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Impact of Teleworking on Childcare Time During the COVID-19 Pandemic: The Role of Owner-Occupied Housing

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Abstract

To prevent further virus transmission during the COVID-19 pandemic, several countries imposed stay-at-home restrictions to refrain people from going out. This exogenously encouraged many workers and companies to adopt telework. This study discusses the relationship between teleworking and childcare participation, considering the housing environment. Data from the Japan Household Panel Survey and its supplementary modules on COVID-19, conducted in 2020, were utilized. After controlling for individual and household attributes, regions, and housing characteristics, we found that male workers who telework in large-sized, owner-occupied housing significantly increased their childcare hours. For the male teleworkers living in owner-occupied detached housing, if telework time per day increases by an hour, childcare time per day will increase by 0.16 hours. This is an increase of approximately 17% in childcare time per day, relative to the sample average for the male subset. This suggests that sufficient space and quality of housing may have a substantial effect on time devoted to childcare by men.

Keywords: housing environment, telework, childcare participation, COVID-19 pandemic

JEL: J13, C23, R20

1. Introduction

A nationwide state of emergency was declared in Japan from April 7 to May 25, 2020, due to the coronavirus disease (COVID-19) pandemic. During this period, some industries that provide face-to-face services were asked to close temporarily, and telework was encouraged. Working from home was particularly promoted because people were required to refrain from leaving their homes to prevent further transmission of the virus. In Japan, a low telework rate has been attributed to the corporate system and culture, but a system for telework implementation had to be developed with the onset of the COVID-19 pandemic. Therefore, it is worthwhile to analyze and discuss how the shift toward telecommuting had brought about changes in Japanese behavior, during this period.

This study aimed to analyze the impact of teleworking on childcare time during the COVID-19 pandemic.[1] Many elementary and high schools in Japan closed temporarily during the period of the emergency declaration. Since children spent more time at home, parents had to take care of them over longer periods of time. Therefore, in this study, we define childcare time in a broader sense to include the time taken to care for preschoolers and help elementary to high school students with their homework, to estimate the impact of working from home on childcare time.

We analyzed the quantitative effect of telecommuting on childcare time using the difference-in-differences (DID) and triple difference (TD) methods. Traditionally, telecommuting has been chosen as a method to balance work and household responsibilities. However, in this situation, endogeneity arises between telecommuting and childcare time, making it difficult to accurately identify quantitative effects. In the case of the COVID-19 pandemic, alleviation of these problems is expected because telecommuting tends to be implemented based on criteria different from work-life balance and childcare. This study also aims to explore the association between working from home and housing characteristics. To work from home, information and communications technology (ICT) tools (i.e., Internet) and a space to work in, are needed. Thus, the relationship between housing attributes and telecommuting may become more apparent. Therefore, we created short panel data from the Japan Household Panel Survey (JHPS/KHPS) and its supplement modules on COVID-19, surveyed in May and October 2020, and analyzed them to measure the impact of working from home on childcare time, during the COVID-19 pandemic.

[1] Herein, teleworking is interchangeable with telecommuting. Since the variables of teleworking are derived from questions about working from home, teleworking equals working from home.

The remaining paper is structured as follows. In section 2, related literature is briefly reviewed. Then, we describe the data set used for the analyses in Section 3 and present the empirical methodology and results of the analyses in Section 4. Section 6 discusses the results and section 5 summarizes the conclusions drawn from the study.

2. Review of Related Literature

2.1 Impact of the COVID-19 pandemic on childcare and telecommuting

In many countries, the COVID-19 pandemic has promoted telework and helped change gender roles in the household. A study by Alon et al. (2020) discussed the impact of the COVID-19 pandemic on gender inequality in the United States (U.S.) They analyzed data on the distribution of women, men, and couples by occupation, and the division of labor time. The results showed that COVID-19 greatly increased the burden on women. In particular, the COVID-19 pandemic, unlike normal recessions, was more likely to reduce employment in sectors where women make up a large portion of the labor force.

Craig and Churchill (2020) conducted a survey on the COVID-19 pandemic and collected 2,722 responses over a three-week period during the Australian lockdown from May 7–30, 2020. This survey evaluated changes in employment status and place of work before and after the COVID-19 pandemic. The results showed that the mandatory restrictions during the pandemic increased fathers' childcare time in dual-earner households, narrowing the burden gap between couples.

Teleworking was not widespread in Japan before COVID-19 hit, but the pandemic clearly promoted it. Okubo et al. (2021) analyzed the effects of COVID-19 on working from home, using data from a unique survey on telework conducted by Keio University and the Nippon Institute for Research Advancement (NIRA). They found that, despite teleworking becoming more prevalent compared with working as normal, the efficiency of new teleworkers was reduced by approximately 20% on average during the COVID-19 pandemic. Conversely, the efficiency of those who had already worked from home pre-pandemic, was maintained.

2.2 Impact of telecommuting and workplace flexibility on childcare time

Some studies have been conducted on the effects of teleworking and workplace flexibility on childcare time. Using matched data from the U.S. Current Population Survey and the American Time Use Survey 2004-2005, Wight and Raley (2009) found that women who worked from home spent less time on paid work, and

fathers who worked from home spent less time on primary childcare. Genadek and Hill (2017) used the same data to analyze the impact of workplace flexibility on the amount of time spent with children, more comprehensively. They found that mothers who telecommute spend more time with their children, whereas fathers do not, and fathers who work on flexible schedules spend less time with their children than those who do not.

