked for full-time jobs is not typically flexible in Japan.

7 Counterfactual Analysis

Based on the estimated model, I conduct a set of counterfactual analyses. I first compare the estimated model with a world where firms observe workers' labor force intentions, leading me to conclude that the hourly wage for women who plan to continue working would increase by 16%, from 250,000 to 290,000 Japanese yen, when they are between 24 and 29 years old and increase by 5%, from 310,000 to 325,000 Japanese Yen, when they between 30 and 35 years old. This increase is due to an increase in human capital investment offered by employers.

In the next counterfactual analysis exercise, I allow the government to reduce (or raise) the price of child care services by providing (or taking away) subsidies. To balance the government budget, increases in child care subsidies are collected by a lump-sum tax on the working-age population. The percentage change of the child care price is held constant across different residential areas. In doing so, I evaluate the effect of increasing and decreasing the price of child care services with respect to female labor supply, gender wage differences, and the efficiency of labor allocation.

I find that the expected change is not necessarily unidirectional. Based on the estimated parameters, the results show that the effect of child care subsidies varies depending on the current price of child care. In Tokyo, where child care costs half as much as in neighboring areas, no reasonable changes in child care subsidies improve efficiency. By contrast, in the suburb area, a 140% decrease in daycare subsidies per child (a reduction of approximately 700 USD per month) changes a pooling equilibrium to a separating equilibrium (See Figure1). This change occurs because the decrease in subsidies discourages non-career type women, who have a higher intention of quitting, from choosing a career course. The graph below shows the counterfactual simulation results. Conversely, in the Tokyo prefecture, small changes in child care subsidies do not bring notable efficiency improvements.

