Employee Loyalty, Training, and Female Labor Supply

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Preliminary and Incomplete

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Abstract

This paper develops a game theoretical model of statistical discrimination against women in the labor market. It then quantitatively analyzes the effectiveness of child-care subsidy with respect to inefficiency in the labor allocation and social welfare. In the model, employers invest in workers without directly observing individual worker's labor force intentions. In an attempt to distinguish female workers who will exit the labor market from those who will stay with the firm, the employers use long-term wage contracts as a screening device. The model suggests that tax credits can bring a drastic change in efficiency by altering the type of equilibrium of the worker-firm game, but the direction of a change is undetermined. I build on this theoretical prediction by applying the model empirically to the Japanese labor market. I find that the Japanese female labor market as it currently stands is best captured by a pooling equilibrium, where employers cannot distinguish between women who will leave the firm and women who will stay, thereby allowing statistical discrimination. The counterfactual simulation results show that a decrease in the subsidies raises efficiency because the equilibrium shifts from pooling to separating, where employers can discern individual women's labor force intentions and make human capital invest accordingly.

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1 Introduction

Is affirmative action effective? A commonly used rationale for affirmative action is the presence of statistical discrimination. Statistical discrimination is discriminatory but rational behavior under asymmetric information based on group characteristics rather than individual characteristics. For example, statistical discrimination occurs when workers know their own productivity but employers do not directly observe individual worker productivity, and therefore the employers determine wage payments based on the average productivity of the workers grouped by gender or education. Such an information problem results in inefficient resource allocation compared to the case with symmetric information because individuals are not evaluated based on their own value but based on the observable characteristics of the group which they belong to. Worse yet, statistical discrimination might create or enlarge inequality through self-fulfilling prophecy (Arrow (1973); Coate and Loury (1993)).[2] While there are many empirical studies on the existing affirmative action programs,[3] they do not consider how statistical discrimination mediate the effect of affirmative action policies. Without taking statistical discrimination into account, the implications of the effectiveness of affirmative action is limited.[4]

In order to more completely evaluate how affirmative action policies could affect inequality and inefficiency, this paper takes into account the extent of statistical discrimination and evaluates the effectiveness of affirmative action policies, in this case, child-care subsidies, in redressing inequality between groups and inefficiencies in productivity. In particular, I develop a game-theoretical model of statistical discrimination with occupation sorting and apply the model to Japanese data, which helps identification of the model by providing exogenous variation in women's job quitting behavior due to severe child-care shortage. Unlike the existing empirical model, my model incorporates long-term wage contracts as a screening mechanism. I find that the Japanese labor market is currently in a pooling equilibrium, where employers cannot distinguish between women who

[2]For instance, suppose all workers are acutally equally productive but somehow employers wrongfully predict that some minority groups are less productive on average and provide them less opportunities at 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 to their work-related skill investment, make less investment in their work-related skills compared to the rest of workers. Thus, discrimination could lead to self-reinforcing feedback loops, as known as self-fulfilling prophecy.

[3]For example, see Donohue and Heckman, 1991; Neumark, 2000a, 2000b; Holzer and Neumark, 2000a; Hickman, 2013). In particular, the effectiveness of quotas on efficiency is weak at best (Holzer and Neumark, 2000b) because of its possible disincentive effect.

[4]In the context of the labor market, a persistent wage disparity among racial and gender groups has been widely studied and is attributed to statistical discrimination (Barron et al. (1993); Altonji and Pierret (2001); Moro (2003); Moro and Norman (2004); Gayle and Golan (2012)).

will leave the firm and women who will stay. Using the model built from my estimates, I then conduct a counterfactual analysis to evaluate how child-care subsidies influence the labor supply and wage compensation of young women, which in turn affects labor allocation efficiency and social welfare in Japan. I also find that a decrease in the child-care subsidies could raise efficiency because the equilibrium in the female labor market shifts from pooling to separating equilibrium, where employers can discern individual women's labor force intentions and make human capital invest accordingly.

To be specific, I look at a particular kind of statistical discrimination that was first theoretically examined by Barron et al. (1993). On average, women of child-bearing age have weaker labor force attachment than their male peers. If costs are incurred when firms hire a new employee or assign a worker to a new position, higher turnover rates make women in the fecund period less profitable to hire. In such a case, firms may prefer not to hire or promote a young female worker even if she is otherwise as productive as a male worker. Thus, a lack of information on an employee's expected tenure may lead to statistical discrimination. This type of statistical discrimination can also account for gender wage gap around the world, which is often described by the oft-cited "glass ceiling" that female workers face.

The objectives of this paper are two-fold. First, it provides a model to capture the underlying mechanisms of statistical discrimination. Second, this paper quantitatively analyzes how child-care subsidies affect statistical discrimination and gender wage gap in Japan. This analysis serves as a good example of affirmative action policy evaluation because the existence of statistical discrimination is examined both theoretically and empirically, and the policy evaluation takes into consideration quantitative importance of policy implications as well as qualitative assessment.

Quantifying statistical discrimination is especially challenging. For example, it is difficult to tell whether a correlation between the wage and an easily observed worker characteristics arises because imperfectly informed firms use the observable trait to discriminate or because the variable is correlated with unobserved productivity. 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.

In my earlier work, I have overcome this problem in the unique features of the Japanese data. The basic identification strategy I use here follows my other work (Tanaka (2014)), which estimates statistical discrimination following Altonji and Pierret (2001). Tanaka (2014) addresses two major

identification problems in detecting statistical discrimination: overestimation, selection bias, and simultaneity issues.

This paper takes a step further than Tanaka (2014) by resolving another identification issue: the underestimation of statistical discrimination, which occurs when the model lacks a self-fulfilling mechanism (Lundberg and Startz (1983); Coate and Loury (1993)). I explicitly capture the mechanism of such self-fulfilling prophecies by adding women's career path choice. In my model, self-fulfilling mechanism happens when female workers, who are discouraged from having little opportunity in the labor market, self-select into a career path associated with low wage growth and low investment.

The contribution in qualitative assessment comes from the nobel feature of my model. Unlike the existing literature, I capture a worker's career path choice using a screening model. In the model, employers attempt to distinguish female workers who will exit the labor market from those who will stay with the firm. Employers do so by offering multiple career tracks, creating wage menus with some options emphasizing long-term gains and others emphasizing high initial salaries with less growth. This is an example of a screening mechanism, first studied by Rothschild and Stiglitz (1976), and Wilson (1977), the canonical model in game theory. When the screening attempt succeeds, it results in a separating equilibrium, where the employer can discern workers' labor force intentions using the wage menus. As a result, workers with higher labor force intention receive more investment in their training than workers with lower labor force intentions. Thus, the resource allocation regarding training investment is as efficient in this scenario as in the economy without information problem. In contrast, when the screening attempt fails, it results in a pooling equilibrium, where all female workers receive investment equally.

The model suggests that tax credits can bring a drastic change in efficiency by altering the equilibrium of the worker-firm game. I then build on this theoretical prediction by applying the model empirically to the Japanese labor market. To be specific, I conduct counterfactual analysis for changing the amount of child-care subsidies, which can be considered as tax credits for working mothers.

I find that the Japanese female labor market as it currently stands is best captured by a pooling equilibrium of the employer-worker game, thereby allowing statistical discrimination. Using the model built from my estimates, I change the model parameters so that they reflect the hypothetical changes in child-care subsidy, and simulate the model with a new set of parameters to generate counterfactual outcomes with potential new policies. In doing so, I assess the effectiveness of

child-care subsidies both by changing the price of public child-care and by providing more quantities of the service. I find that changes in quantities do not shift the type of equilibrium, but price changes does when, somewhat surprisingly, a 140% decrease in the child-care subsidies, which raises the price of the service, raise efficiency because it changes a pooling equilibrium to a separating equilibrium in the Japanese labor market. The model implication that decreasing subsidies results in more efficiency is counter-intuitive, and works against the prevalent claims that affirmative action policies could lift up the barrier for minorities and potentially improve productivity efficiency.

Such counter-intuitive implications about the effect of child-care subsidies are attributed to the incorporation of a screening mechanism. The model shows that the economy achieves a pooling equilibrium, depending on the distribution of workers' outside options relative to their market productivity. When a shift in the distribution of types of women changes a pooling equilibrium into a separating one, there is a drastic change in efficiency because employers can distinguish female workers who plan to stay from those who plan to leave. Since increasing child-care subsidies can work in the both direction: from a pooling equilibrium to a separating equilibrium, and from a separating equilibrium to a pooling equilibrium, the model implies that raising the child-care price (thus decreasing subsidies) could improve inefficiency as well as decreasing the price.

Thus, this work provides new interpretations and empirical discoveries regarding the effect of subsidized child-care. There are numerous empirical studies that examine how child-care subsidies encourage the labor supply of mothers. From the seminal work of Heckman (1974) to more recent work by Bick (2011), most studies report strong evidence that child-care subsidies increase female labor supply. Taking statistical discrimination into consideration, this paper draws the contrasting conclusions in that subsidies could decrease female labor supply in terms of units produced by reducing the amount of investment in women.

