Gender's different choices on labor supply, leisure, consumption and home production

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Abstract

This paper investigates single men's and single women's different optimal choice over time use (labor supply, home production time input and leisure) and consumption choice (market consumption goods, home production goods). I use the structural model of Almost Ideal Demand system with Cobb-Douglas home production function. AIDS is the second-approximation of the arbitrary of the utility function. The simulation results indicate that, if women are provided the same hourly wage as men, they, in turn, receive almost the same income (98.7%) and the market labor supply gap is almost disappeared. While the gender gap in home production does not disappear, women practice more home production than men regardless of their wage.

Key words single households, labor supply, consumption, home production, almost ideal demand system

JEL Classification D13; J12; J16

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I. Introduction

If there were no marriage restriction, if wage levels for females and males were the same, and if women and men had the same family structure (i.e., if there were no need to take care of children or older relatives and if there were no other family members in their households), would women and men provide the same labor supply? How much time or money would they spend on leisure, home production, and market consumption? This study tries to answer these questions.

The egalitarian between women and men is significant. A number of studies focus on this gender gap and the reasons behind it. As for the market labor, in which women earn lower wages than men, is common throughout the world. Several empirical studies, such as that conducted by Arrazola and de Hevia (2016), have identified discrimination against women and 'the reservation wage' as causes of the gender wage gap, possibly due to women's tendency to care for family members and still others have argued that women tend to work fewer hours than men **(**Kato *et al.* (2013); Landivar (2015). As for non-market labor, Alvarez and Miles (2003) showed the asymmetric couple's housework division and found that the gender specific effect causes wife does more housework. Bertrand *et al.* (2013) argued the gender gap in non-market labor tends to be larger if the distribution of the wives' income shares is high. See Blau and Kahn (2016) for a survey.

This paper focuses on single men and women. This sampling choice facilitates a comparison of the willingness levels of single and married men and women. If single men and women have the same tendencies as married couples, then the egalitarian between women and men may be less serious. However, if they exhibit opposing trends, then the inequality between women and men may be more serious than expected.

This study contributes to the extant literature in two primary ways. First, it divides individuals' behaviors into three parts: utilities of market consumption, leisure and home production; wages; and home production technologies. The study uses the Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980) to represent individuals' utility. The merit of the AIDS is that it is the second approximation of the arbitrary utility function. The Cobb-Douglas function represents home production technologies.

Second, the study attempts to differentiate the effects of utilities, wages, and home production technologies by exploring market labor supply, market consumption, leisure, and home production using the developed simulation. This simulation compares (1) the preferences for leisure, market consumption, and home production of women and men with high and low wages and (2) the home production technologies of women and men.

Without the restriction from the marriage and caring for family member, single men and women have the same tends with couple households that single women do less market labor supply and produce more home production goods[2]. The simulation results indicate that the gender's income gap almost explained by the labor supply time gap if women receive the same wage as men (98.7%). Women practice more home production than men regardless of their wage. Women's home production technology reduces only 1.7% labor supply compared to men's.

Section II presents the individual decision-making model. Section III explores the model's empirical application, discusses a two-procedure estimation for obtaining preferences and home production technology parameters, and presents a simulation. Section IV presents a robustness check. Section V concludes.

II. Model

This section presents a model for individuals' decision-making regarding market consumption (c), leisure time (l), and home production $(D(n,h))$. Because this paper seeks to compare women's and men's decision-making, I focus on single women's and single men's households $(i = m, f)$. Individuals obtain utility from market consumption 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 goods (n). The home production function $D(n,h)$ is twice differentiable, strictly increasing, and strictly concave in its arguments.

Individuals are assumed to have two constraints. First, there is a 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 (y) and their working income, which is calculated as working time (z) multiplied by wage (w).

I 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 budget constraints while minimizing their cost over the home production technology. An individual's optimal decision can be illustrated as the solutions of the following optimization problem,

[2] Single women earn 76% of men's hourly wages and represent 88% of the male market labor supply, according to 2006 time use data collected by the Basic Survey of Social Life (BSSL).

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

The corresponding cost minimization problem for home production can be written as:

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

Solving the maximization problem for utility and the minimization problem for home production, the optimal decisions can be obtained as follows:

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

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 (y), the model will reveal the different choices of single men and women.

