The Backward-bending Commute Times of Married Women with Household Responsibility

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Abstract

Though the existing literature provides evidence that married women choose short commutes because of low wages and household responsibilities, this theoretical paper shows that wives employed in highly paid positions also undertake short commutes and endogenously choose longer times for housework. In contrast, middle-class wives choose long commutes and undertake limited household chores. The results suggest that the commute times of wives follow a backward-bending pattern and there is a tradeoff between commute time and the hours devoted to housework in terms of wage rates. Using a sample of married women working full time from the 1993 Japanese Panel Survey of Consumers, we obtain empirical evidence supporting these predictions.

JEL classification: J29, J31, R23

Key words: Backward-bending commute time, household responsibilities

1 Introduction

In most countries, domestic chores remain the primary responsibility of many married women, even though they are often also in full-time employment. In this situation, married women will reduce their commute times in order to do housework. The monetary value assigned to time-saving in commuting is then an important factor when married women make decisions on their residential and employment locations. In this regard, this paper offers both theoretical and empirical evidence on how married women change their commute times in response to wage changes, when considering the endogeneity of housework time.

Kain (1962) empirically shows that females make shorter journeys to work than their husbands. White (1977) and Madden (1981) present theoretical location models to explain these results. Women select jobs closer to their residence because lower female earnings and shorter work hours reduce the motivation to commute. Women's heavy burden of household responsibilities also raises the cost of commuting. Gender differences in commute times are also considered by Freedman and Kern (1997), Hanson and Hanson (1980), Johnston-Anumonwo (1992), Lee and McDonald (2003), Madden and Chen Chiu (1990), Mok (2007), Singell and Lillydahl (1986), and Turner and Niemeier (1997).

Most of these studies ignore the role of women's wage rates in decisions about the location of households. If there is less spatial variation in women's wages, women have less reason to commute and their work trips become shorter. This explanation is particularly applicable to part-time workers, because they face less spatial variation in wages at low-wage levels. Full-time workers, however, encounter greater spatial variation in wages than part-time workers. Married women who work full time will simultaneously determine both their workplace and residence (Madden and Chen Chiu 1990). If wives choose higher-wage jobs, then their commute times may become as long as their husbands' (Shingell and Lillydahl 1986, Lee and McDonald 2003). However, wealthy households also tend to live closer to city centers, because the higher the wages of women, the greater the opportunity cost of commuting in lost leisure time. Furthermore, women's household responsibilities limit their willingness to commute. Therefore, households may offset the effects of long commutes by wives by locating their residences nearer to the wife's place of employment (Freedman and Kern 1997). For instance, Mok (2007) uses a sample of full-time workers to show that the location decisions of dual-income households are more sensitive to the wife's earnings than the husband's. This suggests the importance of considering the relation between married women's commute times and their wage rates in more detail. For this reason, this paper casts light on differences in commute times among married women working *full time*.

Previous studies have considered the time spent on housework as a given, and even though they argued for its impact on commute time, they were not treated as interdependent. We use a traditional labor–leisure model because it endogenously determines the time spent on housework. Solberg and Wong (1992) analyze a household model where the time use for each person is divided into market work, home production, leisure, and work-related travel time. However, the latter is treated as predetermined. In contrast to Solberg and Wong (1992), we consider a model where married women simultaneously decide their commute and housework hours.

Using this theoretical model, we find that there is a case where the effect of wives' wage rates on their commute times follows a backward-bending (inverse C-shaped) pattern. That is, married women's commute times first increase with respect to the wage rate, then decline. Increasing wages also decreases housework hours in Solberg and Wong's (1992) model. However, if we assume, as in Kohara (2000), that commute time is associated with a loss of energy to devote to housework, the housework time of married women follows a C-shaped pattern. Here we observe a tradeoff between commute time and housework time in relation to the wage rate.

Our data set, drawn from the 1993 Japanese Panel Survey of Consumers (JPSC) conducted by the Institute for Research on Household Economics, divides time use into commuting, market work, housework, and leisure. Using a sample of married women working full time, we regress each category of time use on monthly wage rates and their squares, subject to total time restrictions. The empirical results confirm the earlier theoretical predictions. We must consider that our empirical model has a potential endogeneity problem: that is, wage rates are determined in the labor market. Singell and Lillydahl (1986) estimate a two-stage least squares model that simultaneously decides the wage rate and time use functions to control for endogeneity. This paper uses the instrumental variables (IV) method. We again find that married women's commute times follow an inverse C-shaped pattern and that the time spent on housework is inversely related to commute time with respect to wage rates. We also find that ordinary least squares (OLS) underestimates the effect of wage rates when compared with the IV method.

The remainder of the paper is organized as follows. In Section 2, we present a theoretical model of married women's behavior. The data and empirical model used are discussed in Section 3, along with the empirical results. Section 4 summarizes the main conclusions of the paper and gives directions for future research.