Using the Japanese data offers several advantages. First, the extent of statistical discrimination is thought to be serious in Japan, and, in fact, the Japanese data exhibit distinct features that support the presence of statistical discrimination. Given an expected-to-be-larger degree of statistical discrimination, detecting statistical discrimination is easier even when the data is contaminated by measurement errors and noises caused by unobserved variables. Second, 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 firm's employee investment decisions, workers' labor force participation, and statistical discrimination. For example, women's quitting behavior is par-

ticularly concentrated around the event of childbirth, What is more, once they leave the labor force at the time of childbirth, few women return to the labor market as a full-time worker.[5] By focusing on firm's employee investment decisions and dichotomous women's labor force participation decisions before the anticipated time of childbirth, I can avoid technical difficulties in 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 that the model matches observed features of the Japanese labor market well.

Last but not least, the Japanese data I use provide the two kinds of features that are critical to identifying the type of statistical discrimination studied in this analysis: survey questions on individual women's labor force intentions and exogenous variation in young women's quitting behavior. The survey question on individual labor force intentions, which is rarely available in other longitudinal data, allows me to tease out whether women plan to continue working for the next several years, and after giving a birth to the first child. The exogenous variation in quitting behavior is due to a severe shortage of child-care in Japan starting in early 2000's. I use the extent of the child-care shortage as an instrument in order to identify the effect of high average job quit rates on women's earnings. The key assumption for this instrument variable (IV) method to be valid is that child-care accessibility is correlated with variation in women's quit rates, but not correlated with women's quitting intention. I argue that both assumptions are plausible in the main body of this paper.

The rest of the paper is organized as follows: Section 2 reviews related literature. Section 5 documents stylized facts of Japanese labor market and child-care shortage. Based on the observed features, Section 4 formulates a structural model, and then analyzes optimal wage schemes and productivity efficiency under information problem. Section 6 lays out an identification strategy and estimates the model parameters using the simulated method of moments. Section 8 conducts a set of counterfactual analyses to calculate potential efficiency and to evaluate the effect of child-care subsidies on inefficiency. Finally, Section 9 concludes with a discussion of child-care tax efficiency.

[5] According to the Annual National Survey in 2008, more than half of women leave the labor market after their first childbirth in Japan and less than 20% of these women come back as full-time workers, conditional on returning to the labor market. That is, only 10% of women work full-time after having left the labor force at childbirth.

2 Related Literature

The notion of statistical discrimination studied in this paper was introduced by Barron et al. (1993). They formalize a job-matching model where statistical discrimination arises from gender difference in the expected turnover rate. Their model predicts that female workers receive lower level of training and lower wage compensation due to their weaker attachment to the labor market. Instead of estimating their model, they presented empirical findings that are consistent with their model implications.

Their study is extensively examined in Gayle and Golan (2012), the study most closely related to my paper. Gayle and Golan (2012) incorporate statistical discrimination into a dynamic general equilibrium model developed by Altug and Miller (1998), estimate the model of a firm's employee investment and statistical discrimination in a general equilibrium framework, and 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.

My model differs from Gayle and Golan (2012) in two major ways. First, while the goal of their paper is to explain a decline in the gender earnings gap and to account for how much of the earnings gap can be attributed to statistical discrimination, the goal of my work is assessing the effect of affirmative action policies in addition to estimating the extent of statistical discrimination. To conduct counterfactual analysis of affirmative action policies, my paper requires a different modeling approach from Gayle and Golan (2012). For instance, Gayle and Golan (2012) estimate the model using intertemporal Euler conditions, assuming that an individual's lifetime wealth distribution does not change. Such an assumption is too strong to assume in order to evaluate affirmative action policies such as child-care subsidy, which would reallocate the wealth, thereby altering the wealth distribution. Instead, I use a dynamic discrete choice (DDC) model, developed by Keane and Wolpin (2010) that does not require a stationary wealth distribution. Second, this paper is different from Gayle and Golan (2012) in terms of its model structure. While their model incorporates occupation sorting as a signaling mechanism, I build a screening model to capture occupation sorting.

The incorporation of a screening mechanism into a model is new in the empirical work on dynamic labor supply. Despite the fact that a screening model is a canonical theory in the pres-

ence of information asymmetry, to date, the model is rarely used for empirical analysis because of the equilibrium non-existence problem.[6] To avoid the equilibrium non-existence problem, empirical studies change the timing of the game and frame the employer-worker game as a signaling model instead of a screening model, (Moro (2003); Gayle and Golan (2012)). The timing of the game is the only difference in a model setup between signaling and screening—i.e. in a signaling model, informed agents (workers) take an action first while, in a screening model, the uninformed agent (employers) takes an action first. Despite this solitary difference, a standard signaling model always reaches either a pooling or a separating equilibrium but a screening model results in no equilibrium or a separating equilibrium. Given that a screening model cannot reach a pooling equilibrium, it appears reasonable that the empirical literature on statistical discrimination, which is interested in a possible pooling equilibrium, would alter the timing of the game in order to analyze the employer-worker game as a signaling model. Nonetheless, such a change in timing does not reflect what actually happens in the labor market because, if we interpret their framework literally, this framework indicates that workers come to employers and suggest a set of compensations, such as hours of workm associated with wages. In reality, however, it is usually employers who take action first by offering wages, not workers, which is especially true at the time of new hire. In fact, most of the theoretical papers on wage contracts and occupation sortings frame the game as a screening model for this reason (e.g. Miyazaki (1977)). My model of screening has an advantage over the models presented in the existing literature in the sense that the model does not require an awkward changing of the timing of the game or a change in the equilibrium concept from the screening model used in Rothschild and Stiglitz (1976) and Wilson (1977).

By applying the screening model to the empirical analysis of the labor market, the model implications derived in this paper provide new perspectives on the growing body of literature on efficiency wage models. My model can be categorized as an efficiency wage model since, in my model, where firms can provide worker an incentive to stay in the firm by offering long-term wage contracts, equilibrium wages are different from workers' actual productivity for two reasons. First, in my model, wage contracts are designed such that workers with different levels of labor force attachment are sorted into different wage payments schemes. As a result, equilibrium wages differ from workers' productivity. [7] The second reason is that, in my model, firms can offer a

[6] The existence problem is concisely summarized in Riley (2001).

[7] Efficiency wage models have one or more of the following characteristics: 1. Compensation levels and rules affect the types of workers who are attracted to, and retained by, the firm – this is normally referred to as the sorting effect of wages. 2. Compensation rules create incentives for workers to behave in ways that increase firm profits. 3. Wages affect the nutrition and health of workers and thus higher wages directly increase productivity. (Weiss, Andrew. "Effi-

wage contract that provides workers an incentive to stay with the firm. To do so, firms offer wage payments lower than workers' actual productivity in the early career stage and instead promise future compensation higher than workers' productivity. Such a wage determination mechanism is called "deferred payment" and falls into the subcategory of efficiency wage models, as has been studied by Lazear (1979, 1981) from a theoretical approach. The deferred payment theory provides rationale for the seniority system, observed across countries. As discussed by Lazear, deferred payment saves employee replacement costs and prevents workers from shirking. My paper is one of a few papers that apply the deferred payment theory to an empirical context.

In a broader context, this study contributes to a strand of the literature that considers women's life-cycle labor supply and subsidized child-care. Although analyzing female labor supply is an important research agenda that provides insight in explaining the gender wage gap, fertility, and marriage behavior, labor supply of women in a dynamic programming framework has not been the main direction of analysis on the subject until recently, mainly due to technical difficulties.[8] For instance, it is computationally difficult to deal with labor force participation, human capital investment, and savings simultaneously, as Eckstein and Wolpin (1989) note. Besides, modeling fertility choice complicates the difficulty in solving the model numerically even further by creating the curse of dimensionality issue.[9]

Among the recent developments to the DDC (dynamic discrete choice) model of female labor supply are Keane and Wolpin (2010) and Eckstein and Lifshitz (2011).[10] While these papers use a partial equilibrium model and do not incorporate the labor demand side, my work considers firms' strategic response to labor supply and seeks for an equilibrium wage determinant mechanism.

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 Online. Palgrave Macmillan. 23 April 2013 <http://www.dictionaryofeconomics.com/article?id=pde2008_E000245> doi:10.1057/9780230226203.0452)

[8] Many empirical studies on labor supply only look at male workers to avoid this complicity. For example, see Keane and Wolpin (1994, 1997) and Johnson (2013).

[9] The curse of dimensionality in empirical economics refers to the situation where analyzing and organizing data in high-dimensional spaces (often with hundreds or thousands of dimensions) becomes computationally difficult or infeasible when we increase the dimention of variable space. Such a problem is common in solving dynamic programming model in the finite-time horizon, which requires calculation at every state point over time. Even for a deterministic model that results in much fewer state points, if there are n different state points that agents can choose every period, we need to calculate n^t in the t-period model. By allowing women's fertility choice, it multiplicates the number of possible decisions by 2. When the model has 10 periods and each agent has 3 options to choose other than fertility choice in every period, adding the fertility choice increase the state points from 88,572 to 72 million.