Figure 1: The Effect of Child-care Subsidies on Female Labor Force Participation and Welfare
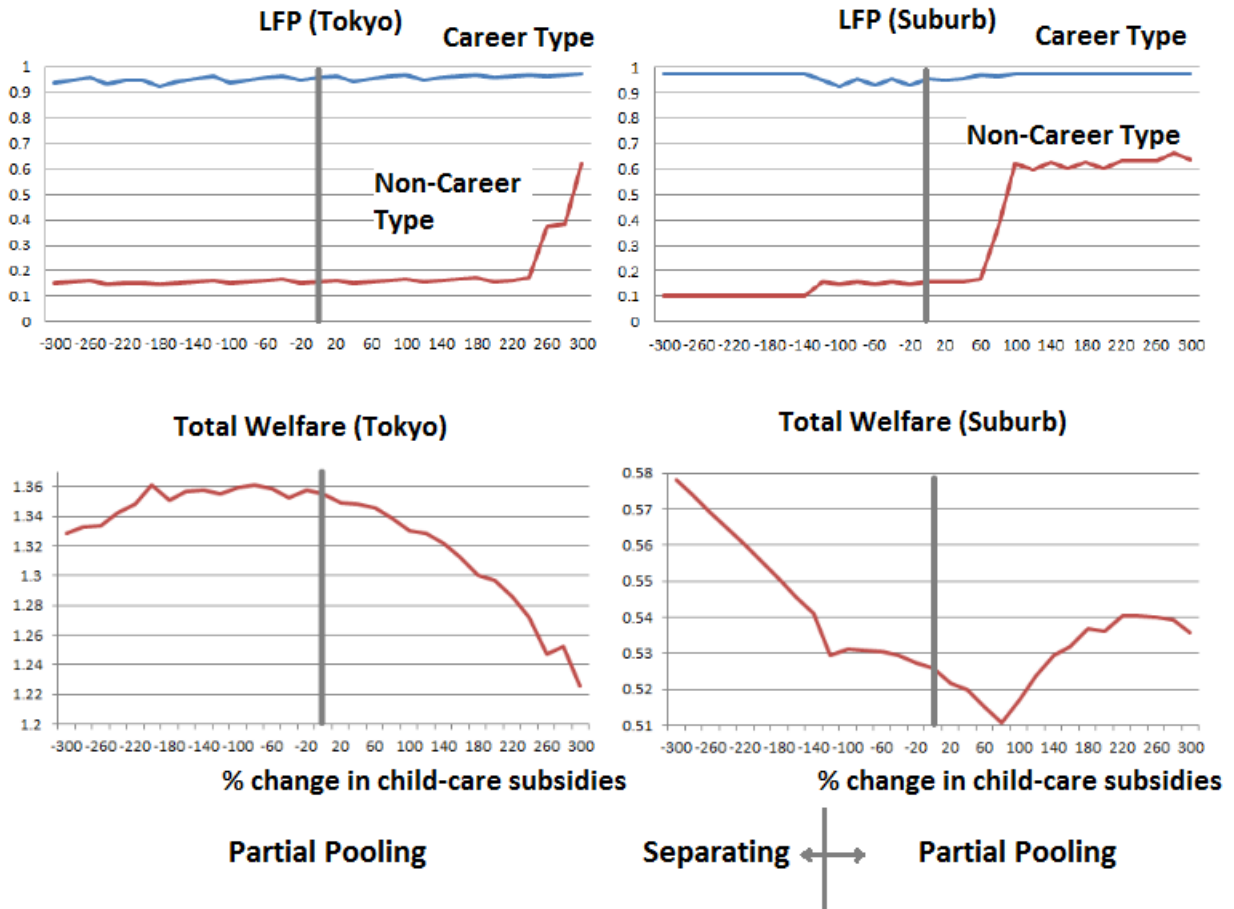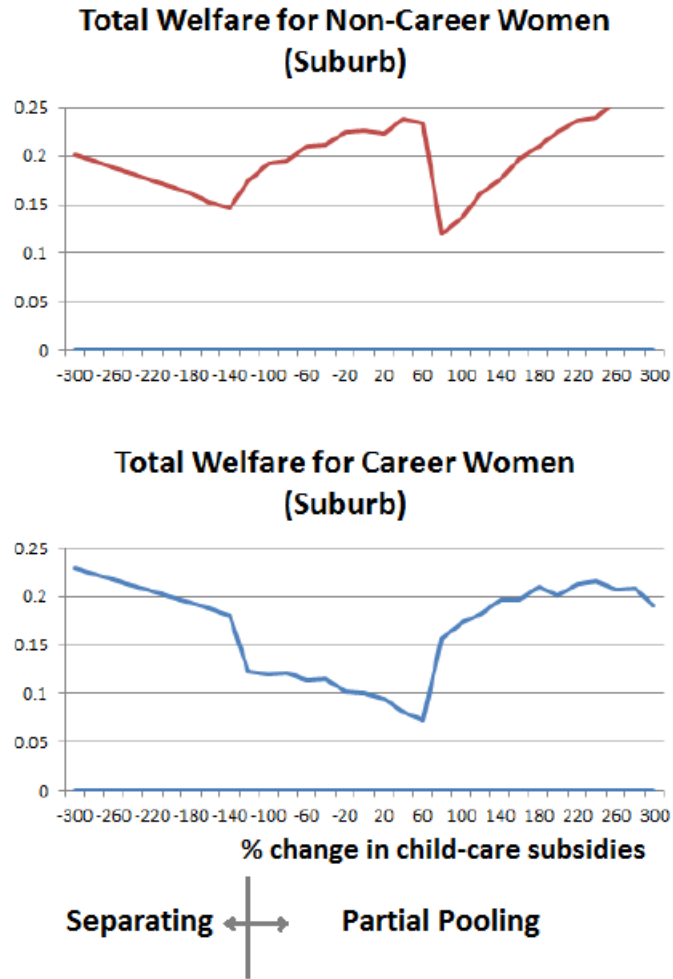
Figure 2: The Effect of Child-Care Subsidies on Female Welfare by Type in the suburb area

Total Welfare for Non-Career Women (Suburb)

Total Welfare for Career Women (Suburb)

% change in child-care subsidies

Separating ← → Partial Pooling

A back-of-the-envelope calculation estimates that an increase of 34% or more in the price of child care services, which corresponds to a 60% increase in child care subsidies, drastically increases participation of young women in the labor force and narrows the gender gap by roughly 10% conditional on occupation and other characteristics. I also find that, somewhat surprisingly, an increase in the price of child care services, which corresponds to a 140% decrease in child care subsidies, improves efficiency because such price changes shift the type of equilibrium.

Such counterintuitive implications about the effects of child care subsidies are attributed to the incorporation of a screening mechanism. The model shows that, depending on the distribution of workers' outside options relative to their market productivity, the economy achieves a pooling equilibrium. When a shift in the distribution of types of women changes a pooling equilibrium into a separating equilibrium, there is a drastic change in efficiency because employers can distinguish female workers who plan to continue working from those who plan to quit. Since increasing child care subsidies can work in the both directions, from a pooling equilibrium to a separating equilib-

rium and from a separating equilibrium to a pooling equilibrium, the model implies that raising the cost of child care (thus decreasing subsidies) could improve efficiency as well as decrease the cost.

