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GENDER GAP IN LABOR SUPPLY, LEISURE, CONSUMPTION, AND HOME PRODUCTION AND NATIONAL POLICY IN JAPAN

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ABSTRACT

This study investigates single individuals' different choices over time in terms of use (labor supply, home production time input, leisure) and consumption (market consumption goods, home production goods) and provides evidence to explain the differences. To this effect, we use the structural model of the Almost Ideal Demand System with a Cobb-Douglas home production function. The results are summarized as follows. Regarding labor supply, both women and men have the same working willingness in the labor market when women are paid as much as men. Overall, although the regional gender income gap appears different between major metropolitan areas and non-major metropolitan areas, our results indicate that the income gap would disappear by diminishing the wage gap. However, for home production, the gender gap persists when women apply the same conditions as men, although the gap is small. Policy implied that reducing the gender wage gap is an important tool to encourage single women to work as men in the workplace regardless of the area.

Contribution/Originality: This study is one of very few studies which have investigated single men's and women's different choices regarding time use (labor supply, home production time input, and leisure) and consumption choice (market consumption goods, home production goods) in Japan.

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1. BACKGROUND

The Japanese government encourages women to increase their labor supply to sustain the Japanese economy affected by the aging population. The female employment rate in Japan has risen significantly since 2012, reaching 64.7% in 2015, well above the 58.5% OECD average. Nevertheless, the total working hours of women have remained steady, as rising part-time employment has reduced their average working hours. Consequently, the gender pay gap is the third-largest in the OECD (OECD, 2017). Moreover, the city- and region-based gender gaps may differ within Japan. Investigation of the regional gender gap in consumption and time use might provide insightful evidence on improving the national policy on women's labor.

There are two popular methods for analyzing intra-household couples' resource (income and time) allocation gap. One is the collective model, which explores how resource-management power is distributed between husband and wife in the household. The other method analyzes the issue through the viewpoint of gender identity. Much of the previous research on decision making has focused on married couples.

The collective model, proposed by Chiappori (1992), examines intra-household resource allocation. The sharing rule, the sharing of monetary resources between household members, is commonly used to proxy the husband and wife's bargaining position. Some studies determined that, on average, a wife's resource sharing is less than that of her husband (Couprie, 2007; Lise & Seitz, 2011).

Some previous studies explain the tendency towards women doing more housework than men in terms of gender identity (Alvarez & Miles, 2003; Baxter & Tai, 2016; Bertrand, Kamenica, & Pan, 2015; Killewald, 2016; Piao, 2021; Yamamura & Tsutsui, 2019). Baxter and Tai (2016) point out that this gender gap in housework is common, existing across multiple countries. Alvarez and Miles (2003) obtained similar results studying European households. Bertrand et al. (2015) outline how gender identity causes married working women, who earn more than their husbands, to do more chores as well, leading them to be less satisfied with their marriages and more likely to get divorced. Similarly, Baxter and Tai (2016) discuss how the housework gap between husband and wife increases the time pressure who do more housework, causing marital conflict and reducing overall levels of happiness.

Evaluating the effects of gender identity and bargaining positions is important; each problem requires different methods to solve. For example, if a couple's intra-household resource allocation gap is due to one party's bargaining position, then it is the government's responsibility to improve the weaker party's position through factors like wage. If the allocation gap is caused by gender identity, the government should instead adopt methods like encouraging husbands to do more housework.

Unfortunately, couples' preferences and bargaining positions cannot be obtained from merely observing data. Thus, we need to analyze couples' monetary bargaining positions and utility function. Effects on a husband and wife's bargaining, including individual preferences, are not identical from case to case. According to Akerlof and Kranton (2000), gender identity[1] in such situations exists when a husband and wife belong to different social categories. Single female and male households are not affected by bargaining positions, but still show the impacts of gender identity because single females and males also belong to different social categories. Exploring single households may present a unique opportunity to learn more about gender identity. Evaluates how much the identity contributes the gap.

In Japan, the gender gap is significant in wages and home production, Japan's gender pay gap being the third highest in the Organisation for Economic Co-operation and Development (OECD) countries in 2015, with women's average wages at 73% (see OECD (2017)). Regarding housework sharing among married couples, Baxter and Tai (2016) show that Japan is one of the most unequal countries on the division of the housework. Therefore, investigating the reason for this significant gender gap in Japan is important.

Why is the gender gap in terms of working hours and spending time on chores and childcare large in Japan? Why do women tend to choose a part-time job while they seem motivated to work? To address these questions, we examine unmarried men's and women's data and examine the gender gap in labor supply, time spent on home production, and consumption behavior. This study focuses on the differences in gender-specific identity by using unmarried, single male and female household data. The data allow us to exclude the complicated problems between partnership after marriage: bargaining power, changing working hours for the tax and social security systems, childcare capacity shortages, etc. This study contributes to the extant gender gap literature in two ways. First, it considers consumption information, not making a strong assumption of separable consumption and leisure in exploring the gender gap, and second, to quantify the effects of utility, wage, and home production technology on investigating the gender gap using simulation.