[10] Keane and Wolpin (2010) build a comprehensive dynamic discrete choice model that incorporates all the major choices that women make over their life cycle such as education, labor participation, marriage, and fertility. Eckstein and Lifshitz (2011) is another dynamic discrete choice model; They use an extended version of Eckstein and Wolpin (1989) to explain the increase in female employment and participation rates during the last century.

With this respect, this paper is related to Lee and Wolpin (2006; 2010), which study dynamic labor supply patterns in the U.S. in a general equilibrium framework. My model is differentiated from theirs in that the labor demand that reflects firms' wage posting mechanism is modeled based on the theory of screening and deferred payment in my model, but the labor demand in their model is modeled in a reduced-form manner, whose model structure lacks the backing of economic theory and is therefore somewhat ad hoc. Their different modeling approach makes sense, however, since their focus is on providing an explanation for labor mobility across sectors over decades by taking skill price determination and skill accumulation into consideration while my focus is on studying the gender wage gap due to statistical discrimination, which derives from employers' information rent seeking process. Unlike their model, which studies the macro trend of labor mobility and workers' heterogeneous skill formation in the U.S. labor market, my model is unable to explain these phenomena, but it can explain labor market inefficiency due to information problems and labor market conditions that discourage young female workers' labor force participation.

3 Institutional Background

Aside from the advantages of Japanese data with respect to identification purpose, the reason why I choose the Japanese labor market to study the statistical discrimination in the gender wage gap is that statistical discrimination in Japan is considered more serious than in most countries, and it is easier to detect statistical discrimination from the data even with measurement errors and all sorts of noise.

This section documents features peculiar to the Japanese labor market in order to show that the extent of statistical discrimination is strong in Japan. I show these features to strengthen my claim that the Japanese labor market is a good setting in which to apply a model of firms' employee investment under statistical discrimination.

There are two major reasons why the statistical discrimination is thought to be more serious in Japan: 1) Japanese firms finance employee investment to a large extent, and hiring new workers is more costly in Japan than in other countries for this reason. 2) The gender difference in lifetime labor supply patterns in Japan is the largest with respect to the average job tenure. In addition to these two reasons, we observe remarkable difference within women in their work life preference even after controlling for education. These stylized facts create a large difference between average

male workers and average female workers and also create a significant difference even within the female workers.

In the rest of this section, I first report raw survey data to show that Japanese firms finance employee investment to a large extent. Then, I briefly document the gender difference in lifetime labor supply patterns in Japan, which is thought to result in statistical discrimination.

After describing the stylized facts about Japanese firms and workers, I present how wages are determined in the Japanese labor market, which provide indirect evidence for firms' employee investment. To be specific, I will introduce seniority-based payment and a dual course system, both of which have been long practiced in Japanese firms after the Second World War.

The end of this section is dedicated to documenting long-lasting child-care shortage in Japan, which is critical for identification strategy used in Section 6. The analysis using the JPSC data shows that excess demand for accredited child-care, resulted from government regulation, creates exogenous variation in women's quitting outcome while it is uncorrelated with women's quitting intention.

3.1 Women's High Quit Rates at the point of Child-bearing

As of 2008, the average job tenure in Japan is 13.1 years for men and 8.6 years for women. The difference in the average tenure, 4.5 years, is the largest figure among developed countries in 2008, exceeding the second largest gender gap observed in Ireland by 1.5 years. [11] The large gender gap in job tenure in Japan is mainly attributed to a sharp decline in the labor force participation rate of women at their first childbirth: more than half of women leave the labor market at the time of motherhood, while most men work until legal retirement age without interruption.

Table 7 in the Appendix shows the labor participation of women conditional on their marital status and motherhood. While more than 90% of single women work, only 35-40% of married women with a small child work. Among those who have left the labor market, more than 80% of women returned to the labor market as part-time workers. Once workers leave the Japanese labor market, they are practically ineligible for career jobs thereafter. This is mainly because of Japanese firms' favoritism towards new graduates, known as the system of "simultaneous recruiting of new graduates" (Shinsotsu-Ikkatsu-Saiyō). Many Japanese firms are reluctant to hire older workers

[11] For reference, the median tenure in the U.S. as of 2010 is 4.4 years for men and 4.1 for women (Source: Bureau of Labor Statistics). The average for the gender gap among the other OECD countries excluding the U.S. is 1.05 years. (Source: OECD)

despite their work experience. Most hiring occurs right after graduation; among new hires in 2010, 31.8% of new full-time employees were just out of school with no work experience.[12] In such a uni-directional labor market structure, the loss in productivity and worker welfare would be large if some workers leave the labor market who would otherwise stay because they have received suboptimal investment.

As a matter of fact, there are few women in Japan who work full-time after a spell outside the labor force. According to the Annual National Survey in 2008, more than half of women leave the labor market after their first childbirth. Less than 10% of women leave and come back to the labor market as full-time workers. That is, less than 10% of women work full-time after having left at childbirth. The ergodic nature of labor force participation is also shown by the transition matrix I created from JPSC panel data. Table 9 in the Appendix provides a transition matrix of women's work status for a time horizon of one year. Among those who engage solely in housework, only 1.1% of women started working full-time and only14.2% are working part-time in the following year. Shifting from part-time employment to full-time employment also happens less frequently. Only 7.5% of part-time workers switched to a full-time job. Similarly small transition rates from out-of-the labor force to full time workers are found in the transition matrix (Table 1) for workers who plan to continue working after childbirth. Despite their willingness to continue to work, 19.2% of married women are found staying at home at some point in the survey, and only 6% of them work full-time in the following year. Therefore, leaving the labor force at childbirth can be seen to have clear and long-lasting effects on women's careers.

Table 1: Transition Matrix for Married Women Who Want to Continue to Work After Childbirth

	Choice (t)				
Choice (t-1)	Full-time	Part-time	School	Housewife	Unemployed
Full-time:	91.54%	4.53	0.00	3.78	0.15
Part-time:	10.05	74.37	0.00	14.07	1.51
School:	0.00	25.00	50.00	25.00	0.00
Housewife:	6.00	18.00	0.50	74.50	1.00
Unemployed:	33.33	16.67	0.00	50.00	0.00
Total	59.76	20.17	0.28	19.23	0.56

(Data Source: JPSC)

According to the Annual National Survey in 1998 and 2008, only about 20% of married women want to continue to work, 25% of them wish to permanently leave the labor market at marriage

[12] These statistics are based on data from 1997 to 2010. The survey is conducted by the Ministry of Labour, Health and Welfare.

or childbirth, and 50% of them wish to leave the labor market temporarily and return when their children grow older.

While most single women work, many women leave the labor market when they get married or/and give birth to a child. Provided that some women are less productive than others, investing equally in all female workers (conditional on observables) is a problem because firms will then allocate resources inefficiently. The extent of the inefficiency problem is thought to be profound in Japan, where leaving the labor market at childbirth significantly affects not only the compensation before leaving but also the rest of a woman's labor supply.

3.2 Firm's Employee Investment

Japanese firms finance employee investment intensively. According to a 2010 survey by SANRO Research Institute Inc, the cost of employee training, per person, before employment is on average ¥43,798 (approximately $437) and the average cost of on-the-job training is ¥165,191 ($1,651) in Japan. Among the most common kinds of training are fostering workers' business attitudes (95.4%); developing workers' communication skills—including, but not limited to, presentation, information exchange, and counseling skills (89.0%); and teaching employees company operations and philosophy (87.7%). On-the-job training for white-collar and professional careers can last from half a year to two years. The training period is especially lengthy in large firms, where employees are assigned to different sectors of the company during the training periods in order to learn how the company operates. In fact, the survey reports that the cost of on-the-job training per employee in large firms with an employee size of more than 3,000 amounts to as much as 252,036 Japanese yen ($2,520). Given the great costs for employee training, Japanese firms, concerned about losing their heavy initial investment, must lower employee turnover. In the following sections, I introduce two kinds of arrangements that firms set up while attempting to retain trained employees in the company.

3.3 Wage Payment System: Increasing Tenure-Wage Profile

Given firms' intensive employee investment, the deferred payment method is commonly adopted in many Japanese firms. To minimize investment loss, firm-specific investment requires a certain form of long-term through commitment between employers and employees. One means of achieving this is commitment contracts, where employers pay workers upfront and workers are asked to

transfer the money back if they quit. Another way to minimize employee loss is by offering long-term contracts which undercompensate initially and overcompensate late in an employee's career. Although the former transaction is rarely observed, a version of the latter makes up the well-known seniority-based compensation system in Japan.

The seniority-based compensation system pays workers with the most seniority more than and workers with little seniority less than their productivity. Under this arrangement, workers prefer to stay with the same firm, which strengthens employer-employee attachment. The seniority payment system thus helps firms increase returns on their employee investment by suppressing employee turnover rates. Such a payment mechanism serves as indirect evidence for firms' employee investment.