8   Concluding Remarks

This paper develops and calibrates a game theoretical model of statistical discrimination against women. Using Japanese data, it then quantitatively analyzes the effects of tax credits in the form of child care subsidies on women's participation in the labor force and gender wage differences. In my model, employers finance employee training without directly observing individuals' intentions to remain at the firm. In an attempt to distinguish female workers who will leave the firm from those who will stay with the firm, employers use long-term wage contracts as a screening device. I find that the Japanese female labor market, as it currently stands, is best captured by a pooling equilibrium, in which employers cannot distinguish between women who will leave the firm and women who will stay, thereby allowing for statistical discrimination. I simulate the effect of child-care subsidies and find that a decrease in child-care subsidies could increase women's welfare. This counterintuitive finding is the result of a shift in equilibrium from a pooling to a separating equilibrium, in which employers can discern individuals' intentions to stay in the firm and provide training opportunities accordingly.

Several limitations to this paper need to be acknowledged. First, the caveat of this paper is that the model is intentionally simple: it is a two-period screening model with two types of female workers with different labor intentions. Indeed, increasing the number of periods or the number of worker types better captures the reality. However, characterizing a dynamic wage contract is challenging, and complicating the model would cause it to lose its tractability. Despite the simplicity of the model, the paper estimates a dynamic model with a wage equilibrium that reflects the interactive skill investment decisions of the firm and workers. The existing literature on model labor supply was not able to either conduct counterfactual policy analysis or model the dynamics in the labor demand side. Thus, this paper offers one starting point for the development of a dynamic general equilibrium model of labor supply that can evaluate new policies.

Second, the counterfactual analysis examines the partial effects of public child care and does not investigate the long-term effects. For example, demand for child care is not modeled comprehensively. Although the supply side is heavily restricted by the government, the demand side may change more extensively in response to child care subsidies by affecting women's fertility choices. In fact, child care subsidies in the model are merely one interpretation of tax credits that exogenously affect women's labor force intentions. The effect of child care subsidies on workers' decisions other than quitting are ignored. Such extensions are feasible, but require more consideration in conducting an estimation analysis.

Third, related to the first point, this paper does not examine how the initial conditions of workers are formed. That is, the model is not capable of analyzing long-term effects of policy intervention if the effects are involved with changes in the initial conditions fixed in the model. In particular, I do not model how worker "types" are determined, how much investment women make, or how women choose education. By taking these choices as given, this paper misses sources of self-

fulfilling mechanisms except occupation choice. Therefore, the effects presented in this paper can be interpreted as the lower bound of the true effects. To determine the long-term effect of child care subsidies on the efficiency and outcomes of the labor market, the model would need to incorporate how worker types are formed and evolve as well as how they affect women's choices regarding education, marriage, and labor force participation after child rearing. However, incorporating these additional decision processes complicates the model to the extent that it loses tractability. Analysis of long-term effects is beyond the scope of this paper since its main focus is characterizing the labor supply and wage determinants with the presence of statistical discrimination and occupation sorting.

Nonetheless, the contribution of this paper is significant. By taking into consideration statistical discrimination and occupation sorting, this study provides surprising yet convincing results in evaluating the effectiveness of policies that redresses wage inequality between groups and inefficiencies in productivity. Based on my findings, I suggest that policy makers should exercise extra caution when implementing new affirmative action policies.
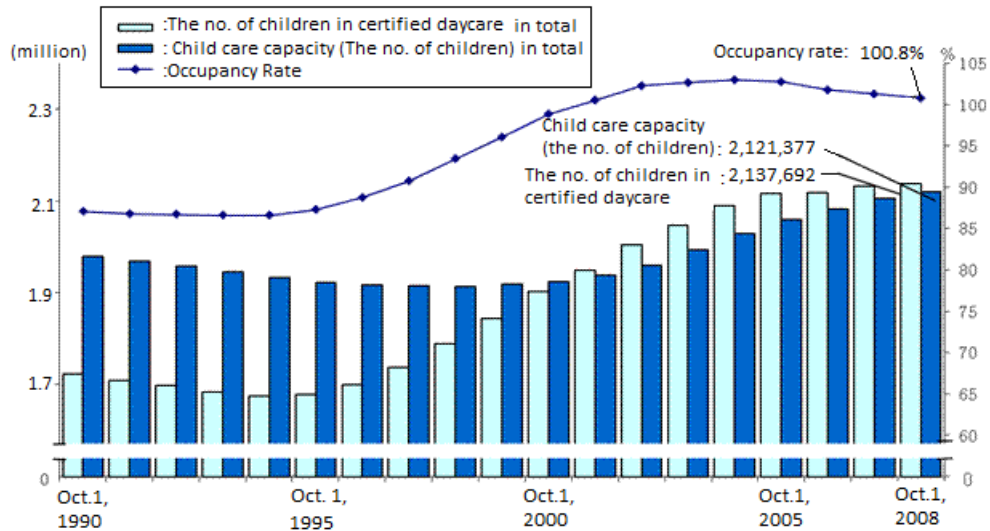
Appendix

