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Effect of Commuting Time on Intra-household Time Allocation of Dual-earner Couples in Japan

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Abstract

Gender inequality and unequal division of labor within the household have been policy concerns in many countries. This paper examines intra-household time allocation within dual-earner couples in Japan. Specifically, we are interested in how changes in the husband's commuting time affects the working wife's time use. By using a longitudinal household survey, we estimate a fixed effects model to isolate the exogeneous changes in commuting time for the same household over time. We show that a longer commuting time for the husband is associated with an increase in the wife's time spent on childcare, while her labor supply and employment probability remain unaffected. The response of childcare time is mainly observed among non-full-time-working mothers with elementary-school-aged children. In additional analysis, we find evidence that a longer commuting time for the husband reduces household educational expenditure, suggesting that households may substitute market-based services with the wife's time in childcare. Our results demonstrate the importance of considering intra-household responses when assessing economic policies.

Key words: intra-household time allocation, commuting time, childcare, gender, labor supply

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I. Introduction

It is widely known that travelling to and from work in Japan, often depicted by images of exhausted men and women standing in the congested trains, occupies a significant part of a workday. According to the data provided by Ministry of Internal Affairs and Communication, the average commuting time per day in Japan is 76 minutes in 2021, which is among the highest in the world.[2] For men, this commuting time increases to 83 minutes, compared to 67 minutes for women (Ministry of Internal Affairs and Communication, 2022).

Japan is also well known for the uneven division of housework and childcare responsibilities between husbands and wives. According to data from the Organization for Economic Co-operation and Development (OECD) gender portal, Japanese women spent on average 224.3 minutes, whereas men spent on average 40.8 minutes on unpaid work per day (gap = 183.5 minutes).[3] This stands in stark contrast to the OECD average, where women spent 264 minutes and men spent 137 minutes (gap = 127 minutes). In addition, a significant higher proportion of women in Japan work part-time compared to those in other countries.[4] Previous studies have indicated that the persistent gender-based division of labor along with the rigid work styles that demand long hours has hindered women from participating in regular employment (Tsutsui, 2016).

This paper explores the relationship between commuting time and time spent on housework and childcare within dual-earner households in Japan. More specifically, we examine how the longer commuting time for the husband affects the time allocation of the wife in terms

[2] Using a slightly different approach, OECD has conducted a cross-country comparison of commuting time. According to the study, Japan's commuting time was 40 minutes per day, which was ranked 2nd among 26 countries (OECD, 2016).
[3] The data is based on year 2021. OECD gender portal is available at https://www.oecd.org/en/data/dashboards/gender-dashboard/comparison.html?oecdcontrol-74aaf2d9f6-var1=JPN
[4] According to OECD data in 2022, 38.5% of the employed women in Japan hold part-time jobs (that is, work less than 30 hours per week), which ranks the third among OECD countries.

of her paid work, housework, childcare, and leisure time. We take three distinctive approaches in our paper. First, while existing studies have mostly focused on the linkage between commuting time and *own* labor supply,[5] we examine how the husband's commuting time affects the wife's time allocation. We focus on the causal relationship that runs from the husband to the wife because males are the major breadwinner in most Japanese households.[6] Second, we restrict our sample to dual-earner households, because this type of households has rapidly become the norm in Japan over the past half century.[7] Third, when defining time use, we distinguish childcare from regular housework because the former combines elements of both work and leisure. Parents may derive utility from spending time with their children, making it distinct from other household tasks.[8]

If commuting time is regarded as a fixed time cost associated with work, *ceteris paribus*, the longer commute of one spouse reduces the total available time for the entire household, effectively acting as a negative income shock. To counter the negative income shock, *both* spouses are expected to work longer hours. However, if market-based goods and domestically produced goods are imperfect substitutes, and there is a productivity gap between husbands and wives, a longer commuting time for one spouse could reduce the labor supply of the other, thereby triggering specialization based on comparative advantage. Our aim is to examine

[5] Theory predicts a negative own labor supply response to a longer commute (e.g. Cogan, 1981). Studies have shown that long commutes are negatively related to female labor market participation (Black et al. 2014; Kawabata and Abe, 2018; Abe, 2011).
[6] In additional analysis which we do not report, we examined how the husband's time allocation responded to changes in wife's commuting time, but we do not find any statistically significant association. This is consistent with the literature on intra-household allocation which tend to find a larger response of her time allocation when his time use changes, but not the other way round (e.g. Bredtmann, 2014; Deding and Lausten; 2006)
[7] According to the Ministry of Health, Labour and Welfare (2023), in 1980 the number of households with male workers and female non-workers was 11.1 million, whereas the number of households with both spouses working was only 6.1 million. In 2022, these numbers have changed to 5.4 million and 12.6 million, respectively.
[8] As Gronau (1977) points out, housework is usually defined as "something one would rather have somebody else do for one", which clearly differs from childcare.

whether the observed uneven time allocation within Japanese households aligns with this hypothesis.

One challenge in identifying the effect of commuting time on time allocation is that labor market decisions and residential choices, which influences commuting time, are often jointly determined. In addition, job and housing choices may be partially driven by changes in the need of household chores. Gimenez-Nadal and Molina (2016) find supporting evidence that those who bear a disproportionate large burden of household responsibility require a shorter commuting time (known as the Household Responsibility Hypothesis). Therefore, to obtain the causal effect of commuting time on the partner's time allocation, we must address reverse causality while also controlling for couple-level unobserved characteristics, such as preferences for home-produced goods, productivity in market and household activities, and gender role attitudes. In this paper, we utilize a longitudinal data to control for unobserved characteristics of the couple and explore exogenous variations in commuting time as the primary method for identification.

The two main findings are as follows. First, we find that the husband's longer commute is associated with an increase in the wife's childcare time, but it is not associated with the time she spends on housework. When we examine the subsamples, we further find that this result applies to dual-earner couples with wives working in non-full-time jobs and those with elementary-school-aged children (6-12 years old). Second, we find that relative time spent on housework and childcare between spouses is affected by their relative wage with the higher earner performing less housework and childcare. This relationship is also found for households with elementary-school-aged children. Regarding other time uses (paid work and leisure), we do not find any statistically significant effect of commuting time and the relative wage. Overall, our

result supports the hypothesis that time allocation within the household is influenced by comparative advantage of the spouses.

One possible explanation for commuting time affecting childcare time on elementary-school-aged children is that households reduce expenditure on extracurricular activities (such as, piano lessons) in response to the negative income shock, leading the wife to spend more time with their children instead. As an additional analysis, we test this hypothesis by examining whether the husband's commuting time affects household educational expenditure. We find that for households with elementary-school-aged children *and* wives working non-full-time (including part-time and contract workers), a longer commute of the husband is associated with a reduction in household educational expenditure.

We further tested whether women would alter their labor market status in response to changes in the husband's commuting time, as previous research have identified this as a possible response (Abe, 2011; Kawabata and Abe, 2018). Different from previous studies, we did not find commuting time to have any statistically significant effect on the wife's probability of employment and full-time employment status, either for the overall sample or subsamples based on the age of children.

Our paper contributes important empirical evidence to the relatively scant literature on intra-household time allocation in Japan. First, our result shows that the longer commute for the husband does *not* have any effect on the wife's time spent on paid work. If we consider longer commute as a negative income shock, our finding that wife's labor supply does not increase may come as a surprise. Our result also differs from Carta and Phillips (2018) who, using data from Germany, find *negative* effect on wife's paid work hours. Our finding corroborates with the argument that household income alone is not sufficient to induce women to spend more time on

paid work because there is opposing incentives to cut down household expenses by increasing their unpaid work (e.g., childcare time).

Second, our finding that wives with children of elementary-school age are most affected by the husband's commuting time is a novel contribution to the literature. This finding may be surprising, as childcare is typically considered most intense for mothers with infants. As we will discuss later, this result may be unique to Japan, as anecdotal evidence suggests that Japanese households face greater time constraint when children enter elementary school. Our result implies that any policy intervention aimed at educational cost for children may be effective in alleviating the burden of mothers in Japan when households face a negative income shock.