More recently, Pabilonia and Vernon (2020) distinguished between full-day telecommuting and weekend or work-at-home telecommuting—an issue that had been overlooked until their study—and analyzed the probability of being a teleworker, weekly earnings on the main job, and time use. The analysis of time use pointed out that men spend more time on primary childcare, while women spend more time on physical leisure activities, during work-from-home days.

Zhang et al. (2020) analyzed the telework choice based on variables related to life stages, such as gender, marital status, and parenthood, using unique German microdata, which were collected before the pandemic. They showed a complex association between telework behavior and life stages.

These studies analyzed the relationship between workplace flexibility, including teleworking and time spent with the family, such as childcare time; however, the endogeneity of teleworking was not discussed. In analyzing the impact of telecommuting on childcare time, an endogeneity issue is expected because having children increases parental responsibilities and workload at home, whereas working from home may facilitate work-life balance.

2.3 Effect of housing characteristics on telecommuting and childcare time

Qin et al. (2021) analyzed telecommuting in relation to housing characteristics. Their study applied a negative binomial regression model to their own survey data to analyze the relationship between housing characteristics and ICT usage and found that the type of housing and the number of rooms significantly affected the probability of telecommuting. In particular, detached and semi-detached townhouses and a higher number of rooms increased the probability of telecommuting. This supports the idea that telecommuting requires a quiet and independent environment for work.

In addition, Grinstein-Weiss et al. (2010) analyzed parental childcare time and housing characteristics. They evaluated parental behavior that affects outcomes for children, by examining whether parental engagement in the home, school, and community differs based on housing characteristics. The results showed that

households in homeownership have increased organized activities and less TV/game time, which means they are more engaged in childcare; thus, homeownership has a positive impact on child outcomes.

Accordingly, this study aimed to analyze whether increased teleworking during the COVID-19 pandemic led to an increase childcare time, considering housing characteristics by means of a micro-survey. Furthermore, since the COVID-19 pandemic promoted telework as “an exogenous shock” for workers (Zhang et al., 2020), the endogeneity of teleworking could be solved based on the data collected during the pandemic.

3. Data

3.1 JHPS/KHPS and supplementary modules on COVID-19

We analyzed data drawn from the JHPS/KHPS and its supplementary module on COVID-19 (COVID-19 Supplement), which were conducted in February, May, and September 2020, respectively. The survey covers general topics, including employment, education, lifestyle, time allocation, health and living environment, along with more detailed subjects, such as respondents’ household composition and their income, expenditures, assets, and housing type. It was originally conducted as two independent panel surveys: the Keio Household Panel Survey (KHPS) and the (former) Japanese Household Panel Survey (former JHPS). The KHPS and JHPS have been conducted annually since 2004 and 2009, respectively, but they were eventually combined in 2014. The initial sample size was 4,005 households for the KHPS and 4,022 households for the former JHPS.

The COVID-19 Supplement aimed to ask specific questions related to the COVID-19 pandemic to understand how people's lives, attitudes, behaviors, and psychological states were affected during the state of emergency. After asking JHPS/KHPS respondents to participate in the COVID-19 Supplement, 3,891 of 5,470 responses were analyzed.

The regular JHPS was conducted in February 2020 (JHPS2020) and surveyed responses at a time during which fewer new infections occurred. It collected information about household and housing characteristics, such as annual household income, number of household members, housing tenure, and so on. Details of housing and household characteristics were asked only in this survey and not in the supplementary modules.

The first supplementary module was conducted from late May to the beginning of July 2020. This period followed immediately after the first wave of new

infections and the first state of emergency (April 7 to May 25, 2020). In this survey, questions regarding the respondents' lives one month prior (April) were used to analyze their situations during the first state of emergency.

The second supplementary module was conducted from mid-October to the end of December 2020. This corresponds to the period after the second wave of new infections. Herein also, respondents' lives one month prior (September) were surveyed.

In this study, we produced short panel data from the JHPS2020 and the first and second supplementary modules, creating variables of household and housing information, and variables related to COVID-19, respectively. Although we could determine which respondents had moved during the course of the study, details of household and housing characteristics could not be observed. Therefore, households that moved during our observation periods were excluded from the data. Based on this data, we aim to clarify the impact of working from home and the housing environment, on childcare participation during the COVID-19 pandemic. In this study, due to sample size issues, the target age for childcare were individuals under 18 years of age.

3.2 Estimation samples and descriptive statistics

We conduct our analysis based on three samples:

(i) workers with children aged 18 years and below,

(ii) workers from sample (i) including those who teleworked by corporate mandate and excluding those who teleworked at their own discretion,

(iii) workers from sample (ii) with children aged from 7–18 years.

Sample (i) included respondents who were working at the time of the survey, with children aged 18 years and below. However, it excluded those whose weekly childcare time exceeded 70 hours; These respondents—accounting for 3% of the total sample—were regarded as outliers and not taken into consideration. This left 1,270 respondents after also excluding those with missing information related to variables used in the analysis. Descriptive statistics of the variables included in sample (i) are tabulated in Table A1 in the Appendix.

Table 1 shows the means of childcare and telework time in February, April, and September 2020. Respondents were asked to indicate the number of days per week dedicated to childcare. We then calculated childcare hours per day from the

answers to this question.[2] In February, the mean amount of childcare time per day was 1.52 hours, increasing to 1.58 hours in April—during the first state of emergency—and 1.55 hours in September. Although similar tendencies were observed between male and female samples, females spent 2.4 hours per day on childcare in February and April, which is roughly three times higher than males' childcare time.

Regarding telework, the ratio of teleworkers was only 5% in February and the mean teleworking hours per day, 0.26 hours. In April, due to the state of emergency, the ratio of teleworkers and telework hours per day increased to 27% and 1.95 hours, respectively. In September, although the state of emergency was not declared during this month, the ratio of teleworkers remained high at 19% and teleworking hours per day were still high at 1.48 hours. From a gender perspective, males tended to perform more telework than females. Similar tendencies were observed in another survey.