2 The model

In this model, we cast light on the influence of wage rates on the commute time of wives. We do not consider gender differences in commute time, thus the commuting decisions of husbands are degenerated outside the model. A married woman is assumed to have the following three options. The first option is that she may work and reside in the suburb. Employment opportunities are also offered in the city center. We assume that city center firms offer higher wage rates to married woman than the suburban firms. Let $\Delta w > 0$ be the difference between a wage rate in the city center and the suburb, where w is a wage rate. The second option is that she may undertake this opportunity and thereby work in the city center and reside in the suburb, commuting regularly to work. The third option is that she may work and reside in the city center. She chooses the option that generates the highest utility, i.e., max $\{U_1, U_2, U_3\}$, where U_i $(i = 1, 2, 3)$ is the utility level of the i-th option. In our model, commute time is given in each option as follows:

$$t_i = \begin{cases} \bar{t} & (i = 1, 3) \\ t(w) & (i = 2) \end{cases}$$

A married women becomes a short commuter when she chooses option 1 or option 3. Otherwise, she is a long commuter. The married women chooses option 2 as a result of wage increases. Thus, the time spent on commuting in option 2 depends on wage rates, where $\Delta t/\Delta w = t_w > \bar{t} > 0$. Because the married woman can choose only one of the three options, travel time is endogenously determined in our model. Note that the commuting time decision is a discrete choice. In addition, we implicitly assume in our model that the married woman's bargaining power in the household increases when her wage rate increases because she can then choose residential location.

Now we consider the utility maximization problem of the i-th option. We present a formal model of the time allocation of married women in the manner of Gronau (1977), which assumes that time use for each person is divided into three basic activities—market work m, home production h, and leisure l. In this paper, however, the basic activity is extended to include the time spent on commuting, as in Solberg and Wong (1992). We also assume throughout the paper that the household consumes a single unit of housing. A woman is considered to have the following well-behaved and quasi-concave utility function:

$$U_i = U(l, X),$$

where l represents leisure time and X a composite good. The quantity of X consumed by the married woman is given by $X = X_m + X_h$, where X_m is goods purchased in the market and X_h is goods produced at home. The quantity of market goods is given by:

$$X_m = wm + R + I - c_i,$$

where R is the nonlabor income of the wife, I is the sum of the labor and nonlabor income of her husband, and c_i is the housing (rental) cost. We assume that R and I are exogenously given. We also assume that the pecuniary commuting cost is zero. Employers often pay the pecuniary commuting cost in Japan (Yamaga 2000). The housing (rental) cost c_i is given by:

$$c_i = \begin{cases} \bar{c} & (i = 1, 2) \\ c(w) & (i = 3) \end{cases}$$

The housing cost is constant $\bar{c}$ when married women dwell in the suburbs. We assume that the housing cost in the city center is higher than in the suburb. A woman chooses option 3 because of the wage increase. Thus, the housing cost in option 3 depends on wage rates, where $\Delta c/\Delta w = c_w > \bar{c} > 0$. Similarly to Kohara (2000), in our model the quantity of home goods is given by:

$$X_h = A(t_i)F(h),$$

where $F(\cdot)$ is the home production function and $A(\cdot)$ is a shift parameter function of productivity that depends on t_i. For all h, $F(h)$ exhibits positive and diminishing marginal products. If

$A_t = 0$, the model is similar to Gronau (1977) and Solberg and Wong (1992). Kohara (2000), however, assumes that women who spend time commuting have less energy for housework, thus reducing their productivity, i.e., $A_t < 0$.

The married woman faces the following two constraints: the income constraint,

$$X = wm + R + I - c_i + A(t_i)F(h); \tag{1}$$

and the time constraint,

$$T = l + h + m + t_i, \tag{2}$$

where T is the total time available.

The first-order conditions for the maximization problem in option i include the following:

$$A(t_i)F_h = w, \tag{3}$$

$$\frac{U_l}{U_X} = w. \tag{4}$$

In our model, the married woman chooses option 1 when she receives a low wage. She obtains a higher wage rate when she chooses options 2 or 3. She will then choose the city center job opportunity if her utility becomes higher. To investigate this, we calculate the response of utility to a change in wage rates. By differentiating the objective function with respect to w we have:

$$\frac{\Delta U_i}{\Delta w} = U_l \frac{\Delta l_i}{\Delta w} + U_X \frac{\Delta X_i}{\Delta w} \quad (i = 2, 3). \tag{5}$$

Suppose that $U_{xl} > 0$. Consider first option 2. By totally differentiating Eqs. (1), (2), (3), and (4), we have:

$$\frac{\Delta l_2}{\Delta w} = \frac{(Zm - Zt_w w + Zt_w A_t F - 1)AF_{hh}}{D}, \tag{6}$$

$$\frac{\Delta X_2}{\Delta w} = \frac{(w - Ym + Yt_w w - Yt_w A_t F)AF_{hh}}{D}, \tag{7}$$

$$\frac{\Delta h_2}{\Delta w} = \frac{(1 - t_w A_t F_h)}{AF_{hh}} < 0, \tag{8}$$

where

$$Y = \frac{U_{ll}U_x - U_{xl}U_l}{U_x^2} < 0,$$
$$Z = \frac{U_{lx}U_x - U_{xx}U_l}{U_x^2} > 0,$$
$$D = (Zw - Y)AF_{hh} < 0.$$

Substituting Eqs. (6) and (7) into Eq. (5), and using Eq. (4), we obtain:

$$\frac{\Delta U_2}{\Delta w} = (m - t_w(w - A_t F)). \tag{9}$$

Eq. (9) investigates the utility level of option 2 compared with the utility level of option 1. The wife is then more likely to choose option 2 than option 1 when her working time is long, when the additional opportunity cost of commuting is low, and when the loss of goods produced at home is small.