In order to measure the effect of these factors on individual decision making, we assume individuals maximize their utility function under budget constraints and minimize their home production cost. As such, this study uses the following two-procedure estimation. we adopt the Almost Ideal Demand System as the utility function, which is the second approximation for the arbitrary utility function of Deaton and Muellbauer (1980), and use the Cobb-Douglas function to represent home production technologies. On the first procedure, we estimate the home production technology parameter using a Hicksian function (ordinary least squares, OLS). Second, we estimate the demand system (generalized method of moments, GMM) to obtain the utility parameters given the price of home production.

The remainder of this study is structured as follows. Section 2 presents the individual decision-making model. Section 3 explores the model's empirical applications, discusses the two-procedure estimation for obtaining preferences and home production technology parameters. Section 4 presents results, and Section 5 concludes the study.

2. MODEL

This section presents a model for individuals' decision-making regarding market consumption (c), leisure time (l), and home production $(D(n,h))$ (e.g. prepared meals). This study aims to provide an insightful evidence of gender's different choice on labor supply, consumption, leisure and home production using single individual households i with two types of single men household i (men $= m$ and women f). The individuals obtain utility from consumption of market goods (c), leisure time (l), and home production goods $(D(n,h))$. The utility function $u(c,l,D)$ is twice differentiable, strictly increasing, and strictly concave in its arguments. Home production is calculated based on the inputs of time (h) and home production consumption of goods (n) and the home production function $D(n,h)$ is twice differentiable, strictly increasing, and strictly concave in its arguments.

[1] Akerlof and Kranton (2000) study conceives gender identity existing due to differences in individuals' social categories.

Individuals are assumed to have two constraints. First, there is the time constraint: the sum of the leisure time (l), the home production time input (h), and the market working time (z) is normalized to unit. Second, there is a consumption constraint: given the price of market consumption goods (p_c) and home production consumption goods (p_n), individuals' consumption expenditures are no greater than the sum of their non-labor income (N) and their working income, which is calculated as working time (z) multiplied by wage (w).

We assume that there are two types of individuals: single women $(i = f)$ and single men $(i = m)$. Individuals seek to maximize their utility under the two constraints, while minimizing their home production technology cost. An individual's optimal decision can be illustrated as the solution of the following optimization problem (see Equation 1):

$$\max_{c^i,l^i,n^i,h^i} U^i\left(c^i, l^i, D^i(n^i, h^i)\right),$$
$$s.t.\quad p_c w^i + p_n n^i \le w^i z^i + N^i, \qquad (1)$$
$$l^i + h^i + z^i = 1 (i = f, m).$$

The corresponding cost minimization problem for home production can be written as follows (see Equation 2):

$$\min p_n n^i + w^i h^i,$$
$$s.t.\ D^i(n^i, h^i) = D^i. \qquad (2)$$

Solving the maximization problem for utility and the minimization problem for home production, the optimal decisions can be obtained as follows (see Equqation 3):

$$\left.\begin{array}{l} c^i = F_c^i(p_c, p_n, w^i, N^i) \\ l^i = F_l^i(p_c, p_n, w^i, N^i) \\ h^i = F_h^i(p_c, p_n, w^i, N^i) \\ n^i = F_n^i(p_c, p_n, w^i, N^i) \end{array}\right\} (i = f, m). \qquad (3)$$

Given individuals' market consumption goods (c), leisure time (l), home production time input (h), home production consumption goods input (n), prices (p_c), (p_n), wage (w), and non-labor income (N), the model is expected to reveal the single men's and women's different choices.

3. EMPIRICAL APPLICATION

3.1. Data

For the empirical application, we use consumption data from the 2004 National Survey of Family Income and Expenditure (NSFIE), time use data from the 2006 Basic Survey of Social Life (BSSL), and price information from the Retail Price Survey (RPS, 2004). All three data sets are collected by Japan's Ministry of Internal Affairs and Communications Bureau of Statistics. The NSFIE is conducted every five years, and studies households' daily account books to obtain detailed data on household demographics, income, and property. Data averages from October and November are used to determine data for single households. The BSSL is also conducted every five years, and it includes information on demographics, income, and one day's worth of detailed time use data. The survey is conducted from October 14 to October 22. Finally, the RPS is conducted monthly, and includes detailed information on commodity and service price levels.

The sample includes single employed women and men. Their employment statuses are full-time, part-time, and self-employed. We exclude observations that are missing values of necessary variables for the analysis. For the time use data from BSSL, we exclude observations for which the studied individual had a job but was on holiday in the survey because the time use on working day and holidays are different. As the cross-sectional information on consumption and time use were taken from different data sets, we grouped the observations using matching variables, gender, age, occupation[2], and three major metropolitan areas, and we exactly matched the observations, creating the cells following the basic idea from previous studies adopting the same matching method (Price, 2008; Van Klaveren & Van Den Brink, 2007)[3]. Regarding the price information, market consumption and home production consumption prices are the weighted averages of the respective commodity prices. The weights stem from consumption data, and the commodity prices are obtained from RPS. The aggregated prices differ by household. The amount of total resource (M), also known as full income, used for the households is the sum of four parts: market consumption expenditure, home production consumption expenditure, wage-valued leisure time (wage×leisure time) and wage-valued home production time input (wage×home production time). The total resource is equal to the wage-evaluated daily total resource (M = 24 hours×wage). Home production time includes housework time and shopping time. Leisure time is the endowment time excluding market labor supply and home production time. The market labor supply includes working time and commute time.