III. Empirical Application

A. Data

For the empirical application, I use consumption data from the 2004 wave of the National Survey of Family Income and Expenditure (NSFIE), time use data from the 2006 wave of the Basic Survey of Social Life (BSSL), and price information from the Retail Price Survey (RPS). 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. Averages of the data from October and November are used to determine the 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 14th October to 22nd October. Finally, the RPS is conducted every month and includes detailed information on commodity price levels and service price levels.

The samples include single women and men who have jobs, do not take care of old or young children, and are between the ages of 25 and 59. I exclude observations that are missing values for necessary

variables from the analysis. For the BSSL, I exclude observations for which the studied individual had a job, but was on holiday on the survey date. Since the consumption information and time use information come from different data sets, I use exact matches using gender, age, occupation, and region.

Table 1 shows the summary statistics for the matched data. The summary statistics before matching are shown in the appendix. Home production consumption includes cereals, meat, seafood, dairy items, vegetables, oils, fats, condiments, domestic durable goods, general furniture, domestic utensils, and domestic nondurable goods[3]. Market consumption expenditure includes all expenditures other than those included in home production consumption. The total resource is defined as the sum of home production, market consumption expenditure, leisure and home production time. The leisure and home production evaluated at wage. Market consumption price and home production consumption price are the weighted averages of their respective commodity prices. The weight stems from consumption data, and the commodity prices are from RPS. The aggregated prices differ by household. The market labor supply includes working time and commute time. Home production time includes housework time and shopping time. Leisure time is total time (1440 minutes) minus market labor supply time and home production time.

Statistics (Table 1) show that there is a gender gap in hourly wages, such that single women earn 76% of the wages earned by men. Similarly, 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 (282%) and consumption (129%) on home production than single men.

Table 1. Basic statistics for single households with matched data

	Single women		Single men		
Variable	Mean	Std.Dev.	Mean	Std.Dev.	Ratio
Market consumption (yen/day)	5501.22	3558.47	6450.80	3044.51	0.85
Home production consumption (yen/day)	465.75	172.39	362.35	173.95	1.29
Home production time (minutes/day)	78.91	39.01	27.95	14.97	2.82
Market labor supply (minutes/day)	508.60	85.86	575.20	61.28	0.88
Leisure (minutes/day)	852.49	74.25	836.86	58.35	1.02
Total resource (yen/day)	30273.93	14427.15	36966.88	13897.60	0.82
Hourly wage	1583.07	763.23	2095.30	807.59	0.76
Age	43.43	10.70	43.61	9.78	
Cell	28		31		

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 the weekly income, which is then

[3] These categories are from the 2004 NSFIE.

divided by weekly working hours to obtain the hourly wage.

B. Almost ideal demand system (AIDS) for women and men

The AIDS model proposed by Deaton and Muellbauer (1980) is a second-order approximation of the arbitrary utility function. The AIDS function is very general, and, thus, is widely used[4]. Individuals' ($i = f, m$) demand system equations are specified in Eq. (3), which can be transformed into 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 ($D(n,h)$) with the aggregated price $g\left(p_n, w\right)$ of the home production consumption goods price (p_n) and the home production time wage price (w). The total resource m for a given a time period, such as one day, is the sum of the consumption expenditure and the time consumed. I 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 women and men.

$$
\begin{aligned}
p_c c^i &= \left(\alpha_c^i + \beta_c^i \ln \frac{m^i}{a^i\left(p_c, p_n, w^i\right)} + \gamma_{cc}^i \ln p_c + \gamma_{cl}^i \ln w^i + \gamma_{cd}^i \ln g^i\left(p_n, w^i\right)\right) m^i \\
l^i &= \left(\alpha_l^i + \beta_l^i \ln \frac{m^i}{a^i\left(p_c, p_n, w^i\right)} + \gamma_{lc}^i \ln p_c + \gamma_{ll}^i \ln w^i + \gamma_{ld}^i \ln g^i\left(p_n, w^i\right)\right) \frac{m^i}{w^i} \\
g^i\left(p_n, w^i\right) D^i\left(n^i, h^i\right) &= \left(\alpha_d^i + \beta_d^i \ln \frac{m^i}{a^i\left(p_c, p_n, w^i\right)} + \gamma_{dc}^i \ln p_c + \gamma_{dl}^i \ln w^i + \gamma_{dd}^i \ln g^i\left(p_n, w^i\right)\right) m^i
\end{aligned}
\tag{4}
$$

where $a^i\left(p_c, p_n, w^i\right)$ is as shown in Eq. (4).