3.4 Wage Payment System and Occupation Sorting: Dual Job Course System and Screening Mechanism

Another indirect evidence for firm's employee investment is the existence of the dual job course system. In Japan, there are two distinct career paths called "Sogo-shoku" (career course) and "Ippan-shoku" (non-career course). These two courses are characterized by difficulty of tasks, chance of promotion and chance of job transfer. While career courses provide chances for promotion, and assign workers to demanding tasks, non-career courses provide little promotion and assign workers to relatively easy tasks. In the beginning of a job application, workers self-select into a course. After choosing, they are rarely allowed to switch course. The non-career courses, which assign workers to tasks that do not require specialized skills, attract almost no male workers but predominantly consist of female workers who plan to leave the labor market upon marriage or motherhood. This is an example of a screening process, by which firms attempt to distinguish workers who will only work for short periods in order to treat them differently. Such an empirical observation makes total sense: in the context of economic theory, the information problem regarding individual productivity should induce employers to backload wages in order to distinguish workers who are worth investing in from those who are not. Thus, this paper provides a coherent link between the theoretical framework of screening and the empirical observations of occupation sorting.

In 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 and to solve this information problem. The year

in which the course system was introduced, 1986, was the year the first equality act prohibiting gender discrimination (Equal Employment Opportunity Law) was enacted in Japan. Since then, 10 to 15 percent of firms in Japan have offered courses that predetermine a worker's career path at the time of their hire. This system is especially prevalent among the firms that hire a large proportion of women. Thus, Japanese firms, which were banned from discriminating against workers in an explicit manner based on gender, use this screening mechanism in order to minimize their potential investment loss from female employee turnover.

The screening does not perfectly distinguish workers with different labor force intentions. Based on information on labor force intentions in the JPSC data, I calculated 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 them in the non-career course plan to do so. This may be because there are only two distinct courses, which differ not only in wage schemes, but also in hours of work and difficulty. The career plans reported in the JPSC data remain the same within individuals unless there is a change in their family structure. The survey asks these questions repeatedly, but only 18% of respondents changed their answer if they initially answered that they want to continue to work full-time. If they answered that they want to stop working, 44% of them changed their answer, but most of them changed to the option where they work part-time. The details of this survey data are found in the Appendix.

4 Model

The previous two sections present several features of the Japanese labor market: an increasing tenure-wage profile, a dual job course system, similar wages for women with different labor force intentions, and a narrowing gender gap over tenure. Standard economic theories cannot provide a rationale for these observed features in a cohesive, comprehensive way. In this section, I introduce a model of firms' investment in their employees with a screening mechanism that can consistently account for all of these features.

Suppose women's home productivity affects the probability of leaving the labor market, but firms do not observe women's outside option when making investment decisions. Being concerned about employee turnover, the firm offers long-term contracts to defer payments. This situation can be characterized as a two-period screening model in a competitive labor market as follows.

4.1 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 proportion of n_N and n_C respectively. Each of the workers lives for two periods, which correspond to a female individual's single young-adulthood and child-rearing years.

Women with different types differ in their second-period outside options θ_i with $\theta_N > \theta_C$. The workers' outside option affects the probability of leaving the firm in the second-period $q(\theta)$. 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 home productivity is shifted by ε_a, a shock that is realized at the time of marriage. Assume that $\varepsilon_a^i \sim N(0, \sigma_\varepsilon^2)$. Let $G(\varepsilon)$ denote the CDF of stochastic term ε_a^i and $g(\varepsilon)$ as its PDF.

In addition to home productivity, workers are different in ability levels: $\mathscr{A}_i \in \{0,1\}$. Ability affects worker productivity when workers receive investment.[13] While employers cannot observe individual home productivity types, they do perfectly observe worker ability. Assume ability type is correlated with home productivity type with correlation coefficient $\rho_{\theta\mathscr{A}}$.

Workers work for firms and receive wages. Firms hire workers and generate profits from production. The interactive investment decisions of the firm and its workers are analyzed as the pure strategy Subgame Perfect Nash equilibria (SPNE) of a game.

A worker has no outside option in the first period, and thus all workers work. In the beginning of the first period, workers privately learn their types. After types are revealed to workers, firms offer them long-term contracts, which consist of wages for two periods (w_t, $t \in \{1,2\}$). Firms commit to wage contracts once offered. In addition to the wage contracts, 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, and decide their second-period labor force participation based on their realized outside option.

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.

[13] That is, if there is no investment, worker ability has no effect on productivity.

4.2 Workers' Problem

The workers' objective is to maximize their lifetime discounted utility. Let $\beta \in (0,1)$ denote the common subjective discount factor,[14] and $\mathbb{E}(\cdot)$ be the expectation conditional on information available at the time of decision making. The number of small children is assumed to be at most one. Given a contract (w_t, $t \in \{1,2\}$), the utility maximization problem for type i worker is specified as

$$\max_{d,w_1,w_2} V^i(w_1,w_2) = \log(c_1) + \beta \mathbb{E}\log(c_2)$$

$$\text{s.t. } c_1 = w_1$$

$$c_2 = \begin{cases} c(\Omega_1) \equiv d^i w_2 \text{ if single} \\ c(\Omega_2) \equiv y_2^i + \eta^i + \theta^i + \varepsilon^i \text{ if married w/o child-care} \\ c(\Omega_3) \equiv y_2^i + \eta^i + d^i\left(w_2^i - cc\right) + (1-d^i)\left(\theta^i + \varepsilon^i\right) \text{ if married w/ child-care} \end{cases}$$

$$d^i = \mathbf{1}_{\{w_2 \geq \theta^i + \varepsilon^i\}}.$$

where Ω_j is a set of state variables. That is, a worker chooses the second-period labor force participation and a contract. A worker consumes c_i from net labor income or her outside option θ_i. While all workers would work in the first period, the second-period labor force participation decisions depend on whether the second-period wage is higher than her outside option. Be reminded that ε is a shock that is realized at the beginning 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.

Workers face uncertainty in the marriage market and the child-care market. That is, workers face the risk of staying single despite her willingness to get married, and their risk of not being able to work due to the child care shortage. The objective function can be rewritten as

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

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

where p_c^i is the probability of child-care being available.

$$p_c^i = \begin{cases} p_j & \text{for female workers} \\ 1 & \text{for male workers} \end{cases}$$

when worker i lives in prefecture j.

Thus, I simplify the marriage market to the extent that a woman gets married whenever she receives a marriage offer. Compared to a preference toward work life, women's preference toward family life has much less heterogeneity; in the JPSC survey data, 87% women at age 25 answered that they want to get married some day, while 10% answered they do not necessarily want to get married and 3% answered they do not 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 (0.19% of the whole population[15]) of women who divorced in the data.

Assume that women know the distribution of their spouses' income. For lifetime singles, spouse's income distribution only affects the worker's contract choice through their expectation. For male workers, spouse's income equals the average monthly total income of all married women, including those who are out of the labor force, calculated from the aggregate data. For female workers, spouse's income is the average monthly total income of all married men, calculated from the JPSC data. Since η_{ia} is a random shock to husband's earnings that is realized at the time of marriage, its variance is obtained from the actual distribution of husbands' earnings in the data.

As documented in Section 5, the child-care market in Japan is strictly regulated by the government, which has led to a shortage across Japan. Since the costs of public child-care are determined by the local government, there is a wide variation in costs across prefectures. Taking these into consideration, I consider the supply of child-care to be exogenously determined and allow women in each prefecture to be different in terms of their labor force intentions if child-care accessibility is different. Thus, the marginal effect of child-care subsidies would be different in each prefecture.

The monthly child-care cost for accredited child-care in Tokyo is \$325, which is a fixed cost for a household with income between ¥3,375,000 (\$33,750) and ¥3,931,666 (\$39,316). For households with the same income ranges, the monthly child-care cost is \$538 in Chiba, \$508 in Kanagawa and \$550 in Saitama. Since the average monthly total income for these households is \$3,500

[15]Data Source: Annual National Survey 2010 by Ministry of Health, Labour and Welfare.

to \$4,500, the relative magnitude of child-care expense is large. Based on the child-care cost difference, women in Tokyo are categorized into one group and women in Tokyo's neighboring prefectures (Kanagawa, Chiba, and Saitama) are put in another group.[16]

4.3 Firms' Problem

The firms' objective is to maximize revenue minus wages. At the beginning of the first period, firms propose long-term wage contracts. By the revelation principle, firms propose two kinds of contracts in attempt to screen workers. After seeing offered contracts, workers choose a firm and a contract. Based on a choice of contract, firms infer the quit rate of each worker, and then make investment decision.

The investment problem is a modified version of Ben-Porath (1967) model, where the investment cost is captured by the opportunity cost of training. A worker is endowed with one unit of time in each period with 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 would become $h(I)$ with $h(0) = H_1$. To avoid a trivial case, I restrict our attention to 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 workers, firms propose at most two contracts ψ_N and ψ_C. Let q_ψ stand for the average quit rate of the workers who choose the contract ψ, then the firm's objective is written as

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

4.4 Timing

The interactive investment decisions of firms and workers are analyzed as the pure strategy subgame perfect Nash equilibrium (SPNE) of a game. The timing of the game is defined as follows:

Age-Period 1: Young Workers

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

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

2. Based on inferences about firm's types, workers choose a contract.

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

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

Age-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 home production.