Next, consider option 3. By totally differentiating Eqs. (1), (2), (3), and (4), we have:

$$\frac{\Delta l_3}{\Delta w} = \frac{(Zm - Zc_w - 1)AF_{hh}}{D}, \tag{10}$$
$$\frac{\Delta X_3}{\Delta w} = \frac{(w - Ym + Yc_w)AF_{hh}}{D}, \tag{11}$$
$$\frac{\Delta h_3}{\Delta w} = \frac{1}{AF_{hh}} < 0. \tag{12}$$

Substituting Eqs. (10) and (11) into Eq. (5), and using Eq. (4), we obtain:

$$\frac{\Delta U_3}{\Delta w} = (m - c_w). \tag{13}$$

Eq. (13) investigates the size of the utility level of option 3 compared with the utility level of option 1. The wife is then more likely to choose option 3 than option 1 when her working time is long and the additional housing cost in the city center is low.

If m is sufficiently small, and if both Eqs. (9) and (13) become negative, then the married woman resides and works in the suburb. She receives a low wage and commutes for a short time. This case is applicable to part-time workers. Because we wish to cast light on the situation of married women employed full time, we consider the case where m is sufficiently large and both

Eqs. (9) and (13) become positive. The married woman then chooses options 2 or 3 when she has the opportunity of a wage increase. Comparing Eq. (9) with Eq. (13), we have:

$$\frac{\Delta U_2}{\Delta w} \gtreqless \frac{\Delta U_3}{\Delta w} \Longleftrightarrow \frac{c_w}{t_w} + A_t F \gtreqless w. \tag{14}$$

Consider $A_t = 0$. The equation is easier to understand in this case. Under $A_t = 0$, option 2 is attractive to a married woman when the wage rate is lower than the ratio of the additional housing cost to the additional travel time. That is, for the married woman the additional housing cost is too high and the opportunity cost of travel time is sufficiently low. The married woman then commutes for a long time because she retains her residence in the suburb. Option 3, however, is attractive to her in the reverse case. If her wage rate is high, she then feels that the additional housing cost is sufficiently low and the opportunity cost of travel time is too high. She thus transfers her residence to the city center. In sum, when the wage rate starts at a low level and then increases, she is more likely to choose a long commute time. However, when the wage starts at a high level and then increases, she is more likely to choose a short commute time. The entire schedule therefore bends backwards (inverse C-shaped) when we place the commute time on the horizontal axis and the wage rate on the vertical axis.[1]

Lastly, we consider the housework time of married women. We find that an increase in the wage rate reduces housework time in both Eqs. (8) and (12). When wage rates rise, it is more attractive to work in the market than at home to obtain consumer goods. If $A_t = 0$, the reduction in housework in option 2 is equal to that in option 3. The married woman, however, further reduces her housework time in option 2 when $A_t < 0$. That is, she is too tired to do housework because of her long commute. We may then observe that a short commuter with a higher wage (option 3) will have longer housework time than a long commuter with a lower wage (option 2) if the productivity loss in housework is sufficiently large in option 2. Because a short commuter with a lower wage in option 1 has a longer housework time than the long commuter with the higher wage in option 2, the entire schedule of housework time follows a C-shaped pattern when we place housework time on the horizontal axis and the wage rate on

[1] Placing the wage rate on the vertical axis is customary in economics. Of course, the entire schedule becomes inverse U-shaped when we place the wage rate on the horizontal axis.

the vertical axis. Therefore, we observe that the time spent on housework is inversely related to commute time with respect to wage rates.

3 Empirical analysis

3.1 Data and empirical specification

The data employed in the estimation are from the JPSC. This survey began in 1993 with interviews of 1500 women, aged 24 to 34 years. One advantage of this survey is that it includes individual wages and time allocations on weekdays, comprising commute, housework, labor, and leisure times. In the theoretical part of the paper, we assume that commute time is a discrete variable and married women have only two options: either a short or long commute. In the empirical part, however, we consider commute time as a continuous variable, because the time allocations for weekdays in the JPSC are recorded in 10-minute intervals. We also note that in the 1993 wave, individual wage rates were reported; after 1993, they were reformulated as categorical data. Accordingly, even though the JPSC provides panel data, we focus on the 1993 wave because we can use the continuous variable for wage rates to confirm our hypotheses.