The home production consumption is generally selected the consumption goods are consumed through housework time input (e.g. cereals, meat) and the market consumption goods are the goods that they are consumed without housework time (e.g. cooked food). The details of the dividend are displayed in the appendix.

[2] The occupation categories include agriculture, forestry, and fishery workers; administrative and managerial workers; employers; and others.

[3] For the created matching groups, there are 28 cells for women and 31 for men. We also conducted the robustness check using other matching groups and adding employment information.

3.2. Almost Ideal Demand System for Women and Men

The almost ideal demand system model proposed by Deaton and Muellbauer (1980) is a second-order approximation of the arbitrary utility function. The almost ideal demand system is very general, and, thus, widely used in the previous studies (Cherchye, De Rock, Lewbel, & Vermeulen, 2015; Şahinli & Fidan, 2012; Unayama, 2008).[4] Individuals' $(i = f, m)$ demand system equations are specified in Equation 3, which transformed from the specifications proposed by Deaton and Muellbauer (1980).[5] The three categories are denoted as follows: market consumption (c) with the price (p_c), leisure (l) with the wage (w), and home production $\left(D(n,h)\right)$ with the aggregated price $g(p_n, w)$ of the home production consumption goods price (p_n) and the home production time wage price (w). The amount of total resource (M) , also known as full-income, used for the households is the sum of four parts: market consumption expenditure, home production consumption expenditure, wage-valued leisure time and wage-valued home production time input. We use the parameters $\left(\alpha_c^i, \alpha_l^i, \alpha_d^i, \beta_c^i, \beta_l^i, \beta_d^i, \gamma_{cc}^i, \gamma_{cl}^i, \gamma_{cd}^i, \gamma_{lc}^i, \gamma_{ll}^i, \gamma_{ld}^i, \gamma_{dc}^i, \gamma_{dl}^i, \gamma_{dd}^i; i = f, m\right)$ to capture the different preferences of single individuals (see Equqation 4).

$$p_c c^i = \left(\alpha_c^i + \beta_c^i \ln\frac{M^i}{a^i(p_c, p_n, w^i)} + \gamma_{cc}^i \ln p_c + \gamma_{cl}^i \ln w^i + \gamma_{cd}^i \ln g^i(p_n, w^i)\right) M^i,$$

$$l^i = \left(\alpha_l^i + \beta_l^i \ln\frac{M^i}{a^i(p_c, p_n, w^i)} + \gamma_{lc}^i \ln p_c + \gamma_{ll}^i \ln w^i + \gamma_{ld}^i \ln g^i(p_n, w^i)\right)\frac{M^i}{w^i},$$

$$g^i(p_n, w^i) D^i(n^i, h^i) = \left(\alpha_d^i + \beta_d^i \ln\frac{M^i}{a^i(p_c, p_n, w^i)} + \gamma_{dc}^i \ln p_c + \gamma_{dl}^i \ln w^i + \gamma_{dd}^i \ln g^i(p_n, w^i)\right) M^i,$$

(4)

where $a^i(p_c, p_n, w^i)$ is as shown in Equation 5.

$$a^i(p_c, p_n, w^i) = \alpha_0 + \alpha_c^i \ln p_c + \alpha_l^i \ln w^i + \alpha_d^i \ln g^i(p_n, w^i) + \frac{1}{2}\gamma_{cc}^i \ln p_c \ln p_c + \frac{1}{2}\gamma_{cl}^i \ln p_c \ln w^i + \frac{1}{2}\gamma_{cd}^i \ln p_c \ln g^i(p_n, w^i) + \frac{1}{2}\gamma_{lc}^i \ln w^i \ln p_c + \frac{1}{2}\gamma_{ll}^i \ln w^i \ln w^i + \frac{1}{2}\gamma_{ld}^i \ln w^i \ln g^i(p_n, w^i) + \frac{1}{2}\gamma_{dc}^i \ln g^i(p_n, w^i) \ln p_c + \frac{1}{2}\gamma_{dl}^i \ln g^i(p_n, w^i) \ln w^i + \frac{1}{2}\gamma_{dd}^i \ln g^i(p_n, w^i) \ln g^i(p_n, w^i). \quad (5)$$

Parameter restrictions for almost ideal demand system are as follows: the summation conditions are $\sum_j \alpha_j^i = 1$, $\sum_j \beta_j^i = 0$, and $\sum_j \gamma_{jk}^i = 0$; the homogeneity condition is $\sum_k \gamma_{jk}^i = 0$; and the symmetry condition is $\gamma_{jk}^i = \gamma_{kj}^i$; $(j = c, l, d; k = c, l, d)$.