[4] Unayama (2008); Cherchye *et al.* (2012); Sahinli and Fidan (2012).

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

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

Parameter restrictions for AIDS 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 $\gamma_{jk}^i=\gamma_{kj}^i$. $\left(j=c,l,d; k=c,l,d\right)$.

C. Home production

The level of home production is a function of the time input (h) consumption goods for home production (n). I assume for both single individuals $\left(i=f,m\right)$ have the Cobb-Douglas home production function as is written in Eq. (6). δ^i captures the difference in home production technologies between single men and women.

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

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

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

D. Parameter estimation

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 the cost for home production. I attempted a two-procedure

estimation, which estimates the Hicksian demand function to obtain the home production price parameters δ^i first and given the aggregated home production price, estimate the AIDS demand system.

In the first procedure, I estimate the Hicksian demand function as shown in Eq. (7). The parameter δ^i is unknown, but we can observe the cost of home production from the data. From the cost function $g^i\left(p_n^i, w^j\right)D\left(n^i, h^i\right)$, the Hicksian demand function can be obtained using Shephard's Lemma. Since the home production function is assumed to be a Cobb-Douglas function, the Hicksian function of the home production time input (h) becomes as follows:

$$h^i = \delta^i x^i + \varepsilon_h^i \qquad (8)$$

where $\left(i = f, m\right)$; $x^i = \dfrac{g^i\left(p_n, w^j\right)D^i\left(n^i, h^i\right)}{w^j}$; and the error term is ε_h^i. The AIDS demand function requires the log function of the aggregated home production price, and I used the following function $\ln g^i\left(p_n, w^i\right) = \ln p_n^{1-\delta^i} + \ln\left(w^i\right)^{\delta^i}$ in the second procedure. Note that the omitted constant term $\ln\left(\left(\dfrac{\delta^i}{1-\delta^i}\right)^{-\delta^i} + \left(\dfrac{\delta^i}{1-\delta^i}\right)^{1-\delta^i}\right)$ does not create any bias in parameters in AIDS demand function.

In the second procedure, given the home production price, I estimate the AIDS demand system as shown in Eq. (8). The price index $a^i\left(p_c, p_n, w^j\right)$ is the same as Eq. (4), and the parameter restrictions are the same as those previously discussed. The third equation, $g^i\left(p_n, w^j\right)D^i\left(n^i, h^i\right)$, is omitted due to the summation condition.

The market consumption price p_c and the home production consumption price p_n are the weighted average of the commodity prices, whose weights come from the consumption data. Therefore, the price levels are different among households[6]. m is the total resource for the households, that is, the sum of the expenditures on consumption, the wage-valued leisure time and home production time inputs. The market consumption price p_c, the home production consumption price p_n, and the total resource m are endogenous variables, which will cause biases in the estimation. To address this endogenous problem, I adopt the Generalized Method of Moments (GMM). The instrument variables for single male households are age, occupation, monthly income, ln(wage), wage, house, and three

[6] Kano *et al.* (2013) used the same aggregated method for each area.

major metropolitan areas for both equation $p_c c$ and equation l. The instrument variables for single female households are occupation, monthly income, square age, ln(wage), three major metropolitan areas, and (education for market consumption and house room for leisure) for equations $p_c c$ and l.

$$p_c c^i = \left(\alpha_c^i + \beta_c^i \ln \frac{m^i}{a^i\left(p_c, p_n, w^i\right)} + \gamma_{cc}^i \ln p_c + \gamma_{cl}^i \ln w^i + \gamma_{cd}^i \ln g^i\left(p_n, w^i\right) \right) m^i + \varepsilon_c^i$$
$$l^i = \left(\alpha_l^i + \beta_l^i \ln \frac{m^i}{a^i\left(p_c, p_n, w^i\right)} + \gamma_{lc}^i \ln p_c + \gamma_{ll}^i \ln w^i + \gamma_{ld}^i \ln g^i\left(p_n, w^i\right) \right) \frac{m^i}{w^i} + \varepsilon_l^i \quad (9)$$

The main results for the two procedures are displayed in Table 2. Single women and single men are estimated separately. The first-procedure estimation results come from estimating Eq. (8) using Ordinary Least Squares (OLS). δ is the parameter for home production. The home production time input has a higher contribution to single women households (0.826) than to single men households (0.709). The second-procedure estimation results come from estimating Eq. (9) using GMM. The parameters for single women and single men have the same sign, except in the case of β_c. 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 chi2(9) is 5.68167 (p = 0.7713). Neither of the over-identification tests is rejected.