The sample used in the analysis is as follows. First, we removed observations on unmarried respondents because our focus is on the commute times of married women. Second, as discussed earlier, we consider only full-time workers. In the 1993 JPSC, full-time workers reported a monthly salary. The monthly salary is suitable for considering the relation between wage rates and commute times, because the statistical variability of the monthly salary is relatively large. Third, we dropped all observations where the necessary information was not available. After screening the data in this manner, we obtained a sample of 128 observations.

Table 1 presents the definitions and Table 2 shows the summary statistics of the dependent variables: commute time, housework time, market working time, and leisure time. Table 1 also provides definitions of the independent variables used in the regression analysis. The most important variable that we focus on is wage rates. We also include a quadratic specification of wage rates, because we hypothesize that the commute time of married women follows a backward-bending pattern. Figure 1 plots data on the commute time and the monthly wage.

Initially we find that wage rates and commute times have a positive correlation. Consider Figure 1 in more detail. On the one hand, there are long commuters whose earnings are between 200,000 and 250,000 yen. On the other hand, married women who earn about 300,000 yen or more have shorter commute times than the former. Therefore, Figure 1 may reveal that commute time is negatively related to wage rate in this range.

The empirical specification is determined as follows. First, each time-use equation is estimated by OLS.[2] Because the total time available for each person equals 1440 minutes (24 hours), the sum of the partial effects of changes in each explanatory variable (except the constant term) automatically equals zero for each set of time-use equations. This implies a tradeoff in time use. In other words, if women spend more time on some activities, then they have to reduce the time for other activities.

For the other control variables, we use the wife's nonlabor income in the previous year and the sum of her husband's labor and nonlabor income in the previous year. These variables may have an influence on the time use of married women. Researchers have used household characteristics as proxies for the degree of household responsibility to test the household responsibility hypothesis (HRH). Similarly to previous research, we include the number of children younger than seven years (child $0-6$) and the number of children aged $7-12$ years (child $7-12$). If working mothers have the greater share of childcare in the household, these variables decrease commute time with an increase in the time spent on housework.

Lee and McDonald (2003) also include the presence in the household of parents or parents-in-law who are older than 59 years. They assume that living with parents or parents-in-law may reduce the household responsibilities of married women because they help with childcare, housecleaning, meal preparation, etc. In fact, Lee and McDonald (2003) find that this variable increases their commute time. Ueda (2005) also include the presence in the household of the wife's or husband's mother at an age of 64 years or younger. However, this estimates a housework time equation, not the commute time equation. In the explanatory variables, Ueda (2005) also includes the presence in the household of other parents, arguing that living with other parents

[2] Solberg and Wong (1992) use Seemingly Unrelated Regression (SUR) to estimate the time-use equations. Unfortunately, we cannot use SUR because the covariance matrix of the errors is singular.

may actually increase housework time in taking care of them, e.g., assisting them to eat or use the bathroom. In this paper, we include the presence in the household of the parents or parents-in-law at an age of 64 years or younger (parents), the presence in the household of parents or parents-in-law who are older than 64 years (parents 65), and the presence in the household of the wife's or husband's grandparents (grandparent). Lastly, three geographical categories are included, comprising 13 major cities in Japan (large city), all other cities (middle city), and towns and villages (small city).

We estimate each time-use equation using the IV method. IV will overcome a potential endogeneity problem: wage rates are determined in the labor market.[3] We use dummy variables for the number of employees, the wife's occupation, and the industry of employment as instruments for wage rates. Table 1 provides detailed information on these variables. We also include the wife's age, tenure in the current job, and tenure squared as instruments.[4]

3.2 Estimation results

Table 3 provides the OLS estimation results, and Table 4 details the IV estimation results.[5] Although Table 4 shows that the Cragg–Donald F-statistic is smaller than the Stock–Yogo weak identification test critical values, the IV method reduces the negative bias of wage rates in the OLS estimation, as explained below. Before discussing the effect of wage rates on the time-use equations, we briefly refer to another control variable. From both Tables 3 and 4, we find that having a child aged $0-6$ has a significant effect on the time allocation of married women. As the number of preschool-age children increases, greater household responsibilities result in shorter commute times and longer work times at home. These findings are intuitive but important. The literature (Madden 1981, Lee and McDonald 2003, Turner and Niemeier 1997) has shown that married women's commuting is influenced by the presence of children because of household responsibilities. However, they do not confirm whether the presence of children increases housework time because their data does not include housework time. In contrast, the

[3] The other consideration is that our empirical model has a potential measurement error problem in that respondents do not always accurately report their wage rates. The IV method also solves this problem.

[4] The estimation results for the wage rate and its square are reported in the Appendix.

[5] We do not report the estimation results of the time spent in leisure, the remainder of Eq. (2), because we can calculate the coefficient of leisure by using the value of the estimated coefficients from other equations.

linkage between commuting time, housework time, and the presence of children in our study is clear. We also find that preschool-age children decrease married women's working time in the market. No other variables related to HRH have any effect on the time-use equations. Both the wives' unearned income and the husbands' income also have insignificant effects on time allocation. The middle city dummies are all insignificant. The OLS and IV results show that small city dummies have a significant impact on housework time. Married women who reside in a small city have shorter housework times than those who reside in a large city.