Table 1 also includes the implementation status of telework during the observation periods. The last row of each panel indicates that approximately 3% and 6% of teleworkers from the whole sample chose teleworking on their own accord in April and September, respectively. They could choose teleworking to enable childcare at home and facilitate work-life balance, as stated in Section 2.2. In the regression explaining childcare time, the coefficients related to teleworking should include the bias due to reverse causality from childcare to teleworking. Therefore, to reduce such bias, we estimate models based on sample (ii), which excludes respondents who voluntarily chose telework and includes only the ones who performed telework at the behest of the company. This restricted sample retains 1,224 respondents and allows us to more accurately identify the causal effects of telework on childcare time.

In sample (iii), we further exclude respondents with children younger than 6 years, from sample (ii). Such respondents account for 21% of those with children aged 18 years and below in the whole sample (Table A1). The exclusion is made because a portion of preschool-aged children could have continued attending daycare facilities even under the state of emergency in April 2020, whereas elementary, middle high, and high school students were unable to attend school during that time (Yokoyama and Takaku, 2020). Ultimately, 970 respondents remained in this restricted sample.

We conduct our analyses on samples (ii) and (iii) to identify the causality from telework to childcare time, in the next section.

[2] The question about childcare time is asked in the JHPS/KHPS, annually. Precise information of the questionnaire is available from:
https://www.pdrc.keio.ac.jp/en/paneldata/datasets/jhpskhps/ (Accessed 9 September 2020)

Table 1: The means of childcare and telework time from the sample of workers with children aged 18 years and below in February, April, and September 2020

	Feb.		Apr.		Sep.		Apr.–Feb.		Sep.–Apr.	
Variable	N.	Mean	N.	Mean	N.	Mean	t		t	
(A) Whole sample										
Childcare hours per week	455	10.65	438	11.03	377	10.85	0.43		-0.19	
Childcare hours per day	455	1.52	438	1.58	377	1.55	0.43		-0.19	
Telework (=1)	455	0.05	438	0.27	377	0.19	9.43	***	-2.92	***
Number of telework days	455	0.18	438	0.95	377	0.64	8.42	***	-2.68	***
Telework hours per week	450	0.81	435	6.79	373	3.87	8.66	***	-3.42	***
Telework hours per day	455	0.26	438	1.95	377	1.16	9.49	***	-3.54	***
Telework status										
Company mandate (=1)	418	0.07	403	0.28	355	0.19	8.19	***	-3.08	***
Implemented at own discretion (=1)	418	0.03	403	0.03	355	0.06	0.09		1.60	
(B) Male sample										
Childcare hours per week	251	5.66	248	6.57	200	5.62	1.13		-1.07	
Childcare hours per day	251	0.81	248	0.94	200	0.80	1.13		-1.07	
Telework (=1)	251	0.05	248	0.31	200	0.23	8.03	***	-2.14	**
Number of telework days	251	0.17	248	1.12	200	0.78	7.45	***	-2.09	**
Telework hours per week	247	1.00	245	8.32	197	4.93	7.08	***	-2.59	***
Telework hours per day	251	0.33	248	2.31	200	1.50	7.72	***	-2.45	**
Telework status										
Company mandate (=1)	238	0.09	235	0.31	190	0.23	6.38	***	-1.93	*
Implemented at own discretion (=1)	238	0.03	235	0.04	190	0.06	0.81		1.15	
(C) Female sample										
Childcare hours per week	204	16.77	190	16.85	177	16.76	0.05		-0.06	
Childcare hours per day	204	2.40	190	2.41	177	2.39	0.05		-0.06	
Telework (=1)	204	0.05	190	0.22	177	0.15	5.09	***	-1.84	*
Number of telework days	204	0.19	190	0.72	177	0.50	4.20	***	-1.52	
Telework hours per week	203	0.58	190	4.81	176	2.68	5.06	***	-2.12	**
Telework hours per day	204	0.18	190	1.48	177	0.79	5.56	***	-2.47	**
Telework status										
Company mandate (=1)	180	0.05	168	0.24	165	0.14	5.12	***	-2.32	**
Implemented at own discretion (=1)	180	0.04	168	0.02	165	0.05	-0.81		1.20	

Note: Apr.–Feb. and Sep.–Apr. represent the results of a t-test of equal means between two samples, using Welch's method under the hypothesis of heterogeneity. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