Third, we demonstrate in this paper the importance of distinguishing between time spent on childcare and time spent on housework when examining household time use in Japan. Since Carta and Philips (2018) did not find such a distinction in the case of Germany, our findings further suggest that this difference may be uniquely related to the institutions (e.g., labor laws, family policies) and culture of Japan.

This paper is organized as follows. We introduce our conceptual framework and brief overview of literature in section II. Data and estimation methods are introduced in section III and V. Main results are summarized in section V. Additional analysis and robust check are shown in section VI and VII. The last section concludes.

II. Conceptual Framework and Brief Literature Review

II.A. Conceptual Framework

According to Carta and Phillips (2018), one spouse's time allocation may respond to the longer commute differently depending on how home production function of the household is modelled. Our theoretical framework is based on their work, but we made some adjustment.

The representative household's utility is defined as a function of housework H, childcare K, and leisure L

$$U = U(H, K, L). \tag{1}$$

Each "good" is produced through the following production functions

$$H = H(C_H, h_m, h_f), \tag{2}$$

$$K = K(C_K, k_m, k_f), \tag{3}$$

$$L = L(C_L, l_m, l_f), \tag{4}$$

where C_H, C_K, C_L are the household consumption associated with housework, childcare, and leisure, which are jointly determined by the couple. Variables h_s, k_s, l_s are the time spent on housework, childcare, and leisure, which are determined by each spouse ($s = m$ for the husband and $s = f$ for the wife). We further assume that the production functions (2)-(4) satisfy concavity with respect to their arguments.

Each household operates under both budget and time constraints. The budget constraint is expressed as

$$P_H C_H + P_K C_K + P_L C_L = w_m m_m + w_f m_f, \tag{5}$$

where P_H is the price of housework goods and services, P_K is the price of childcare services, P_L is the price for leisure activities, w_s is the wage rate, and m_s is hours spent on paid work. The time constraint in its normalized form can be expressed as

$$m_s + t_s + h_s + k_s + l_s = 1, \tag{6}$$

where t_s is time spent on commute, which we regard as a fixed time cost associated with any paid work.[9] As implied by the time constraint, leisure is defined as total time net of time spent on paid work, commute, housework, and childcare.

Based on the above settings, the household chooses the quantity of market services and time to maximize (1) subject to constraints (5) and (6). Substituting equations (2)-(4) into (1) and taking first-order conditions with respect to family consumption, paid work m_s, and time uses yields

$$\frac{\partial U}{\partial X}\frac{\partial X}{\partial C_X} = P_X \lambda_B, \tag{7}$$

$$\lambda_B w_s = \lambda_{T_s}, \tag{8}$$

$$\frac{\partial U}{\partial X}\frac{\partial X}{\partial x_s} = \lambda_{T_s}, \tag{9}$$

where $X = H, K, L$ and $x_s = h_s, k_s, l_s$. Variables $\lambda_B, \lambda_{T_m}, \lambda_{T_f}$ are the Lagrangian multiplier associated with the budget constraint and the time constraints of both spouses. Combining conditions (7)-(9) yields

$$\frac{(\partial X/\partial x_s)}{(\partial X/\partial C_X)} = \frac{w_s}{P_X}, \tag{10}$$

$$\frac{(\partial X/\partial x_m)}{(\partial X/\partial x_f)} = \frac{w_m}{w_f}. \tag{11}$$

Equation (10) states that for a given good, the marginal rate of transformation between time and service purchased is equal to the relative price of the corresponding inputs. Equation (11) states

[9] The constraints for both spouses are symmetric because our sample consists of only working couples.

that for a given good, the marginal rate of transformation between time spent across spouses is equal to their relative wage rate.

In this paper, we are interested in how commuting time of the husband t_m affects wife's nonmarket time use x_f, for $x = h, k, l$. To gain further insights, it is convenient to use the concept of "full income" I (Becker, 1981), defined as the maximum income that a household can generate through paid work. This is given as

$$I = w_m(1 - t_m) + w_f\big(1 - t_f\big), \tag{12}$$

Taking derivative of (12) with respect to t_m yields,

$$\partial I/\partial t_m = -w_m, \tag{13}$$

which implies that additional hour of commuting time of the husband decreases the household's full income by the rate of his wage rate. Thus, the effect of the husband's commute time on the wife's time use can be expressed as

$$\frac{\partial x_f}{\partial t_m} = \frac{\partial x_f}{\partial I}\frac{\partial I}{\partial t_m} = -w_m\frac{\partial x_f}{\partial I}. \tag{14}$$

where the last term in (14) measures how the wife's time changes in response to the changes in full income. As noted in Carta and Philippis (2018), the sign of this term depends on the degree of substitutability of the inputs in the production functions (2)-(4). From (14), we can further see that the size of the husband's wage rate (w_m) has the effect of magnifying the effect that the full income has on the wife's time use.

II.B. Literature

The literature on intra-household time allocation have identified many factors that could affect the division of housework and childcare between spouses. Theoretically, gender gap in time use could be influenced by (a) comparative advantage of the spouse (typically women) in

performing household chores, leading them to specialize in housework (human-capital argument); (2) the spouse who earns more (typically men) having greater bargaining power in negotiating how to split the unpaid work within the household (bargaining models); and (3) the gender norms within society, which may pressure women to take up more household tasks ("do gender" argument).

There are several papers that have specifically used commuting time to understand the mechanism of how paid and unpaid work are split among household members. Early studies (e.g. Solberg and Wong, 1992) have shown that in response to a longer commute of the husband, the employed wife decreases her paid work hours whereas the husband increases paid work hours, though they do not find responses in other time use, such as, housework and childcare. Hersch and Stratton (1994) show that market hours, labor income, and education could affect husbands' share in housework.

The broader literature that examine intra-household time allocation is summarized below. Foster and Stratton (2018) find that women's promotions have the strongest effect on housework reallocation, suggesting gender power dynamics plays a significant role in explaining gender gap in housework. Argyrous and Rahman (2017) examine how paid work affect childcare time, and they show that an increase in the father's work hours increases the mother's total childcare time. Stancanelli and Van Soest (2012) show that one spouse's retirement significantly affects the amount of time the other spouse spent on housework, but the effect is not symmetric between men and women. Ueda (2005) uses Japanese data and finds supporting evidence that the earnings of one spouse influence the allocation of housework within the household. Yamamura and Tsutsui (2019) show that spouse age gap could affect housework allocation, and they find that women older than their husbands tend to have a larger share of housework in Japan. Another

strand of literature examining the interdependence of spousal labor supply often finds complementarities in spousal time use (Bredtmann, 2014; Goux et al., 2014), but none of these intra-household studies specifically focus on commuting time.

III. Data

In this paper, we use data from the Japan Household Panel Survey (JHPS/KHPS), a representative longitudinal household survey conducted annually since 2004 by the Panel Data Research Center at Keio University. JHPS/KHPS is an integration of two surveys: The KHPS, which began in 2004 with 4,000 households, and the JHPS, which started in 2009 with additional 4,000 households and included questions on health and education. The survey subjects include men and women who are 20 years and older, who are selected using stratified two-stage sampling method. In 2014, the JHPS and KHPS were merged. The JHPS and KHPS have slightly different focus, but both data contain detailed information on time use and labor-market status of the respondent and their spouse. Available time use categories include work hours (including over time), commuting time, housework, childcare, training or study for work, volunteer activities, and nursing care, all recorded based on both frequency and time spent within a specific time frame.[10] The advantage of our data is that it is a longitudinal data, spanning over ten years, which allows controlling for time-invariant confounding factors and explore changes in residence and employment over time. There are also disadvantages. Because it is not a dedicated time use survey, we cannot compare time use between weekdays and weekends, and

[10] We note that commute and housework time were not available in JHPS 2009 and 2010 (it is available in KHPS 2009 and 2010). Childcare time was not available in JHPS 2009.

time uses may be distributed unevenly across these days. Since time use variables are not available in 2004, we exclude this year from our sample and only use data from 2005 to 2020.