Our estimation results in Tables 3 and 4 obtain a backward-bending labor supply curve. However, the coefficient for wage squared in Table 3 is insignificant, whereas that in Table 4 is significant. The results suggest the importance of controlling for wage rates using the IV method. The sign of wage rates and their squares on the time spent on commuting and housework are important for our argument. As expected, the wage rate has a significant and positive impact and the square of the wage rate has a significant and negative impact on commute time.[6] Therefore, the estimation result shows that the commute time of married women follows a backward-bending pattern with respect to their wage rates. In contrast, an increase in wages decreases married women's home production times at an increasing rate. This implies that housework time follows a C-shaped pattern. Combining these results shows that married women with either low or high wage rates locate their residences near their job locations and have long housework times. On the other hand, married women with wage rates between these extremes choose longer commutes because they do not have sufficient wages to move to the new location. As a result, their housework times become shorter.

Comparing Table 3 with Table 4 shows that the absolute estimated value of wage and wage squared in Table 4 is larger than in Table 3. This suggests that OLS underestimates the effect of the wage rate on the time-use allocation compared with the IV method. Figure 2 shows the relationship between commuting time and wage rates for married women who reside in a large city with a child. We also set that they have no unearned income but that their husband has the average total income. The empirical result using IV shows that commute time peaks at

[6] Figure 1 reveals that there are only two respondents who earn more than 400,000 yen and only one respondent who commutes more than 250 minutes. The OLS and IV estimation results both support the hypothesis of a backward-bending commute time even when we drop these three observations.

approximately 250,000 yen, while OLS results provide a peak at about 350,000 yen.

Using the IV results, Figure 3 shows the portion of daytime hours devoted to commuting, housework, market work, and leisure. Once again, commute time first increases, and then decreases, with respect to wage rates. When the married women earns a low wage (100,000 yen), the fraction of time spent on housework is 22.5%. This drops until 250,000 yen, before increasing again.

4 Conclusion

The purpose of this paper is to examine the relationship between the commute times of married women with household responsibilities and their wage rates. The analysis differs from previous work because the times spent on commuting and housework are simultaneously determined in both the theoretical and empirical models.

Previous research emphasizes that married women tend to have short commutes because of low wages and high household responsibilities. In the theoretical part of the paper, however, we show that there is a case where wives' commute times follow a backward-bending pattern with respect to wage rates. We also show a tradeoff between commute time and housework time in relation to wage rates. Married women with lower-wage jobs choose short commutes and have longer housework times. Because higher wage rates offset the effects of a long commute, wives will choose a long commute when offered higher-wage jobs. In this case, their housework time decreases because it is more efficient to work in the market than at home. Married women further reduce their housework times in this case because a long time spent commuting reduces energy for housework. However, married women with even higher-wage jobs also choose short commutes. This is because they move to closer to their workplaces: with a higher wage rate, there is a higher opportunity cost of commuting. In this case, they save time to do domestic chores. Empirical results using OLS and IV and a sample of married women working full time from the 1993 JPSC support our theoretical predictions. The results also support the HRH for the number of small children. That is to say, as in previous studies, the number of preschool-age children reduces wives' commute times and substantially increases their housework times.

We note several other considerations in the paper. First, in our study the behavior of husbands is a black box. In the theoretical part, we implicitly assume that married women's bargaining power in a household increases when their wage rates increase. The effect of this bargaining power would be better captured if we constructed a bargaining model. Our empirical results also show that relatively high-wage earners can engage in long housework times and have short commutes. This suggests that while Japanese husbands do not help with domestic duties, they may still have a role in determining the location of the family residence. We could confirm this if we included information on husbands. Second, we do not draw any policy implications because neither the theoretical model nor the empirical model includes any policy parameters. As mentioned in the theoretical part, Japanese firms and government offices often reimburse employees for the cost of commuting. This is because commuting costs are tax deductible in the Japanese tax system (Yamaga 2000). In this tax system, the decisions of wives will be distorted towards long commutes (option 2 in our theoretical model). As a result, their housework times will decline. This policy context is left for future research. Third, as mentioned in the empirical section, we do not use panel data, even though it is available. However, panel data is more suitable for understanding dynamic decisions regarding workplaces and residences. To address this, we will use the panel data in our future research.