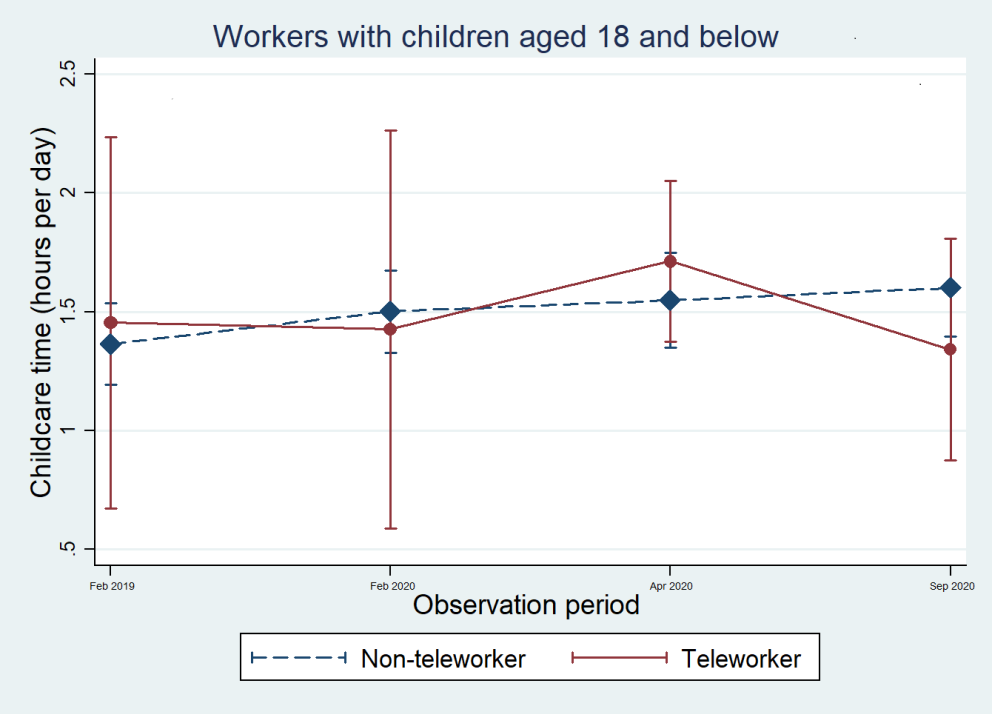
4. Econometric Analysis and Results

4.1 Identification strategy

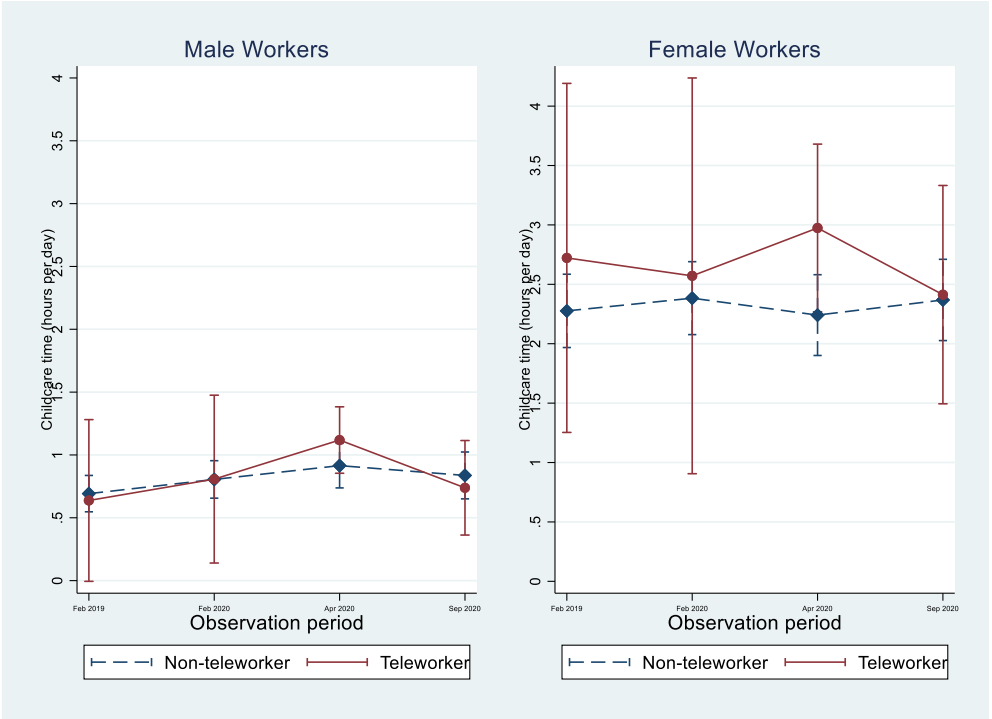
In this section, we describe the econometric methods used in this study. The models to be estimated are divided into two categories: (1) DID method for COVID-19 and (2) TD method considering housing characteristics.

We employed the DID method due to the problem that the COVID-19 pandemic had a confounding impact on both childcare time and teleworking practices. The former can be attributed to children spending more time at home due to the closure of schools and the instructions to refrain from leaving their homes, which increased the amount of time dedicated by parents to taking care of them. The latter is due to the government's strong recommendation for individuals to work from home to prevent them from commuting. Therefore, simply estimating the effect of working from home using data from before and after the onset of COVID-19, is likely to overestimate the effect.

To address this problem, we used the DID method, which estimates the average treatment effect on the treated, based on a parallel trend assumption. We checked this assumption by comparing the average childcare time of the survey in February 2019 and 2020, respectively, as seen in Figure 1. From this, we can see that this assumption is proved for sample (ii) because 95% confidence intervals overlap, and no significant difference exists between the average childcare time of both teleworker and non-teleworker groups, between 2019 and 2020. We further reviewed the assumption for the subsamples, by gender. In the male sample, the upper trends in both the treatment and control groups presented no significant difference. In the female sample, we observed a downward trend among the teleworkers and an upward trend among the non-teleworkers; however, this difference was not significantly different from zero. Thus, we concluded that the parallel trend assumption is satisfied in both the whole sample and subsamples by gender.



(A) Whole sample



(B) Subsamples by gender

Note: These figures are based on sample (ii) in section 3.2.