Our main sample consists of married dual-earner couples in which both the husband and the wife are between the ages of 20 and 64. We dropped couples in which one of the spouses is either unemployed, self-employed, or on leave,[11] which applies to 17.5% of the husbands and 35.2% of the wives in our original sample. Self-employed individuals often have different commuting patterns, and the changes in commuting time for self-employed are likely to be due to different reasons. We dropped couples with either the husband or the wife enrolled in school ("work while studying") [12] and couples reporting zero hours in joint housework time. Lastly, we dropped observations with missing information for any of the variables used in our analysis.

Respondents were asked about their frequency and average time for major daily activities. There are five possible answers for "frequency" (almost every day, a few times per week, once a week, almost never, and never). Commuting time is defined as the one-way commute to work or school, measured in minutes. Housework includes preparing meals, laundry, grocery shopping, and cleaning. Housework and childcare time are recorded as average hours per day if the respondent answered "almost everyday", and as hours per week if the respondent answered "a few times per week" or "once a week". We multiply daily hours spent on housework and childcare by seven to be comparable with weekly hours. We assign a value of zero for the specific time use if the respondent answers "almost never" or "never". Therefore, those who perform housework or childcare only occasionally are coded as zero in our sample. Leisure is defined as in Equation (6), i.e., total available time in a week net of paid work,

[11] This includes those taking leave for health reasons, childcare, nursing care, etc.
[12] The "commute" variable is defined as average time commuting to work or school. In order to isolate commuting time to work, we must remove those enrolled in school.

commuting time, housework, and childcare time. It includes activities such as sleep, personal care, rest and relaxation, hobbies and amusements, and exercise.[13]

Our final sample consists of 3,940 dual-earner couples, with a total of 17,146 couple-level observations.

IV. Estimation

To identify the effect of commuting time on labor market outcomes, we employ a strategy that isolates the exogeneous changes in commuting time. Specifically, we utilize the variation of commuting time when the change is *not* due to changes in either the husband's job or residence. In other words, we exclude the cases for which the change in commuting time is due to endogenous decisions that reflect family needs. Consequently, if there is any change in commuting time, it would be due to reasons that are exogenous to the individual, such as firm relocation or job transfer within the same workplace.[14] This approach of using firm relocation/transfer as a natural experiment to identify the causal effect of commuting time has been adopted in the literature by previous studies (Gutierrez-i-Puigarnau and Van Ommeren, 2010, 2015; Carta and Phillips, 2018; Botha et al., 2022).

We examine cross-couple effects based on exogeneous variations in the husband's commuting time. In other words, the fixed effects are defined using information about the husband's job change and the couple's residence change. We call this residence-job fixed effects. Let $x_{rt,f}$ denote the weekly time use of the wife (= *f*) for a given year (= *t*). The lower-case letter *r* denotes a specific couple residence – husband job combination, which is also our

[13] Note that our definition of leisure partially includes unpaid works such as caring and nursing, travel related to housework, and volunteer activity. However, since the time use for these activities are either rare or remain relatively small for dual-earner couples with young children (which is the main target in this paper), we did not isolate them from other leisure activities.
[14] Other reasons may include occasional road congestion or public infrastructure changes related to transportation.

panel unit. If there is a change in either the couple's address or the husband job, *r* will be different. Within the residence-job combination, the effect of commuting time on wives' time use are unlikely to be due to major life events. Specifically, we estimate the following fixed effects regression model.

$$x_{rt,f} = \alpha_0 + \alpha_1 \ln t_{rt,m} + \alpha_2 V_{rt} + \gamma_t + \delta_r + \varepsilon_{rt}, \quad (15)$$

where $\ln t_{rt,m}$ refers to the log of the husband's commuting time. V_{rt} are couple-level control variables that include both spouses' age, age squared, their age gap squared, whether the person is the household head (often the main earner of the household), number of family members, number of children in three age groups (0-5, 6-12, and 13-20 years old), whether either side of the parents live together with the couple, whether they live in a house, whether they own the current residence, and the couple's nonlabor income. Since age difference and education variables do not change over time, they are excluded from the regression. γ_t is the year fixed effects, δ_r is the fixed effects for each combination of residence and the husband's job. The coefficient α_1 is our main interest because it captures the effect of husband's commuting time on wife's time uses (paid work, housework, childcare, and leisure time) due to exogeneous reasons.

The age groups of children require additional explanation, as they are crucial in understanding and interpreting our later result. In the Japanese school system, children usually start elementary school from 6-7 years old and transition to middle school around 12 years old. For households with infants, enrolling in government-owned daycare center typically requires both spouses to be employed, while enrolling in a private daycare / kindergarten does not have this requirement. The cost of government-owned daycare in Japan is low to almost none, whereas private daycare / kindergarten can be expensive.

For households with children in elementary schools, options vary depending on the work-status of the couple. For full-time working moms, their children can be sent to after-school childcare clubs (*gakudo*), which are primarily provided by the local government. Unlike in the case of daycare, households with either or both parents working part-time are usually not eligible for such services. Thus, the available options for most of these parents are to enroll their children in private daycare services (including sports, music, art class, and cram schools) or to keep their children at home, which is legal in Japan.

The transition from daycare / kindergarten (0-5) to elementary school (6-12), metaphorically referred to as a "steep wall", is the most challenging for many parents. This is due to the additional burden of taking care of children after school, which can start as early as 1pm, depending on the day of the week. The duty often falls on the wife when the household is not eligible for *gakudo*. In comparison, the transition from elementary school (6-12) to middle school and beyond (13-20) is regarded as less problematic for parents. However, their financial and time costs may increase if they send their children to a reputable private school through a competitive entrance exam.

Because of the seemingly important role of development stage in discussing the time use of parents, we also provide results for subsamples based on the child's age in our later analysis. Naturally, some households may appear in multiple subsamples, as they may have children in different age groups.[15]

We further note that the wife's employment may have changed or remain the same. As found by existing studies in the literature, the wife may change her employment probability or job status (full-time, part-time) in response to changes in the husband's commuting time. In

[15] Specifically, 843 households have children in the 0-5 and 6-12 age group. 2138 households have children in the 6-12 and 13-20 age group. 45 households have children in the 0-5 and 13-20 age group. 108 households have children in all three age groups.

alternative regressions, we also examine whether the probability of employment and the full-time working status of the wife respond to the husband's commuting time.

V. Main Results

V.A. Descriptive Statistics

In this section, we provide summary statistics for the variables used in estimation, and describe the methods for validity checks of our identification strategy.

In Table 1(a), we summarize variables that are common to all household members. The average number of family members is 3.82. The percentage of samples with children less than 20 years old is 63%. 18% of the samples live together with parents from either side, and 75% live in a detached house or semi-detached house (town house). 82% own their residence. The average amount of financial asset includes deposits and securities (investment in stock, bond, trust) are 6.69 million yen.

Table 1 (b) provides summary statistics on time uses for the spouses separately. The average age of the husbands is 48.45, while the average age of the wives is 46.44. Additionally, 93% of the household heads are male. In terms of time allocation, we observe a pattern of labor specialization: husbands spend more time on paid work and commuting, whereas wives spend more time on housework and childcare.

Regarding paid work, husbands' average weekly working hours are 18.12 hours longer than those of the wives (46 hours for husbands and 28 hours for wives). Furthermore, husbands' average weekly commuting time is 3.28 hours longer than the wives, with one-way commuting time being 37 minutes for the husbands and 20 minutes for the wives. The reason for the significantly shorter working hours of wives is that most of them are employed as non-regular

workers (*hiseiki koyou*).[16] In our sample, roughly 26% of wives work full-time. The remaining 74% are categorized as non-full-time working wives, which include part-timers and contracted workers.