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Table 1

Definition of variables

Variable	Definition
Commute	Commute time, minutes.
Housework	Housework time, minutes.
Market	Market work time, minutes.
Leisure	Leisure time, minutes. Various subtime categories, e.g., studying, sleeping, eating, are aggregated into leisure time.
Wage	Monthly salary rate, yen.
Wage squared	Square of monthly salary divided by 10,000.
Unearned income	1992 nonlabor income, 1992 10,000 yen.
Husband's income	1992 husband's total income, 1992 10,000 yen.
Child 0–6	The number of children aged 0–6.
Child 7–12	The number of children aged 7–12.
Parents	Dummy variable for living with parents or parents-in-law aged 64 years or younger.
Parents 65	Dummy variable for living with parents or parents-in-law aged 65 years or older.
Grandparent	Dummy variable for living with grandparents.
Large city	Dummy variable for having a residence in a large city (reference).
Middle city	Dummy variable for having a residence in a middle city.
Small city	Dummy variable for having a residence in a small city.
Emp. 1	Dummy variable for 1–99 employees (reference).
Emp. 2	Dummy variable for 100–499 employees.
Emp. 3	Dummy variable for 500–999 employees.
Emp. 4	Dummy variable for 1000 or more employees. The number of employees in government and municipal offices is included in this category.
Professional	Dummy variable for a respondent who is a professional worker.
Technical	Dummy variable for a respondent who is a technical worker.
Other occ.	Dummy variable for a respondent who works in another occupation (reference).
Fin. and pub.	Dummy variable for a respondent who works in a finance company or the public service.
Others ind.	Dummy variable for a respondent who works in another industry (reference).
Age	Age of the respondent, years.
Tenure	Tenure of current job, years.
Tenure squared	Square of tenure of current job.

Table 2

Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Commute	50.63	49.81	0	280
Housework	224.69	136.72	0	780
Market	495.39	77.16	60	660
Leisure	669.30	112.15	360	1030
Wage	201.16	75.29	50	500
Wage squared	460.88	360.33	25	2500
Unearned income	2.33	15.61	0	150
Husband's income	439.38	147.65	140	1000
Child 0–6	0.86	0.88	0	3
Child 7–12	0.38	0.64	0	2
Parents	0.45	0.50	0	1
Parents 65	0.14	0.35	0	1
Grandparent	0.10	0.30	0	1
Large city	0.20	0.40	0	1
Middle city	0.50	0.50	0	1
Small city	0.30	0.46	0	1
Emp. 1	0.38	0.49	0	1
Emp. 2	0.13	0.33	0	1
Emp. 3	0.04	0.19	0	1
Emp. 4	0.46	0.50	0	1
Professional	0.15	0.36	0	1
Technical	0.16	0.36	0	1
Other occ.	0.70	0.46	0	1
Fin. and pub.	0.14	0.35	0	1
Others ind.	0.86	0.35	0	1
Age	30.09	3.10	24	34
Tenure	6.16	3.97	0	16
Tenure squared	53.60	55.40	0	256
Observations		128		

Wage squared is divided by 100.

Table 3

OLS estimation

	Commute		Housework		Market	
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Wage	0.5821***	0.1693	–1.5571**	0.7111	1.0273**	0.4964
Wage squared	–0.0008**	0.0003	0.0028**	0.0014	–0.0015	0.0009
Unearned income	–0.1356	0.1256	0.0633	0.4300	–0.2616	0.3401
Husband's income	0.0242	0.0359	–0.0794	0.0838	–0.0631	0.0522
Child 0–6	–9.5725**	4.5259	87.8656***	13.7797	–22.0667**	10.4753
Child 7–12	–0.5265	6.8676	–21.6006	15.5577	8.1604	9.8008
Parents	–6.2840	9.0969	1.1604	20.5596	–9.4439	11.6558
Parents 65	–11.0340	12.1971	15.1700	27.6631	25.1923*	14.5205
Grandparent	–10.5952	10.8732	–11.5327	27.2139	3.9713	13.3152
Middle city	–10.0329	14.7601	8.1506	22.9800	–18.5007	16.2797
Small city	–23.8530	14.4365	–60.4679**	28.0571	10.8423	17.9324
Const.	–13.6534	33.1090	391.1080***	104.3062	407.5050***	63.9540
Adj-R^2	0.2778		0.3882		0.3114	
Observations	128		128		128	

Std. Err. represents robust standard errors.

*** indicates significant at 1%.

** indicates significant at 5%.

* indicates significant at 10%.

Table 4

IV estimation

Variable	Commute Coeff.	Commute Std. Err.	Housework Coeff.	Housework Std. Err.	Market Coeff.	Market Std. Err.
Wage	1.1290**	0.5083	–2.2232*	1.1634	1.7975***	0.6762
Wage squared	–0.0021*	0.0011	0.0043*	0.0026	–0.0032**	0.0015
Unearned income	–0.1316	0.1447	0.0779	0.4628	–0.2144	0.3601
Husband's income	0.0419	0.0335	–0.1041	0.0887	–0.0449	0.0583
Child 0–6	–9.0748**	4.5610	87.4667***	12.4630	–20.9246**	8.6547
Child 7–12	–0.1982	6.6802	–22.0423	15.3410	8.5337	9.6936
Parents	–9.7027	8.0865	5.7089	19.8580	–13.4397	11.6732
Parents 65	–12.9638	11.3328	17.5603	25.9094	22.5593	14.2868
Grandparent	–11.6638	11.2455	–10.6510	26.6602	1.5729	13.9821
Middle city	–9.8786	14.3764	9.2778	24.8479	–15.4837	16.6575
Small city	–21.5503	14.4443	–62.8158**	28.1083	15.0575	18.8155
Const.	–72.7057	54.5802	460.9202***	140.8516	319.8450***	74.4546
Centered R^2	0.2200		0.3755		0.2710	
Observations	128		128		128	

Std. Err. represents robust standard errors.