Regarding the market consumption price and home production consumption price, let single households consume a set of home production goods (n) and market consumption goods (c). Following Kano, Kano, and Takechi (2013), the home production consumption price (p_n) is defined as the weighted average of the commodity prices (p_j), and it is as $p_n = \sum_{j=1}^{n} \varpi_j p_j$, where $\varpi_j = e_j / (\sum_{j=1}^{n} e_j)$. Those weights ($\varpi_j$) come from consumption data and the expenditure share of jth small category in home production. (e_j) is the expenditure of the jth consumption. The market consumption price is (p_c), where the set of market consumption goods (c) and the commodity price is (p_k) and expenditure is (e_k) for kth small category. The aggregated price of market consumption is $p_c = \sum_{k=1}^{c} \varpi_k p_k$, where $\varpi_k = e_k / (\sum_{k=1}^{c} e_k)$. Therefore, weighted average price levels are different among households because the households choose different weights even though they have identical price levels. The list of small categories of home production and market consumption are displayed in the Appendix.

Assuming the individual's choice is recovered by utility maximization and cost minimization on home production, the demand functions on market consumption, leisure, home production time input, and home production consumption input, which are obtained by solving the utility maximization and cost minimization problems, are as in Equation 3.

3.3. Home Production

Home production is a Cobb-Douglas home production function with the time input (h) and the consumption goods for home production (n). The parameter δ^i capture the gender difference in home production technology (see Equation 6).

$$D^i(n^i, h^i) = (n^i)^{(1-\delta^i)} (h^i)^{\delta^i}. \quad (6)$$

[4] See (Cherchye et al., 2015; Şahinli & Fidan, 2012; Unayama, 2008).

[5] Since market consumption expenditures $p_c c$ and leisure time l can be observed directly from the data, the function emanates from Equation 3 which can be transformed from the equation proposed by Deaton and Muellbauer (1980).

Single individuals are assumed to minimize costs by choosing the optimal time (h) and home production consumption goods (n) inputs. Therefore, an individual's cost function takes the following form: $g^i(p_n^i, w^i)D(n^i, h^i)$. Here, $g(p_n, w)$ is the aggregated price of the home production, where:

$$g^i(p_n, w^i) = \left(\left(\frac{\delta^i}{1-\delta^i}\right)^{-\delta^i} + \left(\frac{\delta^i}{1-\delta^i}\right)^{1-\delta^i}\right) p_n^{1-\delta^i}(w^i)^{\delta^i}. \quad (7)$$

3.4. Estimation Strategy

The purpose of this study is to compare the differences in the choices of single women and men regarding labor supply, market consumption, leisure, and home production, assuming that individuals try to maximize utility and minimize home production costs. This study uses a two-procedure estimation, which estimates the Hicksian demand function to obtain the genders' home production technology δ^i first, and, given the aggregated home production price based on the technology parameter, we estimate the Almost Ideal Demand System for preference parameters on determining labor supply, market consumption, leisure, and home production. The two-procedure estimation method is appropriate because the individuals separately maximize their utility functions under the resource constraint and minimize the cost function when they produce the home production.

In the first procedure, we estimate the genders' different home production technologies by estimating the Hicksian demand function as shown in Equation 8 with the ordinary least squares model. The Hicksian demand function is derived by the home production cost minimization problem that regresses the home production time input on wage standardized home production expenditure.

$$h_s^i = \delta^i x_s^i + \varepsilon_s^i, \quad (8)$$

where h_s^i denotes the home production time input by household s for single women $(i = f)$ and single men $(i = m)$. The dependent variable is a representative workday home production time input (e.g. time used in preparing meals). x_s^i is the summation of the monetary expenditure and wage-valued time spent on home production standardized by wage, that is $x_s^i = \frac{g^i(p_{ns}, w_s^i)D^i(n_s^i, h_s^i)}{w_s^i}$, which can be observed directly from the datasets. ε is the error term. δ^i is a parameter for single women $(i = f)$ and single men $(i = m)$ capturing the genders' different home production technologies. The estimated parameter δ^i is utilized to obtain the aggregated home production price in the second procedure[6], which is $\ln g^i(p_s, w_s^i) = \ln p_{ns}^{1-\delta^i} + \ln(w_s^i)^{\delta^i}$.