3. Workers consume.

4.5 Subgame Perfect Nash Equilibria

The game structure is basically a screening model under perfectively competitive assumption. However, it is well known that an equilibrium may not exist for a standard screening model. 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. In this model, I use Wilson equilibrium to circumvent the problem. Wilson (1977) considers the screening game structure 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. For a comprehensive discussion and literature review, see Riley (2001).

Equilibrium Wage

Owing to the competitive labor market assumption, firm's profit-maximization problem is equivalent to firm's revenue-maximization problem subject to workers' participation constraints. Fur-

thermore, the choice set 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. Last, the zero-profit condition determines the equilibrium first-period wage. That is, the quit rate for worker i who chooses a contract $\psi = (w_1, w_2)$ is a function of the second-period wage w_2:

$$q^{\psi}(w_2) \quad = \quad p_c^i \Pr(w_2 \leq \theta) + \left(1 - p_c^i\right) = p_c^i F(w_2) + \left(1 - p_c^i\right).$$

The firms' investment depends on the second-period wage through the quit rate $q^{\psi}(w_2)$:

$$I^{\psi}(w_2) = \arg\max_I \left\{(1-I) H_1 + \beta (1 - q^{\psi}(w_2)) h(I)\right\}.$$

The first-period wage is uniquely determined as:

$$w_1(w_2) = \left\{ (w_1^{\psi}, w_2^{\psi}) | \sum_{i \in N,C} n_i \{(1 - I^{\psi}) H_1 - w_1^{\psi} + \beta (1 - q^{\psi}) \left(h(I^{\psi}) - w_2^{\psi}\right)\} = 0 \right\}$$

The problem of this screening model would become:

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

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

(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.

The equilibrium is defined as first-best outcomes if it achieves the same outcome as the situation with symmetric information in terms of resource allocation and individuals' welfare. However,

this outcome cannot be achieved if the first-best equilibrium wages are not incentive compatible. 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. With the concave utility function, the equilibrium types depend on the parameter values.

4.6 Discussion

This section introduces a dynamic screening model and illustrates equilibrium wage determination and market failure associated with information asymmetries. With unobserved heterogeneity of workers being taken into consideration, the model can reconcile the features of the Japanese labor market introduced in Section 5: an increasing tenure-wage profile, a job course system, similar wages of women with different labor force intentions, and a narrowing gender gap over tenure.

Incorporating long-term contracts allows us to explain the job course system in Japan as a separating equilibrium and the similar earnings profiles of women with differing plans as a pooling equilibrium in a dynamic screening model. A pooling equilibrium may exist because 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 where, despite firms' best screening efforts, women who plan to continue to work choose the same investment level as those who plan to quit their job at childbirth.

Admittedly, firm-specific human capital is a strong assumption, which is imposed to theoretically justify firms' employee investments in my model. My paper does provide descriptive evidence for firms' employee investment, 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. Examples of mobility costs are replacement costs, administrative costs, and job search costs.The first two examples let employers earn a rent when workers remain in the firm, and the last example prevents workers from switching firms easily. Either case justifies firms' employee investment, which leads to similar setups to my model.

The model exhibits that the economy could achieve either a separating outcome or a pooling outcome, depending on market productivity compared to workers' outside option. If the society is in a pooling equilibrium, investment allocation is not efficient compared to the case where employers observe individual workers' labor force intentions. Efficiency could drastically increase if a pooling equilibrium turns into a separating equilibrium. One possible way to alter the equilibrium type 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.

5 Data

In this section, I will describe how I apply my data sets to analyze women's labor supply decision and to quantify statistical discrimination. I use three kinds of data sets: the Japanese Panel Survey of Consumers (JPSC), the Census, and the aggregate data on child-care services provided by Zenhoren (The Institute for Research on Child-Care).

5.1 Household-level Panel Data

The main data set in this study is the Japanese Panel Survey of Consumers (JPSC) data, offered by the Institute for Research on Household Economics. The survey started in 1993 with a cohort of 1,500 women age 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. The currently available data contains individuals which divide into four cohorts: Cohort I (1958 - 1969), Cohort II (1970-1973), Cohort III (1974-1979), and Cohort IV (1980-1984).[17]

The JPSC contains extensive data on each household member including their residential area, which can inform us about the child-care accessibility that each woman faces. This is the key variable to provide exogenous variation in women's quitting behavior around the time of childbirth. The data also includes detailed information on other labor supply determinants such as a woman's education, husband's income, household assets, remittance, and her own mother's labor force participation when the woman was a child.

[17] The oldest cohort is 49 years old as of 2008, the most recent wave of the survey.

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

I compare women with men with similar characteristics with respect to employing firms' investment decisions. Since the observations most comparable to male workers are single, childless female workers, I limit our sample universe to women aged under 29 who are single and work full-time in their first firm in the data.[18] Among the 246 women who graduated from a four-year college, more than half of them between age 24 and 29 work in the first firm to have hired them after college. [19]

5.2 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),[20] containing 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. Instead of the actual expenses, therefore, I utilize a variation in the availability and costs of public child-care across municipalities.

To identify the causal effect of statistical discrimination, I use cross-sectional variation in the accessibility of accredited child-care as an instrumental variable for women's quit rates. Here, I briefly present the child-care market in Japan so as to discuss how useful the variation of child-care accessibility is in estimating the effect of statistical discrimination on the gender wage gap.

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

[19] The data contains 2,813 women under age 29 at their first observation in the data. The sample size decreases as I focus on full-time workers. Among those, 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% of those are single, so the sample size becomes 1,035. When I further restrict the sample to women who work in their first firm, the sample size is reduced to 633.

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

6 Calibration and Identification

The screening model constructed in Section 4 suggests that whether the separating or the pooling equilibrium occurs depends on the distribution of workers' outside option relative to their market productivity as well as uncertainty. The model also implies that tax credits for working women can push the economy to a separating equilibrium, increasing efficiency and total welfare. In this section, I calibrate the model using the simulated method of moments, which selects parameters that best match a set of properties of both the actual data and the data simulated from the model.

Table 2: Parameters chosen outside of the model

	Cohort (born in 1958-1973)	
	Non-career Type	Career Type
Tokyo	42.2%	57.8%
Suburb	56.9%	43.1%
West	63.3%	36.7%
p_m (married by 35)	81.4%	84.8%
$E(y), Var(y)$ (hinc at 33-35)	285.1	237.1
mean (No. children)	1.52	1.57
p_{cc}	0.97	0.97
Child care cost $(1-\zeta)cc$ (Tokyo)	\$325	\$325
$(1-\zeta)cc$ (Suburb)	\$530	\$530
$(1-\zeta)cc$ (West)	\$500	\$500
H_1	$1 = \$1,450$	$1 = \$1,450$

Note *) The mean of the number of children at age 35 is conditional on being married by age 35
Note 1) The numbers in parentheses are standard deviation.

6.1 Solution Algorithm of the Screening Model

The model with long-term contracts for female workers is solved 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 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-woman type prefers the most among the contracts the non-career type likes less than their first best contract.

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

   (c) If only one of the incentive compatibility binds, 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.

   (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.

6.2 Identification

In this subsection, I provide an overview of the identification strategy. Several normalizations are needed because some variables are not observed in the data. For example, I set the first-period human capital level equal to the initial salary of female high school graduates and then normalize it to one: $H_1 = 1$. This sets one unit equal to ¥145,000 ($1,450) for women in Cohort I.[21]

The parameters to be estimated include (i) the parameters in the human capital production function; (ii) the disutility parameters in the utility function; (iii) the correlation between ability and the outside option; and (iv) the mean and variance of the outside option.

The identification of production function parameters is due to exogenous variation in quit rates across prefectures. The observed quit rate and wage profiles from each gender provides two equations expressed by the two production parameters. Given men's quit rate, the total earnings for men who work for both periods is equal to the total productivity because of the competitive labor market assumption.

$$(1-\mathscr{I})+\beta(1-q_i)\mathscr{H}(\mathscr{I})=w_1^M+\beta(1-q^i)w_2^M.$$

Given female worker's quit rate,

$$(1-\mathscr{I})+\beta(1-\bar{q}^{\psi})\mathscr{H}(\mathscr{I})=w_1^{\psi}+\beta(1-\bar{q}_{\psi})w_2^{\psi}$$

where $q_{\psi}=\bar{q}\left(w_2^{\psi}\right)\equiv\sum_{\psi^i=\psi}\left(n^i\cdot q^i\right)/\sum_{\psi^i=\psi}n^i$ if the types are pooled and $q_{\psi}=q_i$ if the types are separated. Be reminded that $\bar{q}^{\psi}=p_c^j\Pr\left(w_2^{\psi}\leq\theta\right)+\left(1-p_c^j\right)$ where p_c^j is child-care availability in prefecture j.