(Cragg–Donald Wald F statistic) $1.91 < 10.43$ (Stock–Yogo weak ID test 10% critical values)

*** indicates significant at 1%.

** indicates significant at 5%.

* indicates significant at 10%.

Appendix

Table 5

Wage and wage squared estimation

	Wage		Wage squared	
Variable	Coeff.	Std.Err.	Coeff.	Std. Err.
Unearned income	–0.7845***	0.2390	–0.3893***	0.1473
Husband's income	0.0737	0.0474	0.0391*	0.0203
Child 0–6	–16.9732**	6.5734	–7.4221**	3.0275
Child 7–12	9.0298	8.6241	4.0782	3.7597
Parents	–16.4509	11.4033	–9.3653*	5.5138
Parents 65	7.9293	16.4207	3.2671	7.5638
Grandparent	20.9679	18.1974	8.3183	8.1048
Middle city	–38.7207**	16.5592	–15.3712*	8.1188
Small city	–27.3807	22.1833	–9.5967	12.1030
Emp. 2	9.2300	14.1856	0.2000	5.9522
Emp. 3	60.6924*	34.9957	31.2015	19.7711
Emp. 4	20.0088	13.1696	4.4973	6.3871
Professional	45.2951***	14.7572	16.2659**	6.5760
Technical	63.6022***	15.4821	26.8465***	7.8466
Fin. and pub.	62.3157**	23.9369	34.1575**	13.8356
Age	1.1605	2.1400	1.0801	1.0670
Tenure	8.4972	5.3757	4.8979*	2.8865
Tenure squared	–0.3805	0.4116	–0.2818	0.2297
Const.	108.5934*	62.7480	–14.1246	33.2427
Centered R^2	0.4374		0.3990	
Observations	128		128	

Std. Err. represents robust standard errors.

Wage squared is divided by 1000.

*** indicates significant at 1%.

** indicates significant at 5%.

* indicates significant at 10%.