In the second procedure, we estimate the genders' different preferences for labor supply, leisure, consumption, and home production based on an Almost Ideal Demand System, as shown in Equation 9.

$$l_s^i = \left(\alpha_l^i + \beta_l^i \ln \frac{M_s^i}{a^i(p_{cs}, p_{ns}, w_s^i)} + \gamma_{lc}^i \ln p_{cs} + \gamma_{ll}^i \ln w_s^i + \gamma_{ld}^i \ln g^i(p_{ns}, w_s^i)\right)\frac{M_s^i}{w_s^i} + \varepsilon_s^i ,$$

$$p_{cs}c_s^i = \left(\alpha_c^i + \beta_c^i \ln \frac{M_s^i}{a_s^i(p_{cs}, p_{ns}, w_s^i)} + \gamma_{cc}^i \ln p_{cs} + \gamma_{cl}^i \ln w_s^i + \gamma_{cd}^i \ln g^i(p_{ns}, w_s^i)\right) M_s^i + \varepsilon_s^i. \quad (9)$$

where the dependent variables l_s^i denotes the leisure of household s for women $(i = f)$ or men $(i = m)$. The market consumption expenditure is $p_{cs}c_s^i$ for household s, which can be directly observed from data[7]. The total resource (M_s^i), also known as full income, is the sum of market consumption expenditures, home production expenditures, the wage-valued leisure time, and home production time inputs and the full income is used in the previous studies such as Cherchye et al. (2015) [8]. The independent variable log wage, log market consumption price and log home production consumption price denote $\ln w_s^i$, $\ln p_{cs}$ and $\ln p_{ns}$ for household s. The aggregated log home production price is $\ln g^i(p_{ns}, w_s^i)$. The aggregated price index $a^i(p_c, p_n, w^i)$ is the same as in Equation 5. $\left(\alpha_c^i, \alpha_l^i, \alpha_d^i, \beta_c^i, \beta_l^i, \beta_d^i, \gamma_{cc}^i, \gamma_{cl}^i, \gamma_{cd}^i, \gamma_{lc}^i, \gamma_{ll}^i, \gamma_{ld}^i, \gamma_{dc}^i, \gamma_{dl}^i, \gamma_{dd}^i; i = f, m\right)$ are estimated parameters. For parameter estimation, we adopt the generalized moment method (GMM)[9], with the instrumental variables for single male households being age, occupation, monthly income, ln(wage), wage, and house, with three major metropolitan areas used for both equations $(p_c c)$ and (l). The instrumental variables for single female households are occupation, monthly income, age squared,

[6] The Almost Ideal Demand function requires the log function of the aggregated home production price, we used the following function $\ln g^i(p_n, w^i) = \ln p_n^{1-\delta^i} + \ln(w^i)^{\delta^i}$ in the second procedure. Note that the omitted constant term $\ln\left(\left(\frac{\delta^i}{1-\delta^i}\right)^{-\delta^i} + \left(\frac{\delta^i}{1-\delta^i}\right)^{1-\delta^i}\right)$ does not create parameter bias in the Almost Ideal Demand function in the second procedure.

[7] Following the model, independent variables of the model become market consumption price p_c, home production consumption price p_n and wage w, and non-labor income N, as well as aggregated home production price $g(p_n, w)$, wage w, the price index $a(p_c, p_n, w)$ shown in Equation 5, and total resource (M). The amount of total resource (M), which is full income, used for the households is the sum of four parts: market consumption expenditure, home production consumption expenditure, wage-valued leisure time, and wage-valued home production time input.

[8] If the individual consumes all of his or her resources, the total resource is equal to wage-evaluated daily total resource (M = 24×hourly wage); if the individual saves part of his or her resources, the total resource used in the estimation becomes (M = 24×hourly wage-saving).

[9] In this study, individuals maximize their utility under budget constraints, allocating their expenditures between market consumption, leisure, and home production. Therefore, in this second procedure, two demand functions, leisure and market consumption expenditure, can be simultaneously estimated (see Equation 9). The home production can be recovered based on the market consumption equation and leisure equation.

ln(wage), three major metropolitan areas, education, and room[10]. We also employed nonlinear seemingly unrelated regression as a robustness check, and we obtained robust results.

4. RESULTS

4.1. Home Production Technology and Almost Ideal Demand System

Table 1 shows summary statistics revealing single household choices of labor supply, leisure, home production time as well as market and home production consumption. There is a gap in labor supply time, such that single women contribute 88% of the labor supply contributed by men. Single women also spend more time (275%) and consumption (149%) on home production than single men. Regarding hourly wages, single women earn 76% of the wages earned by men. Importantly, we found a regional gender gap between women and men. In major metropolitan areas, single women on average receive 64% of wages compared to working single male households, whereas among non-major metropolitan areas, the share is 87%. This indicates that the wage gap is severe in major metropolitan areas.

Table-1. Descriptive statistics for single households.

Panel A	**Women**		**Men**		
Variable	**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Ratio**
Home production time (minutes/day)	75.72	78.36	27.53	48.74	2.75
Market labor supply (minutes/day)	514.55	173.01	587.36	184.59	0.88
Leisure (minutes/day)	849.74	154.67	825.11	171.04	1.03
Hourly wage (JPY/hour)					
Total	1,583	763	2,095	808	0.76
Major metropolitan areas	1,503	356	2,334	700	0.64
Non-major metropolitan areas	1,643	973	1,899	856	0.87
Observation	1,564		2,668		
Panel B	Women		Men		
Variable	Mean	Std. dev.	Mean	Std. dev.	Ratio
Market consumption (JPY/day)	5,874.34	4,745.17	6,256.90	3,523.94	0.94
Home production consumption (JPY/day)	493.82	295.40	354.40	278.18	1.39
Observation	561		814		

Note: Data are from the 2004 NSFIE, the 2006 BSSL, and the 2004 RPS. The 2006 BSSL includes only annual income information and weekly working hours, so wages are calculated by dividing annual income (from the 2004 NSFIE) by 51.48 weeks to obtain weekly income, which is subsequently divided by weekly working hours to obtain the hourly wage.