Figure 1: Changes in average daily childcare time by teleworking status, with 95% confidence intervals

4.2 DID approach

The DID approach is a popular method to observe the difference in the treatment group before and after treatment. Since the COVID-19 pandemic occurred independently of the survey respondents, we assumed that this factor is a common shock after controlling for the regional difference due to its impact. In this study, treatment was the number of telework hours; the DID model is written as follows, using the notations of Lee (2016):

$$y_{it} = \beta_0 + \beta_g G_{it} + \beta_\tau 1[t_0 \leq t] + \beta_{g\tau} G_{it} 1[t_0 \leq t] + \beta x_{it} + \epsilon_{it}, \quad (1)$$

where G_{it} is the telework hours and $1[t_0 \leq t]$ is the post-treatment era dummy (COVID dummy indicating April and September). Here, we did not assume unobserved individual heterogeneity, such as the fixed effects of respondents. For the control variables, x_{it} includes the variables of housing characteristics (size of dwelling space, age of building, etc.), individual and household characteristics (age of respondents, number of children and household members, household income, employment, industry, etc.), as well as regional and survey period fixed effects, respectively. Since variables of household and housing characteristics are constant over the observation periods due to the nature of the construction of the dataset, we cannot estimate the fixed effects models of respondents. Therefore, we selected pooled ordinary least squares (OLS) models as our baseline models.

Two models were estimated for three samples: whole, male, and female samples. Estimation results of Equation (1) are presented in Table 2, and the full estimation results are shown in Table A2 in the Appendix. The first two columns are based on the whole sample. Column 1 reports the results of workers with children aged 18 years and below including the teleworkers by corporate mandate. We obtained a positive but insignificant estimate of $\beta_{g\tau}$, which is the coefficient of telework hours per days × the COVID indicator. Column 2 reports the results of respondents with children aged from 7 to 18 years. Here, we obtained positive but insignificant results as well. Then, we estimated the model using subsamples by gender and observed insignificant results, similar to that of the whole sample.

Table 2: Estimation results of difference-in-differences models of childcare time, per day

Sample	Whole sample		Male sample		Female sample	
Variables	1. Workers with children aged 18 years and below	2. Workers with children aged 7 to 18 years	3. Workers with children aged 18 years and below	4. Workers with children aged 7 to 18 years	5. Workers with children aged 18 years and below	6. Workers with children aged 7 to 18 years
Telework hours per day	0.0253	0.0394	0.0174	0.0269	0.0137	0.0347
	(0.039)	(0.040)	(0.035)	(0.031)	(0.100)	(0.108)
COVID (Apr. and Sep.) (=1)	0.0181	-0.0891	0.0131	-0.0542	-0.0761	-0.228
	(0.117)	(0.131)	(0.123)	(0.135)	(0.208)	(0.219)
Telework hours per day × COVID (=1)	0.0097	-0.0030	-0.0104	0.0018	0.0590	0.0084
	(0.034)	(0.038)	(0.033)	(0.030)	(0.101)	(0.111)
Housing characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Individual and household characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N.	1,224	970	672	503	552	467
R-squared	0.329	0.322	0.254	0.278	0.292	0.263

Note: Childcare time per weekday is the dependent variable. The cluster standard errors over respondents are given in parentheses. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

4.3 Heterogeneous effects: TD approach

We found positive but insignificant results regarding the DID parameters. However, such effects may change depending on heterogeneity among the respondents, such as their housing characteristics. In previous studies, housing characteristics have been described as a confounding factor that affects both childcare time (Grinstein-Weiss et al., 2010) and telecommuting (Qin et al., 2021). To capture the differences that arise due to the heterogenous effects related to housing characteristics, we used the TD approach, which is an extension of the DID method that allows us to estimate separate effects of housing characteristics.

The TD model is written as follows, using the notations of Lee (2016):

$$y_{it} = \beta_0 + \beta_g G_{it} + \beta_h H_i + \beta_\tau 1[t_0 \le t] + \beta_{gh} G_{it} H_i + \beta_{g\tau} G_{it} 1[t_0 \le t] + \beta_{h\tau} H_i 1[t_0 \le t] + \beta_d G_{it} H_i 1[t_0 \le t] + \beta x_{it} + \epsilon_{it}, \quad (2)$$

where G_{it} is telework hours and H_i is an indicator of housing characteristics. TD identifies the effect of the treated (G_{it} =G^*,H_{it}=1) at the post-treatment era dummy $1[t_0 \le t] = 1$, (COVID dummy indicating April and September). The parameter of most interest is β_d, the effects of which at a specific value of telework hours G^*, are summarized as:

$$\begin{aligned}\beta_d G^* = {} & [E(y_{it} \mid G_{it} = G^*, H_i = 1, T = 1) - E(y_{ist} \mid G_{it} = G^*, H_i = 1, T = 0)] \\ & -[E(y_{ist} \mid G_{it} = 0, H_i = 1, T = 1) - E(y_{ist} \mid G_{it} = 0, H_i = 1, T = 0)] \\ & - \begin{bmatrix} E(y_{ist} \mid G_{it} = G^*, H_i = 0, T = 1) - E(y_{ist} \mid G_{it} = G^*, H_i = 0, T = 0) \\ -\{E(y_{ist} \mid G_{it} = 0, H_i = 0, T = 1) - E(y_{ist} \mid G_{it} = 0, H_i = 0, T = 0)\} \end{bmatrix} \end{aligned} \quad (3)$$

The estimate $\hat{\beta}_d$ provides information about the net change in the marginal effects of teleworking hours of workers living in housing with specific features, represented by H_i.This model is a saturated TD model (Lee, 2016). Here, we assumed that the slopes of telework hours and housing are time-varying (e.g., $\beta_{g\tau}$ for telework hours and $\beta_{h\tau}$ for housing characteristics in the post-treatment era).