Regarding housework, the pattern is reversed. The wife' average time spent on housework per week is 20.83 hours longer than the husband. The same applies to childcare: the wife's average time spent on childcare per-week is 11.30 hours longer than the husband.[17] The unevenness of childcare time is even more pronounced for households with zero and five years old (with a gap of 27.6 hours). When we compare leisure time across spouses, we find that husbands enjoy 6.8 hours more leisure time than wives per week (approximately 58 minutes per day). On the other hand, husbands earn 3.91 million yen more than wives per year (approximately 10,712 yen per day).

In Figure 1, we provide the distribution of the time use gap, defined as the wife's time use minus the husband's time use. We see that the gap in housework and childcare is heavily skewed to the right and positive for 97.5% of the households, which confirms that wives perform more household chores than husbands in majority of the Japanese households. Paid work and commuting time are left skewed. 80% of the husbands have longer work hours than their wife and 64% of the husbands have longer commuting time than their wife. The gap in leisure time is more symmetric with a slight left skewness. The descriptive statistics is consistent with the finding in the literature that the gap in housework is negatively associated with the gap in paid work (Foster and Stratton, 2019; Hersch and Stratton, 1994).

[16] During the past decade, non-regular employment (which include part-timers) has become a prevalent work style among working mothers in Japan (Asano *et al*., 2013; Abe, 2013; Tashiro, 2017). This work style provides more flexibility in work schedule than regular employment (*seiki koyou*). Thus, many mothers with young children choose to work part-time to take care of their children and at the same time financially support their family.

[17] We note that 47% of the husbands report no housework while only 0.24% of the wives report no housework. The high percentage of husbands reporting no housework time is not unexpected in Japan. As Ueda (2005) found using another data source that close to 50% of the husbands report zero housework time and 37% for those with a full-time-working wife.

Since our main identification strategy is based on the changes in commuting time across waves due to workplace relocation and job transfer, we provide summary statistics for the changes of commuting time. Table 2 shows the distribution of changes in commuting time across waves for husbands. We observe that slightly more than half of the husbands (54%) within the same residence-job combination report changes in commuting time across waves. The positive changes are more than negative changes, indicating commuting time associated with exogeneous changes has been slightly increasing. Roughly 20.81% of the husbands report a change in commuting time for more than 15 minutes, and 36.03% report a change in commuting time more than 10 minutes.

Figure 2 shows the distribution of commuting time for both the husband and the wife, and we observe that commuting time is heavily right skewed. In estimation, we take the log of commuting time to account for the skewness, and log transformation also helps to limit the impact of measurement errors.

V.B. Results of the Overall Sample

We report our main estimation results by using residence-job fixed effects models that control for time-invariant unobserved variables as well as household-level time-varying observables.

We first show how the husband's commuting time affects the wife's time use for the overall sample. Results are available in Table 3. We find statistically significant effect for time spent on childcare: doubling the husband's one-way commuting time increases the wife's

childcare time by 0.359 hours (or 21 minutes) per week. However, there is no statistically significant effect on the wife's working hours, housework, and leisure time.[18]

The table further explores whether the effect of the husband's commuting time is different for full-time versus non-full-time-working wives. We find that for wives working non-full-time the coefficient for childcare is statistically significant. Furthermore, the effect appears to be larger than in the case of the overall sample, i.e., doubling the husband's one-way commuting time increases the wife's childcare time by 0.538 hours (or 32 minutes) per week. For wives working full-time, the coefficient for childcare is statistically insignificant.

The above result could be due to several reasons. First, full-time-working moms have better access to *gakudo*, as it has specific working hour requirements to become eligible. Second, households with full-time-working couples can afford to sign up their children for extracurricular activities after school, which helps in reducing their own time spent on childcare.

V.C. Results for Household with Children

The overall sample includes households without children. In this section, we examine the effect of commuting time while restricting our sample to households with children. Table 4(a) shows the result for all households with children, regardless of the wife's work status. When all age group of children are considered, the coefficient on childcare is 0.619, which almost doubles the estimate for the overall sample. For wives with children enrolled in elementary school (ages 6-12), the coefficient for childcare is 1.633 and statistically significant. This coefficient implies that when the husband's commuting time is doubled, the wife's time spent on childcare increases

[18] In Appendix Table A1, we show that husbands reduce their *own* leisure time and time on housework in response to the longer commute. The coefficients imply that doubling husband's one-way commuting time decreases his leisure time by 4.051 hours per week (≈34 minutes per day) and decreases his housework time by 0.206 hours per week (≈2 minutes per day)

by approximately 98 minutes per week. Furthermore, the increase in childcare time is fully matched with the decrease in leisure time, which is also statistically significant. For women with middle-school-age children and above (ages 13-20), the coefficient is moderately high (0.549) and statistically significant. For women with infants (ages 0-5), the coefficient is positive but statistically insignificant.

Table 4 (b) and (c) show the results for the subsamples of wives working full-time and non-full-time, respectively. Same as in Table 3, for wives working full-time (Table 4 (b)), we find that the husbands' commuting time has no statistically significant effect on their time use, regardless of the child's age. For wives working non-full-time (Table 4 (c)), the coefficient on childcare time is 0.984 for all households with children, and 1.958 for households with 6-12 years old, and 0.686 for households with 13-20 years old. The largest marginal effect occurs again for mothers with 6-12 years old, implying that when the husband's commuting time is doubled, the wife's time spent on childcare increases by 118 minutes per week. This increase in childcare time is again fully matched with the decrease in leisure time (-1.996). Another interesting finding is that for wives working non-full-time and household has infants, the increase in the husband's commuting time significantly *decreases* her time spent on housework.[19]

In sum, the largest effect across spouses is found for households with elementary-school-aged children (ages 6-12). One possible reason is that facing the negative income effect, households may reduce educational expenditure for elementary-school-aged children and instead the wife spend more of her own time on childcare. This is consistent with our finding that mother's leisure time is significantly reduced, matching the increase in her childcare time. The

[19] Note that husbands' time on housework is unchanged (Appendix Table A1), which implies that the time spent on housework is effectively "saved".

effect of a longer commuting time diminishes for mothers with older children perhaps because their educational needs become less responsive to households' total income.[20] We will explore this issue in Section V.

V.D. Substitution between husbands' and wives' time use

Our results so far suggest that there is significant substitution in time use across spouses. For the substitution to occur, we would expect that the husband's and wife's time in home production to respond to their relative wages, as shown in Equation (11).

We test this hypothesis by estimating the following fixed effects regression,

$$\ln \frac{x_{rt,m}}{x_{rt,f}} = \beta_0 + \beta_1 \ln \frac{w_{rt,m}}{w_{rt,f}} + \beta_2 V_{rt} + \gamma_t + \delta_r + \epsilon_{rt}, \qquad (16)$$

where V_{rt} are couple-level control variables, which are the same as in equation (15). Since natural log is used in the regression, the sample only consists of couples who have either positive housework or positive childcare hours. Fixed effects models within residence-job combinations are estimated.

Table 5 reports the coefficient estimate (β_1) on the log of the relative wage. We found no evidence of substitution for the overall sample, but for household with elementary school children (ages 6-12) we find that if the husband's relative wage rate increases, his relative time spent on housework or childcare decreases. This subsample was also the sample from which we found the largest effect from a longer commuting time.

[20] For example, to prepare for the college-entrance exams, going to cram schools is a must for high-school students and may not be substituted by parents' time.

VI. Further Analysis

VI.A. Effect of Commuting Time on Household's Educational Expenditure

In this section, we examine how household expenditure on education is affected by the husband's commuting time. In JHPS/KHPS, respondents are asked about their household expenditure in 17 major categories that occurred during the previous month of the interview. One of the categories is education, which includes school tuition, cost of textbooks and learning reference materials, and tutoring fees, among others.