Table 2. OLS estimates for the first procedure and GMM estimates for the second procedure

	Single Women		Single Men	
First procedure				
δ	0.826***	(0.019)	0.709***	(0.019)
R-squared	0.987		0.979	
Cell	28		31	
Second procedure				
α_c	-1.205**	(0.483)	-0.884	(0.593)
γ_{cc}	0.141***	(0.021)	0.127***	(0.015)
γ_{cl}	-0.162***	(0.044)	-0.150***	(0.028)
β_c	0.020	(0.066)	-0.006	(0.105)
α_l	2.903*	(1.667)	2.420*	(1.422)
γ_{ll}	0.120	(0.133)	0.143	(0.142)
β_l	-0.103	(0.188)	-0.070	(0.242)
Cell	28		31	

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. $a\left(p_c, p_n, w\right)$ has a constant

parameter α_0 that cannot be estimated; thus, I followed Poi (2008) and chose 5. $a(p_c, p_n, w)$ ranged from 1.033 to 3.979 for female households and from 4.034 to 6.072 for male households.

Table 3. Simulation results from estimated parameters from women and men data

	(1) Women home production technology and women preferences			(2) Men home production technology and women preferences		
Variable	Mean	Std.Dev.	Ratio	Mean	Std.Dev.	Ratio
Predicted Market labor supply (minutes/day)	567.790	56.903		577.771	56.318	
Market labor supply (minutes/day)	575.197	61.285	0.987	575.197	61.285	1.004
Predicted Leisure (minutes/day)	827.360	57.156		824.875	56.903	
Leisure (minutes/day)	836.856	58.352	0.989	836.856	58.352	0.986
Predicted Home production time (minutes/day)	44.850	13.488		37.354	11.444	
Home production time (minutes/day)	27.950	14.963	1.605	27.950	14.963	1.336
Predicted Market consumption (yen/day)	6267.405	3147.168		6376.643	3089.824	
Market consumption (yen/day)	6450.796	3044.514	0.972	6450.796	3044.514	0.989
Predicted Home production consumption (yen/day)	323.100	162.047		526.955	277.960	
Home production consumption (yen/day)	362.347	173.947	0.892	362.347	173.947	1.454
Predicted Home production price	109.040	27.659		120.658	24.083	
Cell	31			31		

Table 4. Simulation results from estimated parameters from men and women data

	(1) Men home production technology and men preferences			(2) Women home production technology and men preferences		
Variable	Mean	Std.Dev.	Ratio	Mean	Std.Dev.	Ratio
Predicted Market labor supply (minutes/day)	532.183	67.948		522.459	69.858	
Market labor supply (minutes/day)	508.598	85.858	1.046	508.598	85.858	1.027
Predicted Leisure (minutes/day)	875.568	63.455		879.743	64.262	
Leisure (minutes/day)	852.493	74.252	1.027	852.493	74.252	1.032
Predicted Home production time (minutes/day)	32.249	10.463		37.799	12.359	
Home production time (minutes/day)	78.909	39.010	0.409	78.909	39.010	0.479
Predicted Market consumption (yen/day)	6224.897	3690.464		6127.457	3694.295	
Market consumption (yen/day)	5501.216	3558.465	1.132	5501.216	3558.465	1.114
Predicted Home production consumption (yen/day)	336.916	183.468		202.936	110.044	
Home production consumption (yen/day)	465.753	172.388	0.723	465.753	172.388	0.436
Predicted Home production price	107.167	26.425		91.242	28.439	
Cell	28			28		

E. Simulation results

Women and men's preferences, wages, and home production technologies have complex effects on their choices. I attempt to differentiate these effects by exploring market labor supply, consumption, and leisure using the developed simulation.