Tokyo and its Suburbs

Figure 3: Geographical location of Tokyo, Chiba, Saitama, and Kanagawa

Note: The suburb area used for the analysis is Chiba, Saitama, and Kanagawa.

Child Care Shortage

Figure 4: Child Care Shortage

(Data: Annual Report by the Ministry of Health, Labor and Welfare)

Note: There has been a severe shortage of child-care in Japan for more than a decade. Following the long-lasting stagnation of the Japanese economy, family incomes have decreased, and more women have sought to work after childbirth. The rise in maternal employment increased and the demand for child-care drastically, but the supply of public child-care has increased slowly. This caused an excess demand for child-care and, as of 2011, the total occupancy rate of child-care facilities in Japan exceeds 100 % with as many as 25,556 children on waiting lists. This shortage for affordable child-care is so severe that a number of women have to quit their job despite their willingness to continue to work in order to take care of their children.

Labor Supply of Young Female

Table 6: Female Labor Participation Rate for Women aged 25-29 by Marital Status

Year	Single	Married			Total
		w/o small kids	w/ < 3yrs old	w/ 3-5 yrs old	
1987	91.1%	65.0%	36.7%	52.7%	61.9%
1992	93.7	67.5	37.2	55.2	69.2
1997	93.6	68.6	35.8	59.4	72.5
2002	93.3	74.9	38.3	60.3	77.3

Data Source: The National Annual Survey by the Ministry of Health, Labor and Welfare (2002)

Note: The above table shows that the majority of female workers work when single and leave the labor force at their first child-birth.

Indirect Evidence for Imperfect Screening 1: Similar Earnings Profiles of Heterogenous Female Workers

Table 7: Similar Earnings of Heterogeneous Women
(Unit: hundred Japanese yen)

	Mean Monthly Salary	
Age	Non-Career Type	Career Type
24-29	2,553	2,582
(S.D.)	(448)	(504)
30-34	3,031	3,057
(S.D.)	(407)	(536)
35-39	3,576	3,642
(S.D.)	(418)	(491)

Data Source: JPSC 1993 - 2008

Note: The sample is female college graduates who work in their first firm at the time of the survey. The table shows that despite their heterogeneous work-life preferences, Japanese female workers predominantly work similar hours and receive similar wages.

Indirect Evidence for Imperfect Screening 2: Narrowing Gender Earnings Gap over Job Tenure

Table 8: Wage Profile : Fixed Effects GLS estimates

log wage	(1)	(2)
Dependent Variable: Log of monthly salary		
age	0.183**	0.183**
	(0.07)	(0.073)
tenure	0.014	0.004
	(0.027)	(0.027)
work hrs	0.021	0.021
	(0.003)	(0.003)
female×tenure	0.191***	0.102***
	(0.039)	(0.019)
female×(tenure)^2	-0.03***	–
	(0.01)	–
No. Obs.	6419	6419
No. Groups	1964	1964

Note 1: Part-time workers and workers on leave are excluded from the sample.
Note 2: Dummies for year, City size, Firm size are included but not reported.
Note 3: The unit of tenure variable is ten years.
Note 4: The regression results indicate that an interaction term of gender and tenure is positive in the fixed-effects wage regressions, implying that the effect of gender on wage becomes smaller as workers stay in the firm longer. Since the fixed-effects analysis controls for time-invariant unobserved differences in the productivity of workers, this decrease in the gender wage gap over the lifecycle is puzzling. One explanation is that firms decide to postpone investment in female workers in their fecund periods, during which the employer learns about the worker's tendency to quit, or that overall quit rates among female workers drop as pregnancy rates decline. As for male workers, firms do not have to wait to invest because men's career orientation varies much less than that of women. Altogether, these findings reinforce the hypothesis that firms make a significant and costly investment in workers.
(Data Source: JPSC 1993–2008)