The mean and variance of workers' outside options for each type of worker (θ, σ) are recovered from a mapping from outside options to the optimal wage contracts. The increment in productivity for high ability workers (Δ) and the proportion of high ability workers ($\%\mathscr{A}$) 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. The correlation between ability and the second-period outside option ($\rho_{\theta\mathscr{A}}$) is pinned down from the proportion of N-type workers who choose a career course.

[21] Therefore, I cannot estimate ζ in the two-period model.

To identify the causal effect of statistical discrimination, I use child care accessibility as an instrument variable for women's quit rates. I will show child-care accessibility is a valid instrument by presenting that the instrument is correlated with women's quit rates but not correlated with women's potential productivity — or their quitting intentions.

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 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 facility exceeds 100 % with as many as 25,556 children on waiting lists. This shortage of 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. Although the private sector also offers child-care services, they generally charge three to four times of the price of public child-care due to government regulation on child-care quality as well as expensive labor costs. Thus, the shortage of child-care contributes to today's high turnover rates of young female workers, which may trap the society in a low investment equilibrium.

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 to have more children while supporting traditional values.[22] 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 of the government pushing women into more domestic lifestyles and away from professional lives.

Since then, however, the economic climate has greatly changed. In the wake of the long stagnation of the Japanese economy, family incomes decreased, and more women sought to work after

[22]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. The reasons for their early retirement vary; some have strong preferences toward leisure or work in non-market activities; some are married to rich partners or found it efficient as a couple for the wife to specialize in home production. In addition to these reasons, women's high quit rate at marriage is also attributed to the shortage of child-care services, which is intentionally maintained and supported by government policy.

childbirth. The rise in maternal employment increased the demand for child-care drastically,[23] but the supply of child-care has increased more slowly. This led to excess demand for child-care and, 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 1 in the Appendix).[24] This shortage for affordable child-care is so severe that a number of women have to quit their jobs despite their willingness to continue to work in order to take care of their children. According to the Annual National Survey by the Ministry of Labour, Health and Welfare, 15-20% of women leave the labor market at their first childbirth every year. Conditional on continuing working, 70-83% of women take child-care leave, and this proportion increases over the past decade. Among workers who take child-care leave, more than 97% of those 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 service.

The child-care shortage is attributed to government regulation of the child-care market. In order to maintain the quality of child-care services, the Japanese government subsidizes only providers that obtain accreditation. To obtain accreditation, a child-care facility must satisfy the following criteria: 1) the capacity is larger than 60;[25] 2) the space per child is larger than 3.3 square meters (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 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.

[23] More than 80% of families in Japan are nuclear families, which consist of a pair of adults and their children.

[24] 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 greatly different from the system for services for younger children. The criteria to obtain accreditation are much lower for pre-schools and kindergartens.

[25] To obtain subsidies for small sized child-care services, the capacity can be as small as 20.

Partly due to the malfunctioning child-care market, the most common reason women quit their jobs in Japan is due to childbirth and child-care. Among women who quit between ages 25 and 35, more than 25% of them quit the job because of childbirth or child-care (the 2011 Annual National Survey by the Ministry of Labour, Health and Welfare). Given such a severe shortage of child-care, providing a greater capacity of subsidized child-care could greatly influence labor market outcomes.

6.3 Moments

Among the parameters chosen outside of the model are $\{n_N, p_m, E(y), Var(y), p_{cc}, \zeta\}_j$ for $j \in \{1,2,...,J\}$. A one-period (six-year) discount rate (β) is 0.7.

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

- Labor Force Intention: the proportion of female individuals who plan to work after child birth.
- Occupational Sorting: the proportion of female individuals who choose each job course by cohort, age and gender.
- Labor Force Participation: the proportion of individuals who work full-time by cohort, age, gender, and by whether a preschool-age child is present.
- Earnings Profile: the mean log monthly wage by cohort, job course, age and gender.

Variables for women's labor force intentions are created 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 to work at their current job, switch their job for one with shorter hours worked, or stop working when they have a child. The question has been asked three times throughout the survey, in 1994, 1997 and 2000.[26] For those women who answered the survey when they were single and under 29 years of age, I classify them 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 to work as a full-time worker. The proportion of

[26] 1,433 women answered this question once, 898 twice, and 312 three times.

Table 3: 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) Sample: Single female college graduates aged under 30 who answered to survey questions about their labor force intentions after their first child birth.

workers who plan to continue to work is a minority regardless of women's educational attainment. 44.1% of female four-year college graduates (60 out of 136) answered that they plan to continue while 36.3% of women with two-year college degrees or less (218 out of 600) did so.[27] The details of the statistics can be found in Tables 18 to 19 in the Appendix.

Although the panel data does not contain information about which career course an individual chooses, the data include a substantial amount of information on task characteristics. Using the 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 task requires more than one month for a newly-hired worker to become familiar with it. In addition, I excluded 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 a career job when they are first observed in the panel data, and the rest have a non-career job.

Table 3 shows that job courses screen female college graduates with different labor force intentions to some extent, but not perfectly. 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 despite their screening mechanisms.

The labor force participation rates at age 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 any way

[27] 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.

because her outside option 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.

Wages in the model, w, equalize after-tax monthly labor income averaged over a six year period. The data show that wage profiles in non-career courses start about the same as wage profiles in career-courses on average.

7 Empirical Results

This section reports the estimated results from calibration. The parameter estimates and their standard errors are shown in Table 4. Despite a large difference in the costs of public child-care, both Tokyo and its neighboring areas are found to be in a pooling equilibrium.

Table 4: Estimation Results
(Unit: ¥145,000 ≈ $1,450)

		parameter	Cohort I estimate
Demography	% of high ability workers	$\%\mathscr{A}$	0.38
	correlation btwn θ and $\mathscr{A}$	$\rho_{\theta\mathscr{A}}$	0.75
Utility	task disutility for	b_1	1.22
Outside option for men	mean	$\bar{\theta^M}$	1.04
(Uncertainty)	variance	σ_M	1.13
Outside option for women	mean for Type N	$\bar{\theta^N}$	1.96
	mean for Type C	$\bar{\theta^C}$	1.19
(Uncertainty)	variance for Type N	σ_N	1.09
	variance for Type C	σ_C	0.35
Production		A_h	1.28
$\mathscr{H}(\mathscr{I}) = A_h \mathscr{I}^{\alpha} (H_{i1})^{\zeta} + \rho_{\mathscr{I}\mathscr{A}}\mathscr{A}$		α	1.27
	ability effect	Δ	0.81
Equilibrium in Tokyo Area			pooling
Equilibrium in Suburb Area			pooling
Equilibrium in Western Area			pooling

Note 1) The numbers in parentheses are standard error.

Tables 5 and 6 present model fit on various measures, which are not used as moments. Table 5 compares the actual and predicted monthly salary and labor participation rate differences overall, by cohort, gender and age.

Table 5: Moments by Gender

	Female		Male	
Cohort I	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

The pooling outcome fits the data best.
Note 1: Part-time workers and workers on leave are excluded from the sample.
Note 2: Employment rates at age 35 are compared to the employment rates at age 25 being set equal to 100%.
Note 3: The numbers in the columns "job course" show the proportion of workers in career courses.
Note 4: 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).

Table 6: Moments by Women's Type and Residential Area
(Unit: hundred Japanese yen)

		Type N		Type C	
Cohorts I & II	Prefecture	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 1: The second best pooling outcome fits the data the best for both areas.
Note 2: Employment rates at age 35 are compared to the employment rates at age 25 being set equal to 100%.

The model exhibits that the economy could achieve either a separating outcome or a pooling outcome, depending on market productivity compared to workers' outside option.

I find that the Japanese female labor market as it currently stands is best captured by a pooling equilibrium of the employer-worker game, thereby allowing statistical discrimination.

8 Counterfactual Analysis

Based on the estimated model, I conduct a counterfactual analysis of child-care subsidies and evaluate the effect in terms of inefficiency and social welfare. The objective of counterfactual analysis

is to analyze the effects of child-care on labor market efficiency. While types θ that determine women's outside options are assumed to be innate and time-invariant, labor force intentions offer a variable outcome that depends on women's outside option and labor market conditions. To balance the government budget, increases in child-care subsidies are collected by a lump-sum tax on the working-age population.

I first compare the estimated model with a perfect world where firms observe individual workers' labor force intentions. I then examine changes in the accessibility and/or price of child-care would affect efficiency. Inefficiency in my model comes from two sources, information asymmetry regarding a worker's work-life plan and uncertainty in the marriage market. In my model, child-care would change the equilibrium type by shifting women's productivity at home, thereby changing the extent of inefficiency. The expected change is not necessarily unidirectional. Based on the parameters estimated, preliminary results show that a 140% decrease in per-child day care subsidies in Tokyo (a reduction of approximately $700 per month) changes a pooling equilibrium to a separating equilibrium. This is because the decrease in subsidies discourages the women who have a higher intention of quitting. 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.