Table 3 shows the simulation's results based on estimated structural parameters drawn from data on single men. Column 1 displays the results based on the estimated parameters (women's preference parameters and women's home production technology parameters) for single women as applied to men's explanatory variables (wage, aggregated market consumption price, aggregated home production consumption price, and total resource[7], as presented in Table 1). Using these data, the simulation predicts the market labor supply, leisure, home production time input, market consumption expenditure, and home production consumption expenditure. Column 2 shows the simulation's results for the estimated parameters (women's preferences and men's home production technology) for single women as applied to men's explanatory variables. The simulation results for the estimated parameters using data on single women are shown in Table 4. Column 1 of Table 4 shows men's preferences and home production technology parameters as applied to women's explanatory variables. Column 2 of Table 4 shows simulation results from women's data, men's preferences and women's home production technology parameters.

The preference parameters are AIDS model's parameters $\left(\alpha_c^i, \alpha_l^i, \beta_c^i, \beta_l^i, \gamma_{cc}^i, \gamma_{cl}^i, \gamma_{ll}^i ; i = f, m\right)$; the home production technology parameter is δ^i, and those parameters are displayed in Table 2.

Column 2 of Table 3 compares the preferences of women and men with the same wages with men (high wage level) and the same home production technologies. The simulation results suggest that women have the same as men for the labor supply. Furthermore, women prefer home production goods more than men (women spend 133.6% and 145.4% of men's spending on home production time and home production consumption, respectively). Comparing columns 1 and 2 of Table 3 reveals that women and men choose different optimal responses to home production

[7] "Total resource" is the sum of the consumption expenditure and the wage-valued leisure and home production.

technology. Women's cost minimization on home production choose significant time input than men choose, since it reduces the female labor supply by 1.7% and increases home production time input by seven minutes.

Comparing Tables 3 and 4, and regardless of the wage level (i.e., if women and men have the same wages), men produce lower levels of home production goods. If men's hourly wages are the same wage as women, they prefer leisure, market labor supply, and market consumption.

IV. Robustness check

Thus far, I have attempted to study how women's and men's preferences, home production technologies, and wages affect their choices concerning consumption, leisure, labor supply, and home production. The aggregated prices are calculated from detailed prices obtained from the RPS, and the weights are taken from the NSFIE. Prices are differ among households. Households consume numerous consumption goods and services, and the aggregated prices of market consumption and home production consumption depend on the price unit (e.g., meat is yen/100 g, and Internet services are measured in yen/month). Fortunately, food prices depend on price and volume and, thus, can be transformed into prices with the same volume (per 100 g or 100 ml). I use food to check whether the above estimation and simulation results are robust.

Home production consumption includes cereals, meat, seafood, dairy items, vegetables, oils, fats, condiments. Market consumption includes eating out, alcohol, drinks, sweets, and cooked food.

Table 5 displays the estimation results of Eqs. (8) and (9). Table 6 and Table 7 show the simulation results. The results are largely similar to the results in Table 3 and Table 4.

Table 4. Statistics for single households with matched data (food for consumption)

	Single women		Single men		
Variable	Mean	Std.Dev.	Mean	Std.Dev.	Ratio
Market consumption (yen/day)	608.65	346.97	1303.93	613.65	0.47
Home production consumption (yen/day)	380.17	142.89	316.86	155.05	1.20
Home production time (minutes/day)	78.91	39.01	27.95	14.97	2.82
Market labor supply (minutes/day)	508.60	85.86	575.20	61.28	0.88
Leisure (minutes/day)	852.49	74.25	836.86	58.35	1.02
Total resource (yen/day)	25295.78	11507.42	31774.53	12019.93	0.80
Hourly wage	1583.07	763.23	2095.30	807.59	0.76
Age	43.43	10.70	43.61	9.78	
Cell	28		31		

Table 5. OLS estimates for the first procedure and GMM estimates for the second procedure (food for consumption)

	Single Women		Single Men	
First procedure				
δ	0.852***	(0.017)	0.736***	(0.019)
R-squared	0.990		0.981	
Cell	28		31	
Second procedure				
α_c	-0.015	(0.021)	-0.253***	(0.032)
γ_{cc}	0.016***	(0.002)	0.042***	(0.004)
γ_{cl}	-0.034***	(0.005)	-0.072***	(0.016)
β_c	-0.039***	(0.006)	-0.003	(0.021)
α_l	1.352***	(0.154)	1.366***	(0.158)
γ_{ll}	0.014	(0.022)	0.196***	(0.075)
β_l	-0.141**	(0.069)	0.064	(0.086)
Cell	28		31	

Note: The instruments for single women households $p_c c$ and l include house, wage, occupation, monthly income, age, age cubed, age squared, ln(w), and the three major metropolitan areas. The Hansen's J chi2(13) = 14.0695 (p = 0.3690). The instruments for single men household's leisure l includes education, house room, age, monthly income, ln(wage), three major metropolitan areas. The instruments for single men household's consumption $p_c c$ includes house, education, occupation, monthly income, age, ln(wage) and three major metropolitan areas. The Hansen's J chi2(9) = 9.81544 (p = 0.3656).