Table 2 shows the estimated results of the genders' home production technology and preference for labor supply, leisure, home production, and market consumption. The home production technology (δ) is identified based on the Hicksian demand function Equation 9 of the OLS model using single male and female households, which are displayed in Panel A. Gender preferences for labor supply, leisure, consumption, and home production are identified by estimating an Almost Ideal Demand System Equation 9 of the GMM model using single male and female households, which are displayed in Panel B. The results obtained from single female households are summarized in column (1), whereas column (2) presents estimation results from single male households.

The results are as follows. Compared to men, women tend to adopt time-extensive home production technology. The home production technology parameters for women and men are 0.826 and 0.709, respectively, and statistically significant at 1%. The larger value of the home production parameters suggests that when individuals produce one unit of home production goods or services at home, women tend to spend more time than men. This may be because women pay more attention to housework. For example, women are more likely to purchase whole cabbage than thinly sliced packaged cabbage. The results might explain part of the phenomenon that women spend more time on home production than men.

Regarding gender preference for labor supply, leisure, consumption, and home production, the parameters for single women and single men have the same sign, except in the case of β_c. This suggests that the choice of labor supply, leisure, consumption and home production are similar between men and women. For parameter β_c, estimation based on the women's group is a positive value 0.02, whereas for the single men's group, the magnitude of the parameter β_c is close to zero (-0.006). This indicates that when wages increase, the women's choice of market consumption over total resources increases, whereas single men's share of market consumption to the total resource is persistent. The magnitudes of the leisure β_l parameter are -0.103 for women, whereas it is -0.070 from the estimation based on the men's group.

[10] The instrument variable education for endogenous variable from market consumption equation and instrument variable room for endogenous variable from leisure equation.

Table-2. Gender's Home production technology and preference on labor supply, leisure, consumption and home production

Panel A	**Women (1)**		**Men (2)**	
Home production technology				
δ	0.826***	(0.019)	0.709***	(0.019)
R-squared	0.987		0.979	
Panel B	Women (1)		Men (2)	
Preference				
β_l	-0.103	(0.188)	-0.070	(0.242)
β_c	0.020	(0.066)	-0.006	(0.105)
α_c	-1.205**	(0.483)	-0.884	(0.593)
α_l	2.903*	(1.667)	2.420*	(1.422)
γ_{cc}	0.141***	(0.021)	0.127***	(0.015)
γ_{cl}	-0.162***	(0.044)	-0.150***	(0.028)
γ_{ll}	0.120	(0.133)	0.143	(0.142)

Note: Standard errors are in parentheses for the first procedure. Robust standard errors are in parentheses for the second procedure. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. $a(p_c, p_n, w)$ has a constant parameter α_0 that cannot be estimated; thus, we followed Poi (2008) and chose 5. $a(p_c, p_n, w)$ ranges from 1.033 to 3.979 for female households and from 4.034 to 6.072 for male households.

This suggests that the single women's reduction in leisure spending by increasing wages is greater than that of single male households. The over-identification test statistics for single women, Hansen's J chi^2(7), is 4.69328 (p = 0.6973); for single men, Hansen's J chi^2(9) is 5.68167 (p = 0.7713). Neither of the over-identification tests is rejected, which shows that the instruments are statistically exogenous. A detailed choice comparison and preference comparison between single male and female households on time use and consumption will be described in the next section.

4.2. Gender Preference and Choice Comparisons in Japan

Table 3 displays the gender (1) preference comparison and (2) choice comparison using simulation methodology based on estimation results from Table 2 and data. The (1) preference comparison compares the genders' different preferences in determining labor supply, leisure, market consumption, home production time input, and consumption input given the same wage, total resource, consumption prices, and home production technology. The (2) choice comparison compares the gender's choices on the consumption and time use when applying the same conditions of wage, price, and resources to women as men. The results of the gender preference comparisons are showed on the Panel A, whereas the results of the choice comparison are presented in Panel B. Column 3 displays the gender preference differences (panel A) and choice differences (panel B).

On one hand, more precisely, in Table 2, we derived the parameters of men's home production technology $\delta^m = 0.709$ and women's preference parameters $\alpha_c^w = -0.015; \alpha_l^w = 1.352; \beta_c^w = -0.039; \beta_l^w = -0.141; \gamma_{cc}^w = 0.016; \gamma_{cl}^w = -0.034; \gamma_{ll}^w = 0.014$. Given the above parameters as applied to single men's household conditions (wage, aggregated market consumption price, aggregated home production consumption price, and total resource[11]) and Equation 9 and Equation 7, single women's determination of labor supply, leisure, market consumption, home production consumption, and time input can be predicted. The difference between women's and men's determination of time use and consumption captures the genders' preferences.