9 Concluding Remarks

In this paper, I model firms concerned about investment-loss from employee turnover. The firms attempt to distinguish workers' labor force intentions by offering long-term wage contracts. The model reconciles important features of the Japanese labor market such as seniority-based payment, occupation sorting, and a narrowing wage gender gap over tenure. While the empirical model is specifically tailored to the current Japanese labor market, the two-period screening model framework is applicable to analysis of wage differentials arising from employers firm-specific employer-investment decisions made under uncertainty and incomplete knowledge regarding workers' tenure decisions.

The theoretical model shows that whether the economy achieves a pooling equilibrium depends on the distribution of workers' outside options relative to their market productivity. That is to say, because altering the type of equilibrium brings a drastic change in wage contracts and investment

levels, the model implies that, under certain limited circumstances, government intervention could improve social efficiency.

The empirical section builds on these findings, and quantifies the counterfactual effect of public policies that change the home-productivity type distribution of Japanese women. As an example of public policies that are expected to bring about such a distribution shift, I study child-care tax credits for working women. The child-care market in Japan is regulated by the government, which leads to a severe shortage across Japan. The costs of public child-care are determined by the local government, and thus there is large variation in costs across municipalities. Taking these into consideration, I examine the effect of child-care subsidies for Tokyo and its neighboring prefectures separately. My primary findings are as follows:

Despite large differences in child-care costs, both areas are found to be in a pooling equilibrium. However, 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 its neighboring areas, no reasonable changes in child-care subsidies improves efficiency. By contrast, in other regions, a 140% decrease in the subsidies raises investment efficiency because the equilibrium shifts from pooling to separating. Thus, the policy implication from the counterfactual analysis performed in this study depends on local economic conditions.

Several limitations to this paper need to be acknowledged. First, the counterfactual analysis examines the partial effects of public child-care; 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 a 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.

Second, related to the first point, this paper does not examine how workers' "types" are determined. Workers' types are interpreted as home productivity here but could reflect workers' leisure preference. A precise proxy for types enables us to analyze how changes in the child-care market affect workers' labor force intentions, which in turn affects workers' self-investment. Furthermore, building a reliable measure of labor force intentions is necessary for a labor supply model with more than two periods because women's types could change over time.

Thus, to find a general equilibrium effect of child-care subsidies on labor market outcomes and efficiency, the model would need to incorporate how workers' types are formulated and evolve as well as how they affect women's choices regarding education, marriage and labor force participation after child rearing. This is beyond the scope of this paper. Therefore I leave estimation of the general equilibrium effects of child-care to future work.

Nonetheless, this paper's contribution is significant. This paper develops a game theoretical model of statistical discrimination against women in the labor market and quantifies the effects of child-care tax credits. The model leads to a noble implication that tax credits can bring a drastic change in efficiency by altering the equilibrium of the worker-firm game. Built on this theoretical prediction, I apply the model empirically to the Japanese labor market and find that, in Tokyo, where child-care costs half as much as other areas, no reasonable changes in child-care subsidies improve efficiency. By contrast, in its neighboring prefectures, where child-care is a significant expense, a 140% decrease in the subsidies raises efficiency because the equilibrium shifts from pooling to separating. Thus, the policy implication from the counterfactual analysis depends on local economic conditions. Such a complicity of the effect of child-care subsidy suggests the importance of extra casino when policy makers implement new affirmative action.

10 Online Appendix: Descriptive Statistics

Table 7 shows the labor force participation rate of women aged 25 to 29. The participation rate of married women with a small child is only a third of that of single women.

Low labor force participation rates for married women with a small child 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 to have more children while supporting traditional values. 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. The reasons for their early retirement vary; some have strong preferences toward leisure or work in non-market activities; some are married to rich partners or found it efficient as a couple for the wife to specialize in home production. In addition to these reasons, the women's high quit rate at marriage is also attributed to the shortage of child-care services that is intentionally maintained by government policy.

Table 7: 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))

Table 8: Preference for and Realization of Women's Work History

	Preference					
Realization	Total	I	II	III	IV	others
I	1,124(19.0%)	30.6	17.2	15.5	15.8	14.5
II	2,972(50.2%)	47.1	54.1	50.9	44.6	33.8
III	1,211(20.5%)	12.3	21.6	27.9	21.6	12.4
IV	146(2.5%)	4.1	2.1	1.9	11.2	0.7
Others	468(7.9%)	5.6	5.0	3.9	8.3	38.5
Total	5,921(100.0%)	100%	100%	100%	100%	100%

I: % of women who work continuously after their first child birth (includes those who took child-care leave)
II: % of women who leave temporarily after marriage/childbirth
III: % of women who leave permanently marriage/childbirth
IV: % of women who continue to work without children
Note 1) This data is from the National Annual Survey by the Ministry of Health, Labor and Welfare (1998)
Note 2) Using the statistic, I recalculated the proportion of realized career paths by preference.
Note 3) This sample of the data excludes self-employed workers.

Table 10: Reasons for Leaving Previous Job in 2011

	Men			Women		
	Total	High Schl.	College	Total	High Schl.	College
Layoff	5.4%	6.1	5.1	2.9	3.2	2.4
Turnover	6.0	7.0	5.1	5.3	6.5	2.6
Private	84.7	82.9	86.8	89.3	87.8	93.8
Marriage	0.3	0.3	0.3	6.7	6.5	7.9
Child-care	0.1	0.1	0.1	7.2	7.0	8.3
No. Obs.	2,483,100	1,005,500	627,200	3,006,300	1,244,000	414,900

(Data Source: The data is from the National Annual Survey by the Ministry of Health, Labor and Welfare (2011))

Table 9: Transition Matrix

	Choice (t)				
Choice (t-1)	Full-time	Part-time	School	Housewife	Unemployed
Full-time:					
Row %	87.7	5.5	0.1	4.2	2.5
Column %	89.0	5.2	13.3	3.9	24.3
Part-time:					
Row %	7.5	79.5	0.1	10.3	2.4
Column %	8.0	76.4	13.3	9.6	25.0
School:					
Row %	19.1	17.6	52.9	4.4	5.9
Column %	0.2	0.2	60.0	0.1	0.7
Housewife:					
Row %	1.1	14.2	0.1	83.7	0.8
Column %	1.3	15.1	8.3	84.8	8.9
Unemployed:					
Row %	12.9	30.6	0.5	16.3	40.0
Column %	1.3	3.0	5.0	1.5	41.0

(Data Source: JPSC)

Table 11: Similar Earnings of Heterogeneous Women

(Unit: hundred Japanese yen≈$)

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

Table 12: Quitting Behavior of College Female Graduates (first full-time job)

	College	Coll.	Coll.	Coll.	Coll.	All	All
wage	0.003	0.002	0.002	0.002	0.003	-0.005***	-0.005***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.0019)	(0.0019)
wage	0.005	0.004	0.005	0.005	0.005	0.003	0.003
growth	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)
newly	–	–	–	–	–	-0.223	-0.212
married						(0.378)	(0.379)
pregnancy	1.261**	1.176**	1.283**	1.175**	1.238**	0.998***	1.012***
	(0.564)	(0.547)	(0.560)	(0.547)	(0.563)	(0.264)	(0.265)
age	-0.701	-0.066	-1.515***	–	–	–	–
	(0.924)	(0.075)	(0.556)				
age^2	0.009	–	0.022***	–	–	–	–
	(0.014)		(0.008)				
tenure	-0.249	–	–	-0.048	-0.396***	-0.061**	-0.156**
	(0.222)			(0.057)	(0.134)	(0.030)	(0.074)
$tenure^2$	0.012	–	–	–	0.0189***	–	0.005
	(0.011)				(0.006)		(0.003)
overtime	0.016	0.016	0.019	0.015	0.014	0.032*	0.033*
w/o pay	(0.028)	(0.027)	(0.028)	(0.027)	(0.028)	(0.018)	(0.018)
overtime	-0.012	-0.018	-0.017	-0.016	-0.009	-0.016	-0.017
w/ pay	(0.032)	(0.032)	(0.032)	(0.031)	(0.032)	(0.021)	(0.021)
education	–	–	–	–	–	-0.046	-0.061
(yrs)						(0.075)	(0.075)
No. Obs.	567	567	567	567	567	1,971	1,971

Data: JPSC

Note 1) Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note 2) Firm size, city size, and cohort year dummies are also included.

Note 3) Coll. : college graduates (excluding dropouts)

Note 4) Age and tenure year is strongly correlated (with a correlation coefficient of 0.9).

10.1 Child-Care Market

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

Table 13: Wage Profile : Fixed Effects GLS estimates

Dependent Variable: Log of monthly salary		
log wage	(1)	(2)
age	0.183**	0.183**
	(0.07)	(0.073)
experience	0.001	0.003
	(0.007)	(0.006)
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)	–
Father's edu ×tenure	–	0.0004
	–	(0.002)
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, and Firm size are included but not reported.
Note 3: The unit is ten years/hours unless otherwise noted.
(Data Source: JPSC)

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.