The first four rows of Table 6 show the descriptive statistics of the household's education expense for the overall sample, which includes households with and without children. The fraction of households incurring educational expense was 0.559, while the mean expenditure conditional on positive expense was 44,139 yen. When we look at the subsamples based on the child's age, the fraction are 0.631 (0-5 years old), 0.841 (6-12 years old), and 0.825 (13-20 years old). The mean expenditures are 23,599, 27,029, and 48,642 yen for the three age groups, respectively. The latter part of Table 6 shows the results for subsamples based on whether the wife works full-time or not. Same as the overall sample, we find that both the fraction of households with educational expenditure and mean expenditure rise as children grow. The average expenditure is slightly higher for households with wives working full-time compared to those with non-full-time working wives, likely reflecting the difference in household income. The gap between the two groups also depends on the child's age. For households with elementary school children, the gap between the two types of households is almost negligible both in terms of fraction (0.821 for full-time vs. 0.843 for non-full-time) as well as expenditure (26,616 yen for full-time vs. 26,965 yen for non-full-time).

Next, we run the regressions based on residence-job fixed effects. Due to the large fraction of zeroes in the expenditure variable, a linear model would not fully capture the non-linearity in the data. We use a two-part model for estimation. The estimating equations are as follows.

Part I. Probability of incurring a positive spending.

$$P(spending_{rt} > 0) = \theta_0 + \theta_1 \ln t_{rt,m} + \theta_2 V_{rt} + \gamma_t + \delta_r + \varepsilon_{rt}$$

Part II. Expenditure conditional on incurring a positive spending.

$$Y_{rt} \mid (spending_{rt} > 0) = \pi_0 + \pi_1 \ln t_{rt,m} + \pi_2 V_{rt} + \gamma_t + \delta_r + \xi_{rt}$$

$$where\ Y_{rt} = \ln (spending_{rt})$$

In the first part, we estimate the probability of incurring any educational spending. In the second part, we predict (logged) expenditure conditional on incurring a positive spending.[21] The two parts are estimated separately by using the residence-job fixed effects regressions.[22] The covariates used in both parts are the same as in equation (15). The error terms are assumed to be independent. The regressions are run for the overall sample as well as subsamples based on the wives' work status and age of children.

Results are shown in Table 7. First, we find that for both the overall sample (Table 7(a)) and households with full-time-working wives (Table 7(b)), the husband's commute time has no statistically significant effect on educational expenditure. For non-full-time-working wives (Table 7(c)) and only in households with 6-12 years old, the probability of incurring a positive expenditure and expenditure both decrease statistically significantly. The marginal effects

[21] For left-truncation in time use, the Tobit model is also a possible choice. However, the Tobit model imposes a strong assumption that the mechanism governing participation is the same as the mechanism governing the amount of time spent on the activity conditional on participation. In addition, conducting fixed effects on the Tobit model is more challenging.
[22] Part I of the two-part model usually follows a logit or probit distribution because the dependent variable is binary. Fixed effects logit models often encounter convergence issues. In our estimation, we estimate linear fixed effect model for both parts.

suggest that the probability of incurring an expenditure decreases by 3.9 percentage points, and the average expenditure decreases by 10.7% if the husband's commuting time doubles. For full-time and non-full-time-working moms with either 0-5 years old or 13-20 years old, the effect remains statistically insignificant. This exercise suggests that non-full-time-working moms substitute their own time for educational expenditure, but this effect is observed only for households with elementary school aged children.

VI.B. Does Husbands' Commuting Time Affect the Wife's Employment?

Past studies have identified commuting time as an important factor for the wife's labor force participation (e.g. Abe, 2011; Kawabata and Abe, 2018). For example, Kawabata and Abe (2018) find a negative association between men's commuting time and married mothers' labor force participation and regular employment rates using metropolitan data in Japan. In response to the husband's the longer commute, the wife may alter her employment or work status (for example, from full-time to part-time, or vice versa).

To elaborate on this question, we must expand our sample to include non-working wives while keeping employed husbands. The overall sample now includes 26,616 women, of which 66.96% were employed. Among the employed women, 16,447 are employee-type of workers. Among the employee-type of workers, 29.04% of the women are full-time workers and the rest are part-time. We note that full-time and part-time work status is only distinguished for employees. We conduct analysis for the overall sample and the sample with and without children. The estimation equations are the same as equation (15) except that the dependent variables are binary indicator variables: whether employed (= 1 if employed, 0 otherwise), whether working full-time (=1 if working full-time, 0 otherwise).

Table 8 shows the results. We do not find any statistically significant effect on the employment probability of the wife. This is the case for the overall sample and subsamples of women with and without children. For full-time work status, the coefficient of commuting time is negative, but none are statistically significant. Kawabata and Abe (2018) find that a longer husband's commuting time is associated with lower labor force participation and regular work rates for married mothers. The main difference between our paper and theirs is that they use metropolitan data from Tokyo, whereas our data come from all prefectures in Japan. In addition, our data are based on household surveys, rather than metropolitan averages, and the estimation methods employed in our paper differ from theirs.

VII. Robustness Check

One concern is that some of the employer-induced job changes may be endogenous meaning that the worker may request a relocation or job transfer due to family needs. This could introduce a bias in estimating the causal effect of commuting time on time allocation if the job relocation is driven by factors related to the household's time use or needs. For example, the husband may *request* job relocation in anticipation of future childbirth. In addition, at the end of maternity leave, women and/or their husbands may also adjust their commuting time to accommodate returning to work.

In this exercise, we use childbirth as the dependent variable and examine whether his commuting time are associated with the leads and lags of newborn. Childbirth is defined as 1 if the family has a newborn under two years old in time t and 0 otherwise. We examine two lags (t -1, t -2) and two leads (t +1, t +2) of the childbirth variable, which cover about five years around the birth of a child. Results are shown in Appendix Table A2. For all the time use variables, we

find small and statistical insignificant results, suggesting that changes in his commuting time is unlikely to be associated with newborn child.

Another concern with our empirical strategy is that the change in commuting time may be associated with changes in job characteristics. If employer-induced job changes are associated with changes in the wage rate, and since wage differential may be associated with bargaining power, the resulting estimate may be contaminated by the wage effect. In this analysis, we use wage rate as the dependent variable and examine whether changes in commuting time could be related to changes in one's wage. In models with fixed effects either at the couple level or residence-job level, the coefficients of husbands' commuting time are not statistically significant. This result suggests that once time-invariant unobservables are controlled for, the wage rate is no longer responsive to the change in commuting time. This reassures us our main results using fixed effects specifications. The results are available in Appendix Table A3.

Lastly, we conducted analysis to examine whether the effect we detected earlier are due to bargaining power changes in the household. The bargaining models link the bargaining power within the household with time use. Past studies have shown that commuting time is associated with a wage increase in the years after firm relocations (Mulalic et al. 2014). If this is the case, the increase in commuting time might tilt the bargaining power towards the husband, causing the wife to take on more household responsibilities. Past studies have used relative wages, relative education, and relative income to proxy bargaining power (e.g. Gupta and Stratton, 2008; Hersch and Stratton, 1994; Bittman *et al*., 2003, Connelly and Kimmel, 2009). To test whether bargaining power plays a role in the explanation of the effect we found on childcare, we use the relative wage as the dependent variable and perform the fixed effects regressions based on both couple fixed effects and residence-job fixed effects. Results are available in Appendix Table A3.

The husband's commuting time is negatively associated with relative wage, but the effect is statistically insignificant in the overall sample as well as the subsamples based on the child's ages. This result suggests that bargaining power is not the main reason behind the shift in childcare time.

In additional analysis, we conducted regressions by using couple-level fixed effects. We also excluded changes in commuting time less than 10 or 15 minutes because small changes in commuting time could be due to reporting errors. These results are available in Appendix Table A4 and A5. Our main conclusions hold in these alternative specifications.