However, many workers started teleworking from April: $1[t_0 \le t] = 1$. Therefore, G_{it} and $G_{it}1[t_0 \le t]$ showed high correlation, especially in the female sample. Thus, to avoid multicollinearity, we excluded $G_{it}1[t_0 \le t]$ and estimated the following semi-saturated model:

$$y_{it} = \beta_0 + \beta_g G_{it} + \beta_h H_i + \beta_\tau 1[t_0 \le t] + \beta_{gh} G_{it} H_i + \beta_{h\tau} H_i 1[t_0 \le t] + \beta_d G_{it} H_i 1[t_0 \le t] + \beta x_{it} + \epsilon_{it} \quad (4)$$

Several variables for the characteristics of housing were selected to test the hypothesis that housing characteristics, such as the size of the dwelling, housing tenure, and longer commuting time, affect childcare time. The estimates of coefficients of the interaction terms, β_d, are shown in Table 3, according to the three samples.

First, we tested the hypothesis that the size of the dwelling affects childcare time. Dwelling size was determined as the number of empty rooms, which is defined as the difference between the number of rooms and the occupants per household, excluding children below 10 years of age as they are considered half-occupants (Seko et al., 2019). We considered that the number of rooms are important for teleworking to contain the noise generated by other household members, especially children (Qin et al., 2021). Dwelling spaces were controlled in the regression analysis. We examined the hypothesis by including an indicator of one or more empty room. The results showed negative and insignificant coefficients, indicating that the hypothesis is not supported.

Second, we tested the hypothesis that the quality of housing affects childcare time, by including several variables such as building type and age, along with ownership of the dwelling. For the type of building, we used indicators of detached housing and condominiums, neither of which showed significant results. Concerning the age of the building, we used an indicator of dwellings built within the past 10 years, as the quality of housing is higher for newly built dwellings in Japan. This variable also had no significant result. In terms of dwelling ownership, we included an indicator of owner-occupied housing. In this case, we observed a significantly positive coefficient (0.176) for the whole sample, which represented an increase of approximately 11% in childcare time relative to the sample average. For the male sample, the coefficient was 0.178, but we could not obtain similar results from the female sample.

Third, we tested the hypothesis that long commuting time substitutes childcare time for teleworkers. We estimated the model by including an indicator for respondents whose commuting time is longer than one hour one-way. However, we could not derive significant coefficients and therefore, could not conclude that commuting time has transformed into childcare time due to telecommuting.

From the above results, we found that owner-occupied housing is the main housing characteristic to influence childcare time for teleworkers.

Furthermore, we evaluated whether the heterogeneity of owner-occupied housing affects childcare time. These results are tabulated in Table 4. For owner-occupied dwellings with one or more empty rooms, we observed a positive and significant coefficient if we restricted the sample to workers with have children aged 7–18 years in the entire sample, as well as the male subset. If the telework time per day increases by an hour, the childcare time per day increases by 0.119 hours for the male subset, which represents an increase of approximately 12% in childcare time, relative to the sample average. We also observed significantly positive effects in the case of owner-occupied detached housing, based on the entire sample and the male subset. Telework per day increased by 0.16 hours for the male subset. This value represents an increase of approximately 17% in childcare time, relative to the sample average for the male subset. However, no such effects were observed in the case of condominiums.

Table 3: Estimates of interaction terms of triple difference models

Sample	Whole sample		Male sample		Female sample	
Variables	1. Workers with children aged 18 years and below	2. Workers with children aged 7 to 18 years	3. Workers with children aged 18 years and below	4. Workers with children aged 7 to 18 years	5. Workers with children aged 18 years and below	6. Workers with children aged 7 to 18 years
Telework hours × COVID (=1)						
× one or more empty room (=1)	-0.156	-0.195	0.0105	-0.0317	0.0105	-0.0317
	(0.165)	(0.164)	(0.096)	(0.106)	(0.096)	(0.106)
× detached housing (=1)	-0.0863	-0.0007	-0.221	0.166	0.0425	0.0165
	(0.211)	(0.227)	(0.251)	(0.150)	(0.104)	(0.115)
× condominium (=1)	0.119	0.0263	0.313	-0.110	-0.0021	-0.0387
	(0.215)	(0.226)	(0.250)	(0.152)	(0.087)	(0.089)
× built less than 10 years ago (=1)	0.0458	0.0355	0.0050	0.0319	0.0925	0.0235
	(0.076)	(0.084)	(0.065)	(0.072)	(0.116)	(0.131)
× owner-occupied housing (=1)	0.176***	0.203***	0.178***	0.146***	0.0259	0.0119
	(0.060)	(0.063)	(0.054)	(0.049)	(0.104)	(0.113)
× commuting time (more than 1 hour, one-way) (=1)	-0.0573	-0.0823	-0.0291	-0.0618	-0.0412	-0.149
	(0.075)	(0.078)	(0.070)	(0.070)	(0.101)	(0.115)

Note: Childcare time per week is the dependent variable. Estimates of columns 5 and 6 are calculated based on the semi-saturated model. The same covariates as in Table 2 are used. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

Table 4: Estimates of interaction terms of triple difference models

Sample	Whole sample		Male sample		Female sample	
Variables	1. Workers with children aged 18 years and below	2. Workers with children aged 7 to 18 years	3. Workers with children aged 18 years and below	4. Workers with children aged 7 to 18 years	5. Workers with children aged 18 years and below	6. Workers with children aged 7 to 18 years
Telework hours × COVID (=1) × owner-occupied housing with one or more empty room (=1)	0.109	0.129*	0.0916	0.119**	-0.0023	-0.0393
	(0.070)	(0.073)	(0.059)	(0.060)	(0.098)	(0.108)
× owner-occupied detached housing (=1)	0.191***	0.207***	0.160***	0.160***	0.0436	0.0149
	(0.054)	(0.057)	(0.054)	(0.052)	(0.103)	(0.115)
× owner-occupied condominium (=1)	-0.0596	-0.0648	-0.0437	-0.0597	-0.0360	-0.0714
	(0.076)	(0.079)	(0.071)	(0.071)	(0.102)	(0.112)