Table 6. Simulation results from estimated parameters from women and men data
(food for consumption)

	(I) Women home production technology and women preferences			(II) Men home production technology and women preferences		
Variable	Mean	Std.Dev.	Ratio	Mean	Std.Dev.	Ratio
Predicted Market labor supply (minutes/day)	574.773	59.964		582.053	57.987	
Market labor supply (minutes/day)	575.197	61.285	0.999	575.197	61.285	1.012
Predicted Leisure (minutes/day)	812.899	46.770		812.592	46.458	
Leisure (minutes/day)	836.856	58.352	0.971	836.856	58.352	0.971
Predicted Home production time (minutes/day)	52.328	13.300		45.355	11.689	
Home production time (minutes/day)	27.950	14.963	1.872	27.950	14.963	1.623
Predicted Market consumption (yen/day)	1390.455	589.089		1386.963	571.064	
Market consumption (yen/day)	1303.930	613.650	1.066	1303.930	613.650	1.064
Predicted Home production consumption (yen/day)	309.624	127.011		552.650	222.823	
Home production consumption (yen/day)	316.865	155.050	0.977	316.865	155.050	1.744
Predicted Home production price	99.849	26.908		99.655	19.795	
Cell	31			31		

Table 7. Simulation results from estimated parameters from men and women data
(food for consumption)

	(I) Men home production technology and men preferences			(II) Women home production technology and men preferences		
Variable	Mean	Std.Dev.	Ratio	Mean	Std.Dev.	Ratio
Predicted Market labor supply (minutes/day)	521.660	81.902		514.943	82.656	
Market labor supply (minutes/day)	508.598	85.858	1.026	508.598	85.858	1.012
Predicted Leisure (minutes/day)	886.543	86.147		894.393	87.176	
Leisure (minutes/day)	852.493	74.252	1.040	852.493	74.252	1.049
Predicted Home production time (minutes/day)	31.797	20.714		30.664	19.619	
Home production time (minutes/day)	78.909	39.010	0.403	78.909	39.010	0.389
Predicted Market consumption (yen/day)	1014.696	529.849		987.375	567.179	
Market consumption (yen/day)	608.648	346.965	1.667	608.648	346.965	1.622
Predicted Home production consumption (yen/day)	241.599	116.776		143.131	61.959	
Home production consumption (yen/day)	380.172	142.891	0.635	380.172	142.891	0.376
Predicted Home production price	86.611	20.125		82.928	24.514	
Cell	28			28		

V. Conclusion

This paper investigates single men's and single women's different optimal choice over time use (labor supply, home production time input and leisure) and consumption choice (market consumption goods, home production goods). I have assumed that individuals try to maximize the utility over market consumption, leisure and home production and try to minimize the cost over home production.

For the empirical application, I sampled single households who have job, do not need to take care of old and children. The consumption data from 2004 wave of National Survey of Family Income and Expenditure (NSFIE); time use data from 2006 wave of Basic Survey of Social Life (BSSL) and price information is from Retail Price Survey (RPS). And I use exact match using gender, age, occupation and region to make the matched sample.

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

The simulation results based on the estimated parameters show that if the single women (single men) are given the same market consumption goods price, home production goods price, wage and total resource as single men (single women), how single women (single men) choose their optimal choice over market labor supply, leisure, home production time, market consumption expenditure and home production consumption expenditure Women receive 98.7% of men's income. Women prefer home production, and men prefer leisure. Women devote a higher time input to home production, reducing the labor supply by 1.7%. Men produce lower levels of home production goods than women, regardless of wage. Given the same wage as men, women spend 133.6% and 145.4% of men's expenditures on home production time and home production consumption.

The simulation results show that women provide less leisure and as much of the labor supply as men when they applied the same wage as men; however, men produce less home production than women and consume more leisure when they earn lower wages (equal to women's wages).