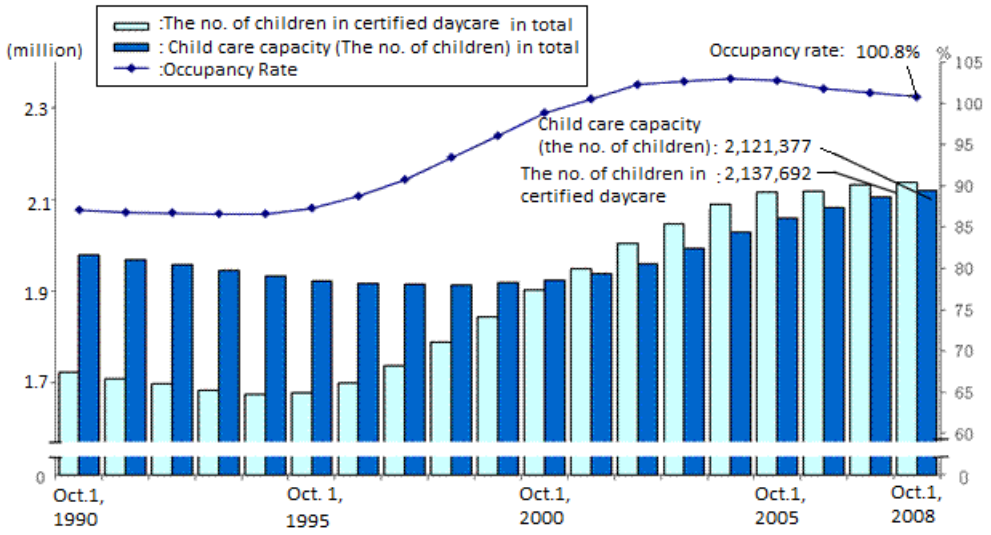
Historically, Japan has provided the lowest child-care subsidies proportional to GDP among OECD countries. In addition to the lack of support for child-care, the government started subsidizing households with members who earn less than 1,030,000 yen (approximately $10,000) per year. Thus, the government 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 of the government pushing women into more domestic lifestyles and away from professional lives.

Since then, however, the economic climate has greatly changed. In the wake of the long stagnation of the Japanese economy, family incomes decreased, and more women sought to work after childbirth. The rise in maternal employment increased the demand for child-care rose drastically,[28] but the supply of child-care has increased slowly. This led to excess demand for child-care and, as

[28] More than 80% of families are nuclear families, which consist of a pair of adults and their children, in Japan.

of 2011, the total occupancy rate of child-care facilities exceeds 100%, with as many as 25,556 children on waiting lists (See Figure 1 in the Appendix).[29] This shortage for affordable child-care is so severe that a number of women have to quit their jobs despite their willingness to continue to work in order to take care of their children. According to the Annual National Survey by the Ministry of Labour, Health and Welfare, 15-20% of women leave the labor market at their first childbirth every year. Conditional on continuing working, 70-83% of women take child-care leave. This proportion has increased over the past decade. Among workers who take child-care leave, more than 97% of those 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 service.

Figure 1: Child Care Shortage



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

[29]Child-care hereafter 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 greatly different from those of services for younger children. The criteria to obtain accreditation are much lower for pre-schools and kindergartens.

Table 14: Sample across Prefecture

	Price (2000)		Price (2000)
1. Hokkaido	50800	25. Shiga	56900
2. Aomori	50000	26. Kyoto	53300
3. Iwate	53100	27. Osaka	52200
4. Miyagi	53600	28. Hyogo	55500
5. Akita	45030	29. Nara	43000
6. Yamagata	51500	30. Wakayama	53000
7. Fukushima	55400	31. Tottori	59000
8. Ibaraki	57000	32. Shimane	53000
9. Tochigi	51000	33. Okayama	42650
10. Gunma	50000	34. Hiroshima	57250
11. Saitama	46800	35. Yamaguchi	62500
12. Chiba	54830	36. Tokushima	55000
13. Tokyo	37200	37. Kagawa	52000
14. Kanagawa	53500	38. Ehime	54000
15. Niigata	49400	39. Kouchi	56000
16. Toyama	50800	40. Fukuoka	61800
17. Ishikawa	46300	41. Saga	51000
18. Fukui	48640	42. Nagasaki	51000
19. Yamanashi	46300	43. Kumamoto	51000
20. Nagano	48400	44. Ooita	45000
21. Gifu	53300	45. Miyazaki	51000
22. Shizuoka	45500	46. Kagoshima	46500
23. Aichi	45700	47. Okinawa	40800
24. Mie	48000	48. Abroad	–

Table 15: Average Household Earnings by Prefecture
(unit: hundred Japanese Yen)

	Household Monthly Earnings					Husbands' Monthly Earnings			
Prefecture	Mean	S.D.	Min	Max	Prefecture	Mean	S.D.	Min	Max
Tokyo	771.2	467.9	90.0	5166.7	Tokyo	701.9	415.2	90.0	3333.3
Kanagawa	680.8	252.9	260.0	1500.0	Kanagawa	564.9	190.0	260.0	1083.3
Chiba	548.4	181.0	25.0	819.2	Chiba	458.6	176.8	25.0	740.0
Saitama	653.7	258.4	105.8	1852.5	Saitama	533.0	228.3	100.0	1560.8

(Data: JPSC)
(Sample: Spouses of Female College Graduates)

Table 16: The Average Expense for Accredited Child-Care by Prefecture
(unit: hundred Japanese Yen)

Prefecture	Mean	S.D.	Min	Max
Tokyo	213.1	112.4	10.0	500.0
Kanagawa	264.3	193.0	20.0	700.0
Chiba	237.5	138.4	20.0	650.0
Saitama	250.3	147.0	10.0	650.0

(Data: JPSC)

Table 17: Women's Wage Profiles of College Graduates on the first job
(Dependent Variable: log of wage)

Sample:	**Female College Graduates**		
	All	Career	Non-career
tenure	0.6***	0.7***	0.4***
	(0.03)	(0.05)	0.05
tenure squared	-0.1***	-0.1***	-0.1***
	(0.01)	(0.02)	(0.02)
hours worked	0.03***	0.05***	0.02**
	(0.006)	(0.01)	(0.01)
with small child	-0.08***	-0.97***	0.26***
	(0.02)	(0.024)	(0.07)
const.	5.1***	5.01***	5.06***
No. Obs.	1032	411	218
R^2	0.33	0.27	0.005
within R^2	0.51	0.63	0.27
between R^2	0.28	0.007	0.01

Note) The sample includes college graduates who are employed as a full time worker in their first firm and are not on child-care leave.

10.2 Women's Labor Force Intentions

The JPSC data contains several questions that ask workers about their career plans. One of the questions asked of all women in the sample is whether they want to continue to work at their current job, switch the job for one with shorter hours worked, or stop working when they have a child. Table 18 shows the proportion of each answer given by women ages 24 to 29. As is consistent with the aggregate report, the survey in the panel data show that less than half of women with college degrees plan to continue to work full-time at their childbirth.

The question has been asked three times throughout the survey, in 1994, 1997, and 2000. 1433 women answered once, 898 twice, and 312 answered this question three times. To see whether preferences changed over time, I look at 93 women who answered the question more than twice while they were single and worked full-time in their first job. While 44% of them changed their answer, 56% of them answered the same. Most of the changes are found in those who answered they want to switch the job or stop working. As for those who answered that they want to continue to work, 18% of them changed their answer to other options.

The labor force participation rates at age 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 any way because her outside option remains 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.

Table 18: Career Plans of Women Aged 24-29

	All		College		Single College	
		employed full-time		employed		employed
continue to work	22.8%	35.1%	34.7%	45.7%	41.25%	43.9%
switch to part-time	17.4%	28.0%	20.0%	21.7%	23.13%	21.95%
stop working	27.2%	37.0%	28.0%	32.6%	33.13%	34.15%
no work $\rightarrow$ no work	30.6%	—	17.3%	—	2.5%	—
No. Obs (100%)	1,291	896	225	138	160	123

(Data Source: JPSC)

Note 1) The sample is all women who answered the JPSC survey.

Note 2) The sample labeled "employed full-time" is women who were working full-time at the time of the survey.

Table 19: Labor Force Intentions and Other Characteristics

	Type N	Type C
prob (married by 30)	63.7%	65.6%
prob (married by 35)	75.6%	75.3%
mean (edu. yr)	13.2 (1.8)	13.6 (1.8)
mean (no. kids at 35)*	1.55 (0.91)	1.60(0.95)
mean (hinc at 33-35)	285.1 (167.6)	237.1 (180.2)
prop (career)	46.8	50.4

Note *) The mean of the number of children at age 35 conditional on being married by age 35

Note 1) The numbers in parenthesis are standard deviation.

References

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.

K. J. Arrow. *The Theory of Discrimination*. Prinston, NJ: Princeton University Press, 1973.

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

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.

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.

Z. Eckstein and K. I. Wolpin. The specification and estimation of dynamic stochastic discrete choice models: A survey. *The Journal of Human Resources*, 24(4):562–598, 1989.

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.

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.

E. Lazear. Why is there mandotry retirement. *Journal of Political Economy*, 87(6):1261–1284, 1979.

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

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

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

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.

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