Characteristics of the Career Type and the Non-Career Type Women

Table 9: Labor Force Intentions and Job Course Choice

	non-career type		Career-woman type		(row total)
non-career course	41 (54.6%)		10 (14.9%)		51
(row)		(80.3%)		(19.7%)	(100%)
career course	34 (45.4%)		57 (85.1%)		91
(row)		(37.4%)		(62.6%)	(100%)
(column total)	75 (100%)		67 (100%)		

Note: Table 9 shows that job courses screen female college graduates with different labor force intentions to some extent, but not perfectly. The sample is single female college graduages aged under 30 who answered to survey questions about their labor force intentions after their first child birth. Among those who choose a non-career course, 80.3% plan to leave the labor market or work as a part-time worker. On the contrary, among those in a career course, as many as 37.4% of workers plan to leave. Thus, mixed types of workers (in terms of their labor force intentions) are more likely to be observed in career courses.

References

Y. Abe. Specific capital, adverse selection, and turnover: A comparison of the united states and japan. *Journal of the Japanese and International Economies*, 8(3):272 – 292, 1994.

J. G. Altonji and C. R. Pierret. Employer learning and statistical discrimination. *The Quarterly Journal of Economics*, 116(1):313–350, 2001.

S. Altug and R. A. Miller. The effect of work experience on female wages and labour supply. *The Review of Economic Studies*, 65(1):45–85, 1998.

M. Aoki. *Information, incentives, and bargaining in the Japanese economy*. Cambridge University Press, 1988.

K. Arrow. *Discrimination in Labor Markets*. Princeton, N.J.: Princeton University Press, 1973.

Y. Asai, R. Kambayashi, and S. Yamaguchi. Childcare availability, household structure, and maternal employment. *Journal of the Japanese and International Economies*, 38:172 – 192, 2015. ISSN 0889-1583.

M. U. Audrey Light. Early-career work experience and gender wage differentials. *Journal of Labor Economics*, 13(1):121–154, 1995.

J. Barron, D. Black, and M. Lowenstein. Gender differences in training, capital and wages. *Journal of Human Resources*, 28:343–364, 1993.

G. Becker. *Human Capital*. New York: Columbia Univ. Press, 1964.

Y. Ben-Porath. The production of human capital and the life cycle of earnings. *Journal of Political Economy*, 75(4):352–365, 1967.

M. Bertrand and S. Mullainathan. Are emily and greg more employable than lakisha and jamal? a field experiment on labor market discrimination. *The American Economic Review*, 2004.

A. Bick. The quantitative role of child care for female labor force participation and fertility. Available at SSRN: http://ssrn.com/abstract=1688845 or http://dx.doi.org/10.2139/ssrn.1688845, 2011.

A. Blinder. Wage discrimination: reduced form and structural estimates. *Journal of Human Resources*, 28:436–455, 1973.

K. Burdett and M. Coles. Equilibrium wage-tenure contracts. CESifo Working Paper Series 3203, CESifo Group Munich.

K. Burdett and M. Coles. Equilibrium wage-tenure contracts. *Econometrica*, 71(5):1377–1404, 2003.

M. Carlsson and D.-O. Rooth. Evidence of ethnic discrimination in the swedish labor market using experimental data. *Labour Economics*, 14(4):716 – 729, 2007. European Association of Labour Economists 18th annual conference CERGE-EI, Prague, Czech Republic 21-23 September 2006.

L. S. Carney and C. G. O'Kelly. Barriers and constraints to the recruitment and mobility of female managers in the japanese labor force. *Human Resource Management*, 26(2):193–216, 1987.

S. Coate and G. C. Loury. Will affirmative-action policies eliminate negative stereotypes? *The American Economic Review*, 83:1220–1240, 1993.

Z. Eckstein and O. Lifshitz. Dynamic female labor supply. *Econometrica*, 79(6):1675–1726, 2011.

H. Fang and A. Moro. *Handbook of Social Economics*. North-Holland, 2010.

G. Gayle and L. Golan. Estimating a dynamic adverse selection model: Labor force experience and the changing gender earnings gap 1968-97. *Review of Economic Studies*, 79(1):227–267, 2012.

M. Hashimoto. Bonus payments, on-the-job training, and lifetime employment in japan. *Journal of Political Economy*, 87(5):1086–1104, 1979.