Appendix

Table A1 shows the time use statistics for single women and single men before matching. The table illustrates that single women spend more time on home production and leisure and less on market labor supply. Table A2 shows the consumption of single women and single men before matching. It illustrates that single women consume more home production consumption goods and fewer market consumption goods than single men. Table A3 shows the aggregated price of market consumption goods and home production consumption goods. Single women pay higher prices for these two kinds of goods than single men.

Table A4 compares the variables drawn from the data and the variables predicted by the estimation. Table A5 predicts the robustness check for the estimation results.

Table A1. The statistics of time use before match

	Single women		Single men	
Variable	Mean	Std.Dev	Mean	Std.Dev
Home production time (minutes/day)	75.719	78.355	27.526	48.736
Market labor supply (minutes/day)	514.546	173.014	587.361	184.586
Leisure (minutes/day)	849.735	154.669	825.112	171.037
Obs	1564		2668	

Note: Data is from the 2006 BSSL.

Table A2. The statistics of consumption of single women and single men before match

	Single women		Single men	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Market consumption (yen/day)	5874.339	4745.171	6256.903	3523.943
Home production consumption (yen/day)	493.818	295.395	354.404	278.179
Obs	561		814	

Note: Data is from 2004 from the 2004 NSFIE.

Table A3. The statistics of price information on single women and single men before match

	Single women		Single men	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Price of market consumption	6682.939	9788.471	5759.920	7573.349
ln(Price of market consumption)	11.910	0.557	12.018	0.503
Price of home production consumption	2241.666	9564.131	1516.294	4706.195
ln(Price of home production consumption)	9.432	0.612	8.967	0.893
Obs	561		814	

Note: The data are drawn from the 2004 RPS and 2004 NSFIE. The RPS is composed of the retail prices of major items arranged by city (71 cities in Japan). The price information was organized as follows: (1) The volume was first transformed into identity for cases in which the volume differed among the 71 cities. (2) The average price per detailed category of the 71 cities was taken. (3) The food price was transformed into unit volume (100 g, 100 ml); the same was done for electricity and gas. These categories included volume and price; thus, I was able to transform the prices. (4) The RPS and NSFIE categories were matched, and the average of the prices was taken in cases for which several RPS categories were merged to match a single NSFIE category. (5) I took the weighted average of the price (price of market consumption and price of home production consumption). Since the weight was drawn from the NSFIE, the prices differed by household. The price of automobiles was excluded.

Table A4. Compare the variables from the data and predicted variables

	Single women		Single men	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Predicted Market labor supply (minutes/day)	513.275	69.773	587.872	54.626
Market labor supply (minutes/day)	508.598	85.858	575.197	61.285
Predicted Leisure (minutes/day)	871.136	68.117	827.504	52.208
Leisure (minutes/day)	852.493	74.252	836.856	58.352
Predicted Home production time (minutes/day)	55.589	18.272	24.624	7.585
Home production time (minutes/day)	78.909	39.010	27.950	14.963
Predicted Market consumption (yen/day)	5757.290	3584.670	6962.956	3201.962
Market consumption (yen/day)	5501.216	3558.465	6450.796	3044.514
Predicted Home production consumption (yen/day)	303.648	185.273	340.677	157.430
Home production consumption (yen/day)	465.753	172.388	362.347	173.947
Predicted Home production price	91.242	28.439	120.658	24.083
Cell	28		31	

Table A5. Compare the variables from the data and predicted variables (food for consumption)

	Single women		Single men	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Predicted Market labor supply (minutes/day)	511.458	82.144	590.729	63.764
Market labor supply (minutes/day)	508.598	85.858	575.197	61.285
Predicted Leisure (minutes/day)	862.138	62.675	816.726	70.775
Leisure (minutes/day)	852.493	74.252	836.856	58.352
Predicted Home production time (minutes/day)	66.404	19.664	32.545	16.889
Home production time (minutes/day)	78.909	39.010	27.950	14.963
Predicted Market consumption (yen/day)	817.526	464.022	1796.084	765.523
Market consumption (yen/day)	608.648	346.965	1303.930	613.650
Predicted Home production consumption (yen/day)	289.193	121.798	347.236	122.749
Home production consumption (yen/day)	380.172	142.891	316.865	155.050
Predicted Home production price	82.026	26.045	99.655	19.795
Cell	28		31	

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