The results are summarized as follows. First, for preference comparison, the simulation result of women's labor supply is 578 minutes each day, whereas the men's is 575 minutes, and statistically insignificant. This suggests that given the same wage condition, the women's willingness toward labor supply is not significantly different from the men's choice. A similar choice is seen as market consumption: single women spend 6,377 Japanese yen each day, which is statistically insignificant to men's market consumption. On the contrary, regarding preferences for home production, it is different between men and women. For women's home production consumption and time use when producing goods or services, women spend 37 minutes and 527 JPY each day, whereas the men choose 28 minutes and 362 JPY, and both are statistically significant. This indicates that regarding preference comparison, single women tend to spend more time and expenditure on home production than single men households, though the magnitudes of the differences are mild. Regarding leisure time, women, on average, take 825 minutes each day, which

[11] The amount of total resource (M) used for the households is the sum of four parts: market consumption expenditure, home production consumption expenditure, wage-valued leisure time, and wage-valued home production time input.

is slightly shorter than single male households' leisure time but statistically significant at 10%. Overall, the gender preferences on labor supply, leisure, market consumption, and home production are similar, which suggests that when women applied the same conditions as men, their choices were quite close. Regarding home production, we found that single women slightly prefer home production goods or services compared to single men.

(2) The gender's choice comparison utilized the parameters from the women's group $\delta^m = 0.709$ and women's preferences $\alpha_c^w = -0.015; \alpha_l^w = 1.352; \beta_c^w = -0.039; \beta_l^w = -0.141; \gamma_{cc}^w = 0.016; \gamma_{cl}^w = -0.034; \gamma_{ll}^w = 0.014$. Given the parameters applied to single male households' conditions and Equation 9 and Equation 7, the predicted labor supply, leisure, market consumption, home production consumption input, and time input are derived.

The results are as follows. When women applied the same conditions as men, the women's choices on labor supply, leisure, market consumption, and home production time use and consumption were similar. For consumption, the women's expenditure on market and home production are 6,267 and 323 Japanese yen each day, which are statistically insignificant with single men households. Regarding time use, the differences between women and men are slightly different; the women's labor supply, leisure, and home production time input are 568 minutes, 827 minutes, and 45 minutes, respectively, each day, whereas the differences between women and men are around -7, -10, and 17 minutes, respectively. Regardless of major metropolitan areas or non-major metropolitan areas, women's working time has increased, and they are willing to work as much as single male households.

The results suggest that single women tend to spend slightly more time on housework and less on labor supply and leisure. It provides insightful evidence that the results show gender similarities in consumption and time use when the conditions are identical. The policy implied for reducing the wage gap might be a tool to promote single women households' labor supply.

Table-3. Gender preference and choice comparison on labor supply, leisure, consumption, and home production.

Panel A: Preference comparison	**Women (1)**		**Men (2)**		**Women-Men (3)**	
	Mean	**Std. dev.**	**Mean**	**Std. dev.**	**Difference**	**t-value**
Market labor supply (minutes)	578	56	575	61	3	0.58
Leisure (minutes)	825	57	837	58	-12	1.65
Market consumption (JPY)	6,377	3,090	6,451	3,045	-74	0.61
Home production time (minutes)	37	11	28	15	9	2.74
Home production consumption (JPY)	527	278	362	174	165	2.69
Panel B: Choice comparison	Women (1)		Men (2)		Women-Men (3)	
	Mean	Std. dev.	Mean	Std. dev.	Difference	t-value
Market labor supply (minutes)	568	57	575	61	-7.41	1.74
Leisure (minutes)	827	57	837	58	-9.50	1.31
Market consumption (JPY)	6,267	3,147	6,451	3,045	-183.39	1.56
Home production time (minutes)	45	13	28	15	16.90	4.61
Home production consumption (JPY)	323	162	362	174	-39.25	0.88
Market labor supply (minutes)						
Major metropolitan areas	562	60	569	68	-7	1.04
Non-major metropolitan areas	572	56	580	57	-8	1.37

Note: Data are from the 2004 NSFIE, the 2006 BSSL, and the 2004 RPS.

5. CONCLUSION

This study investigated regional single men's and women's different choices regarding time use (labor supply, home production time input, and leisure) and consumption choice (market consumption goods, home production goods) to provide evidence for the national policy of Japanese encouragement of women's labor supply. For the empirical application, we sampled single employed households that do not care for elderly people or children. The consumption data are from the 2004 NSFIE study, the time use data are from the 2006 BSSL study, and the price information is from RPS, with exact matching at the group level based on gender, age, occupation, and three major metropolitan areas.