M. Hashimoto and J. Raisian. Employment tenure and earnings profiles in japan and the united states: Reply. *The American Economic Review*, 82(1):346–354, 1992.

J. J. Heckman. Effects of child-care programs on women's work effort. *The Journal of Political Economy*, 82 (2) Part 2:S136–163, 1974.

M. P. Keane and K. I. Wolpin. The role of labor and marriage markets, preference heterogeneity, and the welfare system in the life cycle decisions of black, hispanic, and white women. *International Economic Review*, 51(3):851–892, 2010.

T. Lamadon. Productivity shocks, dynamic contracts and income uncertainty. Working paper, 2014.

E. Lazear. Agency, earnings profiles, productivity, and hours restrictions. *The American Economic Review*, 71(4):606–620, 1981.

E. Lazear and S. Rosen. Rank-order tournaments as optimum labor contracts. *The Journal of Political Economy*, 89(5):841–864, 1981.

R. Lentz. Optimal employment contracts with hidden search. NBER Working Paper 19988, 2015.

A. Light and M. Ureta. Panel estimates of male and female job turnover behavior: Can female nonquitters be identified? *Journal of Labor Economics*, 10(2):156–81, 1992.

J. A. List. The nature and extent of discrimination in the marketplace: Evidence from the field. *The Quarterly Journal of Economics*, 119(1):49–89, 2004.

S. Lundberg and R. Startz. Private discrimination and social intervention in competitive labor market. *The American Economic Review*, 73(3):340–347, 1983.

G. Menzio and S. Shi. Block recursive equilibria for stochastic models of search on the job. *Journal of Economic Theory*, 145(4):1453 – 1494, 2010. Search Theory and Applications.

H. Miyazaki. The rat race and internal labor markets. *The Bell Journal of Economics*, 8(2):394–418, 1977.

H. Morita. Multi-skilling, delegation and continuous process improvement: A comparative analysis of usa-japanese work organizations. *Economica*, 72(285):69–93, 2005.

A. Moro. The effect of statistical discrimination on black-white wage inequality: Estimating a model with multiple equilibria. *International Economic Review*, 44(2):467–500, 2003.

A. Moro and P. Norman. A general equilibrium model of statistical discrimination. *Journal of economic theory*, 114:1–30, 2004.

R. Oaxaca. Male-female wage differentials in urban labor markets. *International Economic Review*, 14(3):693–709, 1973.

M. Okuno-Fujiwara. Monitoring cost, agency relationships, and equilibrium modes of labor contracts. *Journal of the Japanese and International Economies*, 1(2):147–167, 1987.

M. Okuno-Fujiwara. On labor incentives and work norm in japanese firms. *Journal of the Japanese and International Economies*, 3(4):367–384, 1989.

P. Oreopoulos. Why do skilled immigrants struggle in the labor market? a field experiment with thirteen thousand resumes. *American Economic Journal: Economic Policy*, pages 148–171, 2011.

H. Owan. Promotion, turnover, earnings, and firm-sponsored training. *Journal of Labor Economics*, 22(4):pp. 955–978, 2004.

E. Phelps. The statistical theory of racism and sexism. *American Economic Review*, 62:639–651, 1972.

J. G. Riley. Silver signals: Twenty-five years of screening and signaling. *Journal of Economic Literature*, 39 (2):432–478, 2001.

M. Rothschild and J. Stiglitz. Equilibrium in competitive insurance markets: An essay on the economics of imperfect information. *The Quarterly Journal of Economics*, 90(4):629–649, 1976.

C. Sanders and C. Taber. Life-cycle wage growth and heterogeneous human capital. *Annual Review of Economics*, 2012.

M. Spence. Job market signaling. *The Quarterly Journal of Economics*, 87(3):355–374, 1973.

J. Stock and M. Yogo. *Testing for Weak Instruments in Linear IV Regression*, pages 80–108. Cambridge University Press, New York, 2005.

R. Topel. What have we learned from empirical studies of unemployment and turnover? *The American Economic Review, Papers and Proceedings of the Hundred and Fifth Annual Meeting of the American Economic Association*, 83(2):110–115, 1993.

K. Tsuyuhara. Dynamic contracts with worker mobility via directed on-thejob search. forthcoming in International Economics Review, 2015.

C. Wilson. A model of insurance markets with incomplete information. *Journal of Economic Theory*, 16(2), 1977.