Note: Childcare time per day is the dependent variable. Estimates of columns 5 and 6 are calculated based on the semi-saturated model. The same covariates as in Table 2 are used. The cluster standard errors over respondents are given in parentheses. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

4.4 Robustness checks

To check the robustness of the outcomes of analyses in Section 4.3, we conducted an analysis using a sample limited to February and April and another using the variables measured in hours per week. The aim of the first analysis was to focus on the instantaneous increase in childcare hours (see Figure 1) caused by the closure of schools and daycare facilities due to the COVID-19 pandemic between February and April 2020. The second analysis was based on a sample of hours per week reflecting the number of days per week that each person teleworked. We report selected results that are related to our main findings.

Panel A of Table 5 shows the results of the TD models for childcare hours per day based on the sample from February and April. Estimates of the TD term related to one or more empty rooms showed positive results like in Table 4; however, the results are insignificant. This is partly due to the reduction of sample sizes by limiting observation periods. Estimates of the TD term related to owner-occupied housing showed positive and significant results, though their magnitude decreased compared with the same estimates in Table 4.

Panel B of Table 5 shows the results based on the variables measured in average hours per week. We estimated Equation (2) with $y_{it} =$ average childcare hours per week and $G_{it} =$ average telework hours per week. These variables reflect the average number of days per week, which was not considered before because average hours per week is obtained by multiplying average hours per day and the product of average number of days in a week. The results based on these variables are similar to, but comparatively larger than, those in Table 4. Therefore, we can conclude that the results in Table 5 are robust if we use the sample defined in hours per week, incorporating the difference in the number of telework days a week.

Overall, our results are robust if we take into consideration the longer observation periods of February, April, and September 2020 and the number of teleworking days.

Table 5: Robustness checks of estimates of interaction terms of triple difference models

	Whole sample		Male sample		Female sample	
Sample	1. Workers with children aged 18 years and below	2. Workers with children aged 7 to 18 years	3. Workers with children aged 18 years and below	4. Workers with children aged 7 to 18 years	5. Workers with children aged 18 years and below	6. Workers with children aged 7 to 18 years
(A) Dependent variable: Childcare time per day (Feb. and Apr. sample)						
Telework hours per day × COVID (=1)						
× owner-occupied housing with one or more empty room (=1)	0.0548	0.0821	0.0754	0.0888	0.0508	0.0009
	(0.081)	(0.084)	(0.074)	(0.076)	(0.114)	(0.132)
No. of observations	849	674	476	356	373	318
× owner-occupied detached housing (=1)	0.125*	0.143**	0.111*	0.112*	0.0966	0.0619
	(0.064)	(0.066)	(0.065)	(0.064)	(0.114)	(0.128)
No. of observations	864	685	482	360	382	325
(B) Dependent variable: Childcare time per week						
Telework hours per week × COVID (=1)						
× owner-occupied housing with one or more empty room (=1)	0.172	0.234**	0.160*	0.206**	0.113	0.0849
	(0.111)	(0.116)	(0.089)	(0.096)	(0.191)	(0.221)
No. of observations	1,188	945	652	491	536	454
× owner-occupied detached housing (=1)	0.285***	0.319***	0.278***	0.258***	0.151	0.135
	(0.091)	(0.099)	(0.087)	(0.086)	(0.186)	(0.208)
No. of observations	1,209	961	660	496	549	465

Note: The same covariates as in Table 2 are used. The cluster standard errors over respondents are given in parentheses. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

5. Discussion

The DID results above imply that an increase in telework hours will not necessarily increase the time spent by teleworkers with their children. This result is consistent previous studies, such as by Wight and Raley (2009). Genadek and Hill (2017) found that mothers who work from home increase the time spent with their children aged 13 years and below. However, our results indicate that male respondents living in larger, owner-occupied dwellings, increase the time spent with their children.

Significantly positive effects are mainly observed in the results of the male sample. It is well known that children are mainly cared for by females in Japan. Before COVID-19 started to spread—represented by the February sample—average daily childcare time was 0.204 and 1.122 hours for male and female workers, respectively. Therefore, an evident gap in childcare time existed between the two sexes before the COVID-19 pandemic. These findings correspond to a report issued by the Cabinet Office (2020) that stated that during the COVID-19 pandemic, the number of households that cited an increase in the husbands' role at home accounted for more than 25% of total household survey coverage. However, the gap of childcare time between male and female workers cannot be easily filled by reducing commute time for males who work from home, as we showed in Section 4.3. Instead, housing characteristics seemed to play a more significant role in increasing men's childcare time.

Regarding housing characteristics, respondents living in larger, owner-occupied dwellings tend to increase childcare time when working from home. Qin et al. (2021) showed that detached housing and dwellings with more rooms is positively related to telecommuting. Additionally, based on Japanese data, Okubo (2021) recently showed that workers living in owner-occupied housing tend to telework. In Japan, it is well known that a large gap exists in the quality between owner-occupied and rental housing. In terms of space, rental housing is significantly smaller than owner-occupied housing. In 2013, the average space per person was 122.32 m^2 for owner-occupied housing and 44.39 m^2 for private rental housing (Statistics Bureau of Japan, 2013). Homeowners can more easily secure space for both working and living with their family, in their respective homes.