Given utility maximization and cost minimization, we use the Cobb-Douglas function for home production and the almost ideal demand system model for preferences. The two-procedure estimation is as follows: first estimate the Hicksian function to obtain the home production price parameters δ, then, given the home production price, estimate the almost ideal demand system. The single households are estimated separately based on gender.

The simulation results based on the estimated parameters show that if single women (single men) are given the same market consumption goods price, home production goods price, wage, and total resources as single men (single women), single women (single men) will make their optimal choice regarding market labor supply, leisure, home production time, market consumption expenditure, and home production consumption expenditure. When women applied the same conditions as men's wages, the women's preferences and choices on the labor supply, leisure, market consumption, and home production time use and consumption were quite close. In particular, women tend to work as much as men when they receive the same wage. Although the major metropolitan areas and non-metropolitan areas have different gender gap situations, our results show the genders' similarity in working time when the conditions are identical. The simulation results show that women choose less leisure, and as much of the labor supply as men when they earn the same wage as men; however, men have less home production than women and consume more leisure when they earn lower wages (equal to women's wages).

There are policy implications that arise from this study. First, although the pattern of women doing more housework and men doing more outside work is observable even among single women and men, the gap between genders working outside the home almost disappears among singles if women are provided the same wage as men. (This is similar to the results observed with married couples.) The gender gap in labor supply is caused not only by partnership problems, bargaining power differences, care work for family members, or tax exemption on dependents. This indicates that economic incentive (wage) is important in explaining the labor supply gap between single men and women. The Japanese government appeals to women to increase their labor supply to make up for the diminishing amount of labor contributed by the aging population. From the results of this study, increasing women's wages is an effective way to encourage single women to work as much as single men. Of course, the question remains as to why there is a gender pay gap between single men and women. We do not discuss it because it is beyond the scope of our analysis, though we point out that one of the possibilities is that women tend to leave a job or take maternity leave for a long time after childbirth more than men, resulting in lower wages for even single women.

Second, the pattern of women doing more housework cannot be explained by the wage gap and use of home production technology, as shown in this study. The previous research finds that becoming a mother shifts the woman's attitude of gender to the view that husbands work outside of the home to earn money and wives do the housework leaves the man's attitude unaffected. Unlike married couples, single women in the same situation still spend more time doing housework, while their attitude of working outside the home is the same as a single man's attitude. The wife's household income share, the more the family will eat out instead of at home; this also reduces consumption of healthy foods like vegetables and seafood. This might show that men are unwilling to significantly increase the time they spend on housework to fill the gap caused by wives working. At the same time, women might have a strong sense of value that domestic work is women's work and feel stigmatized by outsourcing or husband's housework time. One way for policy makers to alter this phenomenon is to change attitudes toward doing housework. For example, it may be effective to change public advertisements or movies that imply a role for women in domestic work and for men the central part of the breadwinner.

There are some limitations in this study. One is the home production wage; to explain the gap between single men and women, home production technology is assumed as the Cobb-Douglas home production function, and the time input is evaluated by individual wage. Though wage evaluation of the home production time input is used in the previous research, the other type of evaluation of time input is from the market wage. For example, if we cook a meal at home, then we are shopping, cooking, and washing the dishes. The cost of meals are estimated from a chef's wage while cooking, a waitress's wage while washing the dishes, and the expenditures while shopping. This kind of evaluation is closer to the market cost. However, from the consumption expenditure data from the 2004 NSFIE study and time-use data from the 2006 BSSL study, the market wage evaluation of home production time input is impossible. Therefore, in future work, if we have more detailed information about what subjects cook at home and how much time they spent on cooking, we may use a market wage evaluation of the home production time input.

Another limitation is the small size of the sample group. The cross-sectional data of the 2004 NSFIE study includes consumption information and the 2006 BSSL study collects time-use information. Since none of them includes both simultaneously, we choose to combine them using a method that compares exact matches in group level. For example, the single women in the 2004 NSFIE study who are aged 30-34, managerial workers, and live in three major metropolitan areas match the group having the same characteristics in the 2006 BSSL study. The consumption expenditure and time-use information is analyzed as a group average. This methodology has the limitation of a small group size: there are 28 groups for women and 31 groups for men. Though we tried other characteristics in group level to increase the number of the group, we did not find the appropriate instrument variables to deal with the endogeneity problem. In future work, we will consider changing to other data sets, such as the repeated cross-sectional data, family income and expenditure survey; this is conducted monthly, and the study contains six months of data for each household. This data set includes both the consumption expenditure and time use.

A third limitation is the sample selection bias. The sample includes single employed women and men who do not care for elderly people or young children on the survey date, and are between the ages of 25 and 59. This may create a sample selection bias, mainly from excluding single people who live with parents, as well as excluding women and men who were taking care of elderly parents or young children. We cannot deny the possibility that we are analyzing with exceptional cases due to the selection bias.

However, the gender gap is more severe in reality, and our results are likely to be an underestimate. It is often observed that women tend to be in charge of caregivers, and they leave a job or reduce working time in the process. It might be associated with human capital depreciation. In future work, we need to address this problem using an advanced method.

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