VIII. Conclusions

In this paper, we study spousal commuting time and its impact on intra-household time allocation. We examine this question: Do women change their time spent on paid work, housework, childcare, and leisure when their partner incurs a longer commuting time? To answer this question empirically, we utilize a longitudinal Japanese household survey that spans from 2004 – 2020 and restrict our sample to dual-earner households. The longitudinal nature of the data allows us to track the same household over time while controlling for time-invariant factors. As commuting time, labor supply, and household responsibilities are often jointly determined, we handle this endogeneity by utilizing a fixed effects model in which the panel unit is based on the residence of the couple and job status of the husband. We find that (1) childcare time increases for wives whose husband incurs a longer commuting time; (2) the effect is strongest for part-time working wives with elementary-school-aged children; (3) spouses substitute their time spent on housework / childcare based on their relative wages. Further analysis reveals that an increase in the husband's commuting time is associated with a lower

probability of incurring educational expenditure, as well as lower expenditure, for non-full-time moms with elementary-school-aged-children. Such effects do not exist for households with either older or younger children. Various robustness analysis suggest that our results were neither driven by changes in the wage rate, nor associated with childbirth and changes in bargaining power within the household.

Our paper demonstrates that there is strong evidence supporting intra-household substitution in the domain of childcare. As demonstrated in Carta and Phillips (2018), when the service bought in the market and those produced in the household are not perfect substitute, households may shift from services bought in the market to domestically produced goods in response to a negative income shock. The adjustment is most likely to occur for the partner who has a lower opportunity cost of time within the household. Our findings demonstrate that the margin of adjustment in home production appears to occur for non-full-time-working mothers in Japan, as they reduce their leisure time and increase their time spent with children, though there is no significant response in their labor supply. Our result suggests that policies that could potentially affect commuting time may influence labor specialization within the household, which, in turn, affects childcare and children's education.

Our results have several implications. Since the COVID-19 pandemic, many firms have offered the option of working from home, which has necessarily changed commuting time and frequency. Understanding the impact of commuting time on partners' time allocation could help in understanding gender gap and labor specialization within the household. As we know, a large portion of the gender inequality in Japan comes from the inequality in the division of labor in the household. If commuting time is associated with a shift of household burdens among dual-earner

couples, then policies that change commuting time could possibly alter gender inequality and division of labor within the household.

One limitation of our study is that we cannot identify the exact nature of the expenditure on education, such as, whether it is used for general activities (art, sports) or educational activities (such as, cramming school), whether it is used for daughters or sons. Therefore, we cannot draw conclusions about who are affected the most by this change in time use and how they are affected. In addition, our time use data are not from time diaries, which means we cannot distinguish between time use on weekdays and weekends. With better data, we may be able to address these questions in future research.

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Appendix Tables

Table A1 Effect of Husband's Commuting Time on Own Time Use

	Full-time work	Work hours	Housework	Childcare	Leisure
Overall sample (*N*=17,146)	0.005 (0.004)	0.249 (0.293)	-0.206** (0.094)	0.041 (0.058)	-4.051*** (0.315)
(a) Households with 0-5 years old (*N*=1,639)	-0.030* (0.016)	0.561 (1.210)	0.003 (0.329)	-0.247 (0.465)	-4.252*** (1.323)
(b) Households with 6-12 years old (*N*=5,031)	0.000 (0.006)	0.312 (0.677)	0.022 (0.273)	0.066 (0.205)	-4.580*** (0.735)
(c) Households with 13-20 years old (*N*=7,340)	0.003 (0.004)	0.108 (0.442)	-0.365** (0.142)	-0.003 (0.083)	-3.800*** (0.495)

Note: The estimations are based on job-residence-couple fixed effects of equation. The sample consists of only males. The dependent variables are weekly time allocation of themselves. Commuting time is used in logarithm form. We divide the sample based on whether the household has children in the three age groups (0-5, 6-12, and 13-20 years old). Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table A2 Are Commuting Time Related to Childbirth?

	Childbirth $(t-2)$	Childbirth $(t-1)$	Childbirth (t)	Childbirth $(t+1)$	Childbirth $(t+2)$
His commuting time	0.0027 (0.002)	0.0017 (0.0014)	-0.0022 (0.0015)	0.00002 (0.001)	0.0017 (0.0015)
N	14,637	16,190	17,146	14,884	12,811

Note: The dependent variable is whether the household has a newborn in year t, $t-2$, $t-1$, $t+1$, and $t+2$ Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. The numbers in the parenthesis represent standard errors.

Table A3 How Husbands' Commuting Time Affect Own Wage and Relative Wage

	Relative wage	Relative wage	Own wage	Own wage
Overall sample (N=12,281)	-0.007 (0.014)	-0.010 (0.016)	0.004 (0.011)	-0.008 (0.011)
(a) Households with 0-5 years old (N =967)	-0.055 (0.036)	-0.084 (0.053)	0.029 (0.025)	0.040 (0.033)
(b) Households with 6-12 years old (N =3,405)	-0.022 (0.028)	-0.038 (0.032)	0.008 (0.023)	0.008 (0.027)
(c) Households with 13-20 years old (N =5,070)	0.018 (0.022)	0.013 (0.025)	-0.005 (0.018)	-0.007 (0.019)
Estimation method	Couple fixed effects	Residence-job fixed effects	Couple fixed effects	Residence-job fixed effects

Note: Relative wage is defined as wife's wage divided by the husband wage. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. The number in the parenthesis represent standard errors.

Table A4 Effect of Husbands' Commuting time on Wife's Time Allocation (Couple Fixed Effects)

	Work hours	Housework	Childcare	Leisure
Overall sample (*N*=17,146)	-0.095 (0.235)	-0.029 (0.159)	0.132 (0.162)	-0.146 (0.311)
(a) Households with 0-5 years old (*N* =1,639)	-0.137** (0.698)	-0.944* (0.561)	1.034 (0.789)	1.180 (1.219)
(b) Households with 6-12 years old (*N* =5,031)	-0.482 (0.410)	-0.171 (0.369)	1.014** (0.469)	-0.445 (0.767)
(c) Households with 13-20 years old (*N* =7,340)	-0.112 (0.328)	0.176 (0.275)	0.450** (0.212)	-0.623 (0.443)

Note: The estimations are based on couple-level fixed effects. Time allocation is in terms of weekly. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table A5 Effect of Husbands' Commuting Time on Wife's Time Allocation

(a) Excluding those with <=10 minutes changes in commuting time

	Work hours	Housework	Childcare	Leisure
Overall sample (N=14,636)	-0.057 (0.286)	0.069 (0.206)	0.273 (0.184)	-0.318 (0.377)
(a) Households with 0-5 years old (*N* =1,433)	-1.037 (0.926)	-0.866 (0.686)	1.207 (0.988)	0.527 (1.533)
(b) Households with 6-12 years old (*N* =4,339)	-0.302 (0.496)	-0.196 (0.407)	1.510*** (0.531)	-1.161 (0.864)
(c) Households with 13-20 years old (*N* =6,244)	-0.018 (0.336)	-0.041 (0.330)	0.328 (0.258)	-0.395 (0.501)

(b) Excluding those with <=15 minutes changes in commuting time

	Work hours	Housework	Childcare	Leisure
Overall sample (*N*=12,509)	-0.233 (0.308)	-0.111 (0.223)	0.335* (0.176)	-0.155 (0.403)
(a) Households with 0-5 years old (*N* =1,241)	-0.582 (0.705)	-0.606 (0.751)	1.052 (1.072)	-0.035 (1.656)
(b) Households with 6-12 years old (*N* =3,701)	-0.561 (0.518)	-0.446 (0.432)	0.948 (0.588)	-0.048 (0.913)
(c) Households with 13-20 years old (*N* =5,279)	-0.067 (0.372)	-0.082 (0.364)	0.461* (0.275)	-0.441 (0.535)

Note: Job-residence-couple fixed effects are used in these regressions. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table 1 Descriptive Statistics

(a) Household-level variables

	Mean
Number of family members	3.82 (1.31)
Fraction of households with a wife working full-time	0.26 (0.44)
Fraction of households with children between 0 and 20	0.63 (0.48)
Number of children between 0 and 20	1.16 (1.08)
Number of children between 0 and 5	0.11 (0.36)
Number of children between 6 and 12	0.41 (0.71)
Number of children between 13 and 20	0.63 (0.84)
Whether parents living together	0.18 (0.38)
Whether live in a house (versus apartment)	0.75 (0.43)
Whether own residence	0.82 (0.39)
Nonlabor income of the household (measured in million yen)	6.69 (13.21)

Note: Sample size is $N = 17{,}146$ couples. These variables are common to the household. Nonlabor income is the sum of savings and securities. The numbers in the parenthesis are standard deviations.