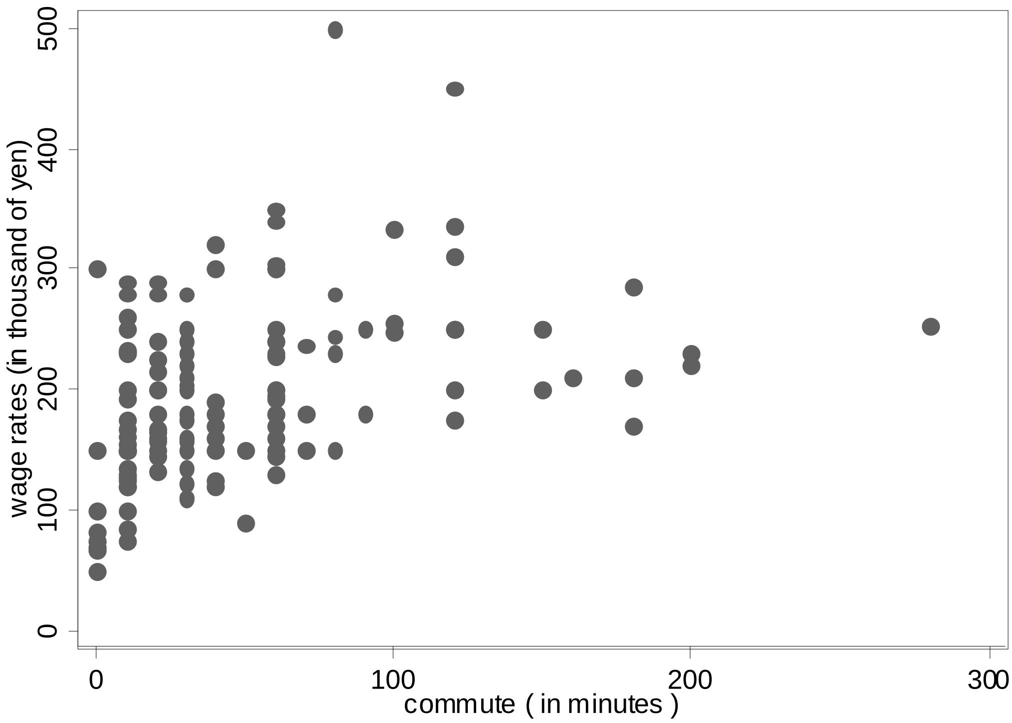

Figure 1. Commute times and wage rates of married women

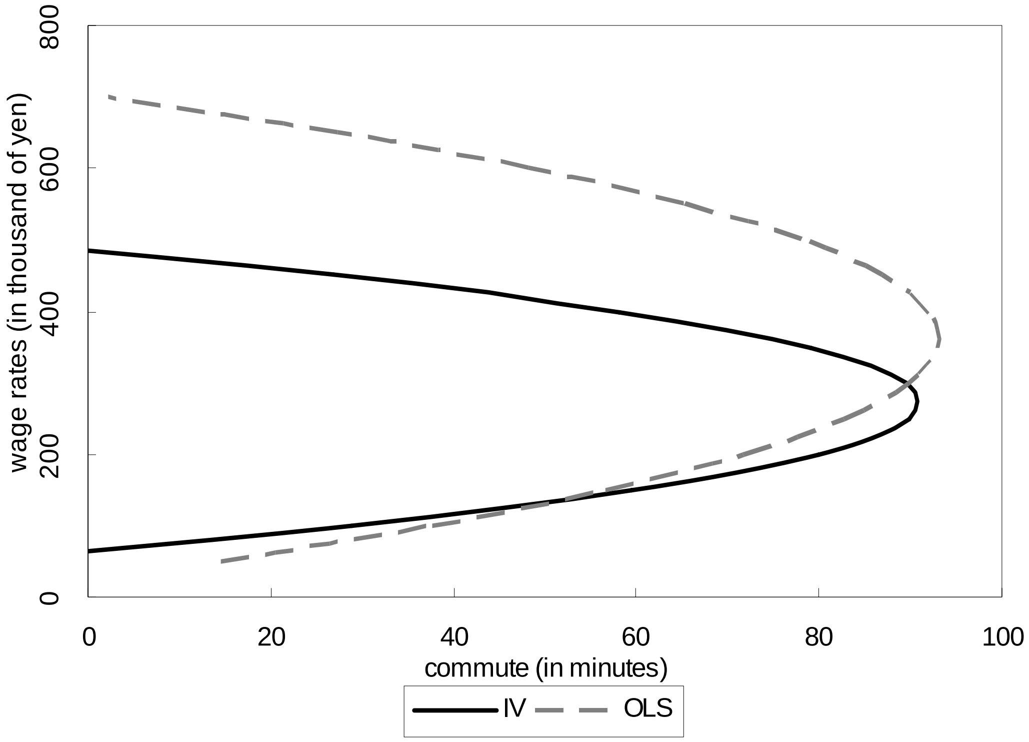

Figure 2. The backward-bending commute times of married women

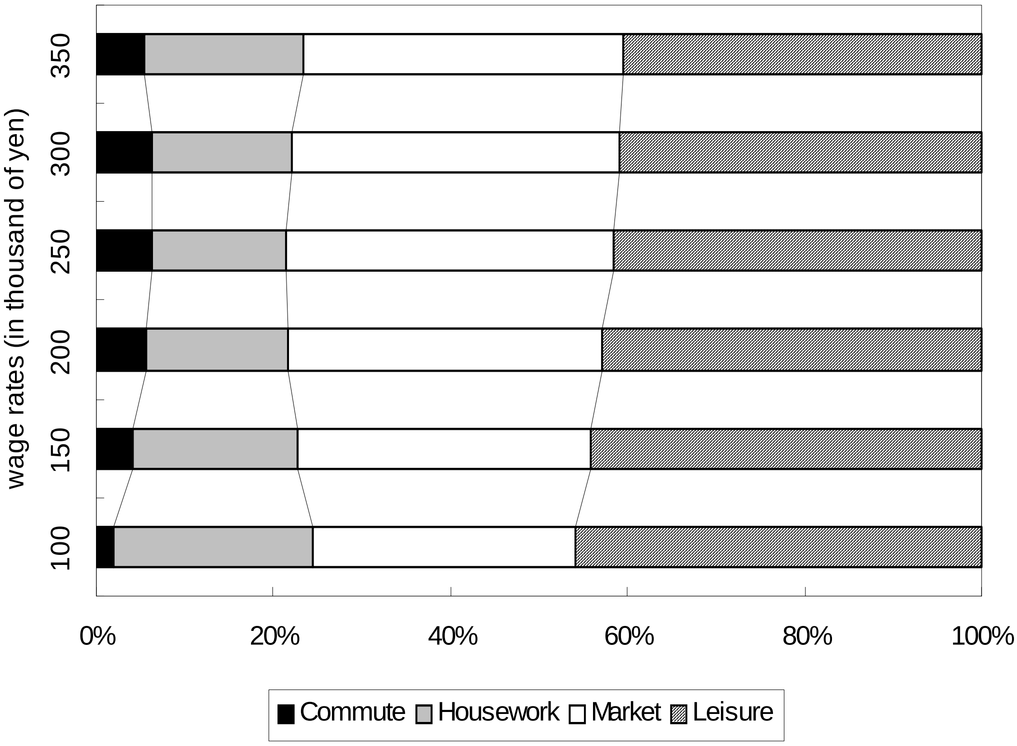

Figure 3. Time allocation