(b) Individual-level variables

	Husband	Wife	Wife minus husband
Age	48.45 (8.67)	46.44 (8.21)	-2.01 (3.60)
Head of the household	0.93 (0.25)	0.07 (0.25)	-0.91 (0.42)
Market work (hours per week)	45.92 (15.53)	27.80 (15.19)	-18.12 (20.88)
Commuting time (hours per week)	6.10 (4.68)	2.82 (2.67)	-3.28 (514)
Commuting time (one-way, minutes)	37.11 (27.95)	20.26 (17.60)	-16.84 (30.53)
Housework (hours per week)	2.14 (4.00)	22.96 (13.03)	20.83 (14.02)
Childcare time (households with 0-20 years old) ($N = 10{,}768$)	2.60 (5.63)	13.90 (18.85)	11.30 (17.40)
Childcare time (households with 0-5 years old) ($N = 1{,}639$)	8.17 (8.46)	35.77 (22.80)	27.60 (23.70)
Childcare time (households with 6-12 years old) ($N = 5{,}031$)	3.78 (6.13)	21.11 (19.50)	17.33 (18.99)
Childcare time (households with 13-20 years old) ($N = 7{,}340$)	0.98 (3.28)	7.28 (12.99)	6.30 (12.42)
Leisure time	112.12 (17.52)	105.32 (24.61)	-6.80 (27.35)
Labor income from last year (measured in million yen)	5.75 (2.85)	1.84 (1.77)	-3.91 (3.31)

Note: Sample size is $N = 17{,}146$ couples. The numbers in the parenthesis are standard deviations.

Table 2 Exogenous changes in commuting time for the husband

Changes in commuting time	Percentages
% without changes in commuting time	46.02%
% with positive changes	29.71%
% with negative changes	24.27%
% with changes in commuting time >= 15 minutes	11.97% (positive) 8.84% (negative)
% with changes in commuting time >= 10 minutes	20.10% (positive) 15.93% (negative)

Note: these changes in commuting time exclude changes due to a job change or a residence change. The numbers indicate that the husband's commuting time has become longer because there are more positive changes than negative changes.

Table 3 Effect of Husbands' Commuting Time on the Wife's Time Allocation, Overall, and by Work Status

	Paid work	Housework	Childcare	Leisure
Overall sample (N = 17,146)	0.004 (0.262)	0.047 (0.184)	0.359** (0.174)	-0.545 (0.355)
Wife working full-time (N = 4,498)	0.299 (0.495)	0.063 (0.251)	-0.145 (0.242)	-0.432 (0.646)
Wife working non-full-time (N = 12,648)	-0.036 (0.296)	0.054 (0.221)	0.538** (0.215)	-0.689 (0.432)

Note: The estimations are based on job-residence-couple fixed effects of Equation (15). Time allocation is in terms of per week. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. The subsample of wives working non-full-time include part-time and contract workers. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table 4 Effect of Husbands' Commuting Time on the Wife's Time Allocation, by Children's Age and Wife's Work Status

(a) Overall Sample

	Paid work	Housework	Childcare	Leisure
Households with Children	-0.233	0.146	0.619**	-0.619
(*N* = 10,768)	(0.290)	(0.257)	(0.247)	(0.462)
(a) Households with 0-5 years old	-0.754	-0.873	1.023	0.446
(*N* = 1,639)	(0.834)	(0.660)	(0.977)	(1.449)
(b) Households with 6-12 years old	-0.224	0.165	1.633***	-1.679***
(*N* = 5,031)	(0.437)	(0.397)	(0.516)	(0.846)
(c) Households with 13-20 years old	0.005	0.093	0.549***	-0.725
(*N* = 7,340)	(0.328)	(0.312)	(0.246)	(0.491)

(b) Wife Working Full-time

	Paid work	Housework	Childcare	Leisure
Households with Children	0.447	0.297	-0.341	-0.722
(*N* =2,611)	(0.698)	(0.375)	(0.420)	(0.934)
(a) Households with 0-5 years old	-1.566	0.029	-0.677	1.827
(*N* = 648)	(2.065)	(1.377)	(1.447)	(3.018)
(b) Households with 6-12 years old	-0.148	0.144	0.561	-1.004
(*N* = 1,181)	(1.193)	(0.699)	(1.215)	(1.874)
(c) Households with 13-20 years old	0.797	-0.041	0.083	-1.222
(*N* = 1,565)	(0.770)	(0.474)	(0.504)	(1.137)

(c) Wife Working Non-Full-time

	Paid work	Housework	Childcare	Leisure
Households with Children	-0.243	0.085	0.984***	-0.857*
(*N* = 8,157)	(0.292)	(0.293)	(0.288)	(0.520)
(a) Households with 0-5 years old	-0.281	-1.572**	1.430	0.346
(*N* = 991)	(0.742)	(0.708)	(1.158)	(1.609)
(b) Households with 6-12 years old	-0.147	0.156	1.958***	-1.996**
(*N* = 3,850)	(0.443)	(0.454)	(0.598)	(0.938)
(c) Households with 13-20 years old	-0.188	0.195	0.686**	-0.716
(*N* = 5,775)	(0.334)	(0.352)	(0.282)	(0.563)

Note: The estimations are based on job-residence-couple fixed effects of Equation (15). Time allocation is measured as weekly time use. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. The subsample of wives working non-full-time include part-time and contract workers. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table 5 Substitution Between Husbands and Wives' Time Spent on Housework and Childcare

	Housework	Childcare
Households with children between 0-20	-0.046 (0.046) *N* = 2,542	-0.074 (0.047) *N* = 1,629
(a) Households with children between 0-5	-0.074 (0.112) *N* = 475	0.001 (0.096) *N* = 609
(b) Households with children between 6-12	-0.152** (0.070) *N* = 1,211	-0.213*** (0.051) *N* = 1,190
(c) Households with children between 13-20	-0.019 (0.058) *N* = 1,658	-0.094 (0.077) *N* = 559

Note: fixed effects models for the residence-job combination are conducted. The dependent variable is log of the relative housework hours or relative childcare hours (wife/husband). The coefficient reported is the coefficient for the relative wage (also logged). The estimation requires both spouses report positive hours, thus the sample size differs from the overall sample. Time allocation is measured as weekly time use. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table 6 Descriptive Statistics for Household Educational Expenditure

	Fraction of households incurring educational expense	Mean expenditure conditional on positive spending (measured in 1,000 yen)
Overall sample (N = 17,146)	0.559	44.139 (102.996)
of which, children between 0 and 5 (N = 1,639)	0.631	23.599 (24.166)
of which, children between 6 and 12 (N = 5,031)	0.841	27.029 (47.150)
of which, children between 13 and 20 (N = 7,340)	0.825	48.642 (99.921)
Wife working full-time (N = 4,498)	0.512	44.788 (100.819)
of which, children between 0 and 5 (N = 648)	0.551	26.090 (30.384)
of which, children between 6 and 12 (N = 1,181)	0.821	26.616 (31.109)
of which, children between 13 and 20 (N = 1,565)	0.840	49.027 (95.267)
Wife working non-full-time (N = 12,648)	0.576	43.933 (103.68)
of which, children between 0 and 5 (N = 991)	0.686	21.968 (19.965)
of which, children between 6 and 12 (N = 3,850)	0.843	26.965 (52.717)
of which, children between 13 and 20 (N = 5,775)	0.817	47.762 (102.038)

Notes: the number in the parenthesis is the standard deviation.

Table 7 Effect of Husbands' Commuting Time on the Household's Education Expense, by Children's Age and Wife's Work Status

(a) Overall Sample

	Probability of incurring educational expenditure	Amount of expenditure conditional on spending
Overall sample (N = 17,146)		
(a) Households with children, 0-5 years old	-0.021 (0.031)	0.014 (0.082)
(b) Households with children, 6-12 years old	-0.013 (0.014)	-0.045 (0.051)
(c) Households with children, 13-20 years old	-0.004 (0.010)	-0.018 (0.042)

(b) Wife Working Full-time

	Probability of incurring educational expenditure	Amount of expenditure conditional on spending
Wife working full-time (N = 4,498)		
(a) Households with children, 0-5 years old	-0.006 (0.047)	0.042 (0.159)
(b) Households with children, 6-12 years old	0.017 (0.030)	0.007 (0.106)
(c) Households with children, 13-20 years old	0.014 (0.018)	0.079 (0.083)

(c) Wife Working Non-Full-time

	Probability of incurring educational expenditure	Amount of expenditure conditional on spending
Wife working non-full-time (N = 12,648)		
(a) Households with children, 0-5 years old	-0.022 (0.043)	0.001 (0.090)
(b) Households with children, 6-12 years old	-0.039** (0.015)	-0.107* (0.062)
(c) Households with children, 13-20 years old	-0.013 (0.013)	-0.048 (0.050)

Note: Educational expenditure includes school tuition, textbooks, learning reference materials, tutoring, among others. Time allocation is measured as weekly time use. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. The subsample of wives working non-full-time include part-time and contract workers. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Table 8 Effect of Husband's Commuting Time on the Wife's Employment Status

	Wife's probability of being employed	Wife's full-time work status (conditional on being employees)
Overall sample	0.001 (0.005) *N* = 26,616	-0.003 (0.005) *N* = 16,447
(a) Household, with children 0-5 years old	-0.003 (0.015) *N* = 4,079	-0.004 (0.014) *N* = 1,860
(b) Household, with children 6-12 years old	-0.003 (0.011) *N* = 8,085	-0.005 (0.010) *N* = 4,769
(c) Household, with children 13-20 years old	0.010 (0.009) *N* = 9,859	-0.006 (0.007) *N* = 6,938

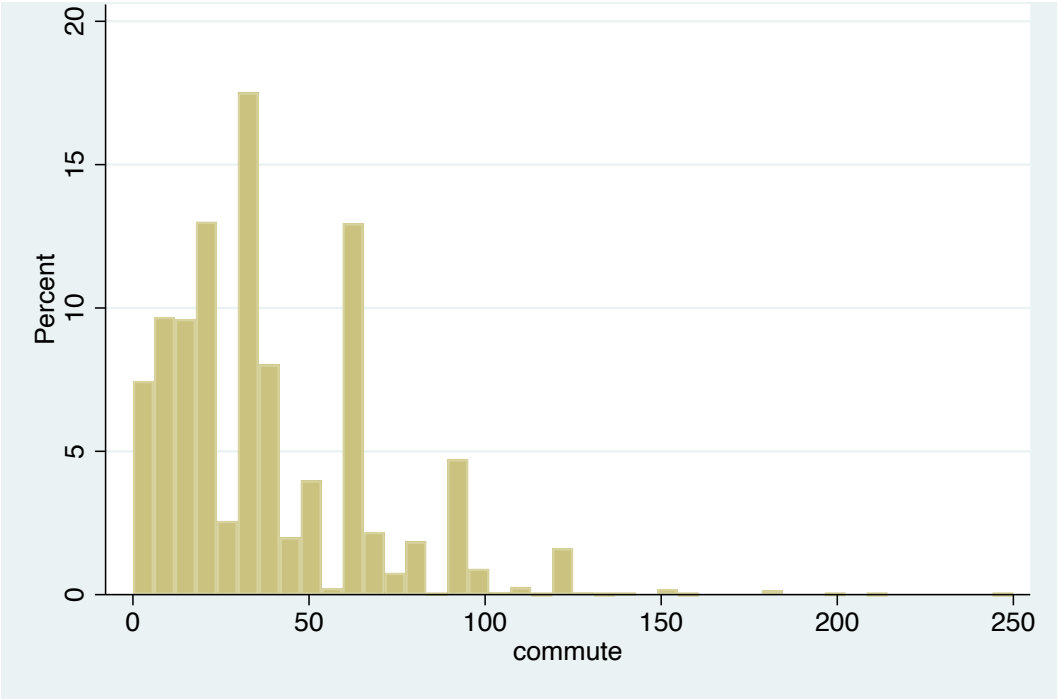
Note: For the probability of being employed, the sample is based on couples in which the husband is working (not self-employed), and the wife may or may not work. For full-time work status, the sample is limited to "employees" only. Self-employed, family employees, commissioned workers, and professionals are excluded. Time allocation is measured as weekly time use. Control variables include ages of the spouses, their age squared, age difference squared, whether the wife is the household head, number of family members, number of children in three age groups (0-5, 6-12, 13-20), whether parents live together, whether they live in a house, whether they own the current residence, nonlabor income of the household, and year dummies. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. The number in the parenthesis represent standard errors.

Figure 1 Gender Gap in Time Allocation for Dual-earner Couples

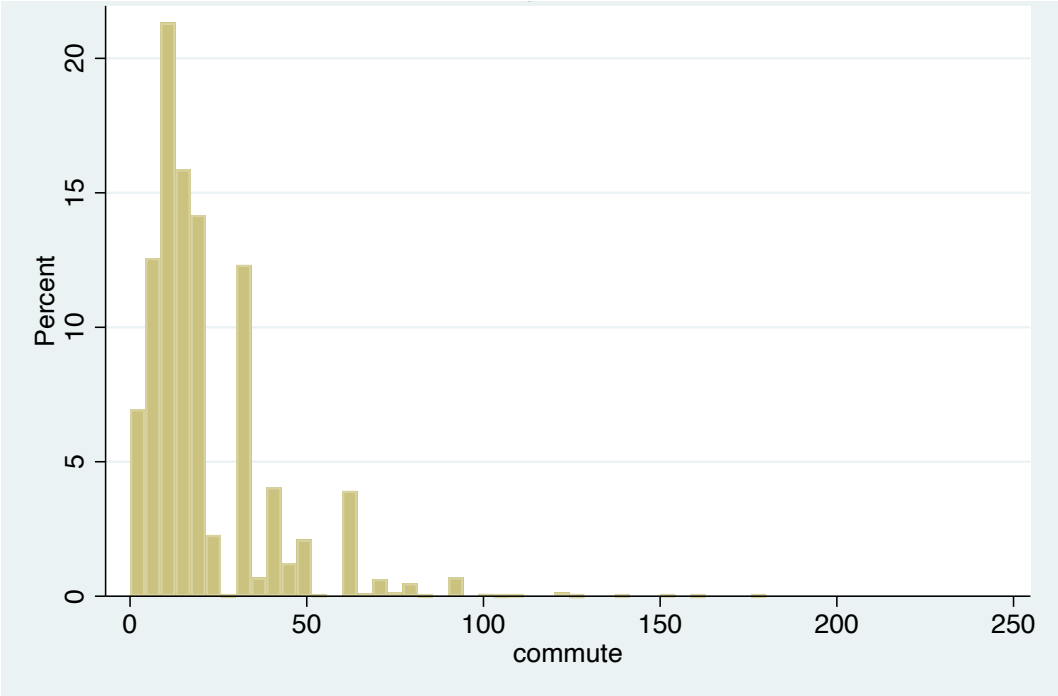
Note: Data are based on weekly time use variables extracted from JHPS 2005-2020. The graphs describe the gap in time use between the wife and the husband. For housework and childcare, the gap is mostly positive and right skewed, indicating wives perform most of the household chores. Commuting time and paid work hours are longer for the husbands than the wives.

Figure 2 Distribution of Commuting Time for Working Couples

a) Commuting Time for the Husbands



b) Commuting Time for the Wives



Note: Data are based on weekly time use variables extracted from JHPS 2005-2020. Both graphs show that commuting time are right skewed.

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Effect of Commuting Time on Intra-household Time Allocation
of Dual-earner Couples in Japan

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