Recently, from their unique survey, Okubo and NIRA (2021) showed that having own rooms in their housing increased teleworkers' productivity. If teleworkers living in larger housing worked in their own rooms, their productivity increased, thereby securing additional time to spend with family and practice childcare. These differences might be reflected in the results. Confirming that larger, owner-occupied housing increases the childcare time of male teleworkers.

6. Conclusion

In this study, we measured the impact of teleworking on childcare time during the COVID-19 pandemic. Many workers were forced to work from home to prevent further transmission of the virus. Such an exogenous shock allowed us to measure the average treatment effect of teleworking on childcare time by considering housing characteristics. This study found that childcare time per day increased for male respondents who teleworked in larger, owner-occupied housing.

Given this, it is recommended that future studies clarify the mechanism of causality by which teleworking increases childcare hours for the respondents living in larger, owner-occupied housing.

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Conflicts of Interest

None

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Appendix

Table A1: Descriptive statistics of samples of workers with child(ren) aged 18 years and below

	(a) Whole		(b)Telework		(c) Non-telework		(b)-(c)	
Variables	Mean	S.D.	Mean	S.D.	Mean	S.D.	t	
Childcare hours per week	10.84	13.48	11.27	13.60	10.75	13.47	0.51	
Childcare hours per days	1.55	1.93	1.61	1.94	1.54	1.92	0.51	
Telework (=1)	0.17	0.37	1.00	0.00	0.00	0.00		
Number of telework days	0.58	1.43	3.45	1.50	0.00	0.00	33.64	***
Telework hours per week	3.78	10.62	22.10	15.97	0.03	0.93	20.21	***
Telework hours per day	1.11	2.78	6.59	3.14	0.00	0.00	30.70	***
Telework status								
Did not want to telework	0.74	0.44	0.15	0.36	0.87	0.33	-26.65	***
Requested but not granted to telework	0.04	0.19	0.02	0.14	0.04	0.20	-1.87	*
Conducted by company mandate	0.18	0.38	0.70	0.46	0.07	0.25	19.12	***
Implemented at own discretion	0.04	0.19	0.13	0.34	0.02	0.14	4.80	***
COVID (Apr and Sep) (=1)	0.64	0.48	0.89	0.31	0.59	0.49	11.57	***
Age of respondents	41.99	6.20	42.35	6.08	41.91	6.22	0.95	
Female (=1)	0.45	0.50	0.36	0.48	0.47	0.50	-2.81	***
Married (=1)	0.94	0.23	0.98	0.14	0.94	0.24	3.68	***
College degree (=1)	0.45	0.50	0.71	0.46	0.40	0.49	8.91	***
No. of household members	3.98	1.02	3.95	0.97	3.99	1.03	-0.46	
No. of children	1.92	0.73	1.90	0.68	1.92	0.73	-0.48	
Age of children (years)								
0–6 (=1)	0.21	0.41	0.24	0.43	0.21	0.40	1.00	
7–12 (=1)	0.35	0.48	0.41	0.49	0.33	0.47	2.10	**
13–15 (=1)	0.18	0.39	0.17	0.37	0.18	0.39	-0.55	
16–18 (=1)	0.26	0.44	0.18	0.39	0.28	0.45	-3.13	***
Monthly household income (10,000 yen)	44.9	33.5	51.4	44.9	43.6	30.5	2.44	**
Missing cases of monthly household income (=1)	0.05	0.22	0.05	0.21	0.05	0.22	-0.22	
Real saving (2010, 10,000 yen)	574.9	881.7	852.7	1278.4	518.5	765.6	3.69	***
Missing cases of saving (=1)	0.03	0.17	0.03	0.18	0.03	0.17	0.18	
Employment status								
Self-employment (=1)	0.08	0.27	0.10	0.30	0.08	0.27	1.17	
Regular employment (=1)	0.68	0.47	0.81	0.39	0.66	0.47	5.12	***

Non-regular employment (=1)	0.23	0.42	0.08	0.28	0.27	0.44	-7.75	***
Unknown type of employment (=1)	0.00	0.03			0.00	0.03		
Employment status of spouse								
No spouse (=1)	0.06	0.23	0.02	0.14	0.06	0.24	-3.68	***
Housework (=1)	0.14	0.34	0.20	0.40	0.13	0.33	2.45	**
Self-employment (=1)	0.06	0.24	0.07	0.26	0.06	0.24	0.73	
Regular employment (=1)	0.48	0.50	0.36	0.48	0.51	0.50	-3.91	***
Non-regular employment (=1)	0.25	0.44	0.33	0.47	0.24	0.43	2.55	**
Unknown type of employment (=1)	0.01	0.09	0.02	0.14	0.01	0.08	1.26	
Industry								
Agriculture, fish, woods, and mining (=1)	0.00	0.06			0.00	0.07		
Construction and production (=1)	0.25	0.43	0.25	0.44	0.25	0.43	-0.02	
Wholesale and retail (=1)	0.13	0.34	0.09	0.29	0.14	0.34	-2.19	**
Restaurant and hotel (=1)	0.02	0.15			0.03	0.17		
Finance, insurance and real estate (=1) (=1)	0.05	0.22	0.10	0.30	0.04	0.20	2.86	***
Transportation (=1)	0.03	0.18	0.01	0.10	0.04	0.19	-3.32	***
Information and communication (=1)	0.06	0.24	0.21	0.41	0.03	0.17	6.45	***
Electricity, gas, and water (=1)	0.01	0.10	0.01	0.12	0.01	0.09	0.64	
Healthcare (=1)	0.17	0.38	0.01	0.10	0.20	0.40	-13.83	***
Education (=1)	0.06	0.24	0.10	0.30	0.05	0.23	2.00	**
Other services (=1)	0.12	0.33	0.13	0.34	0.12	0.32	0.46	
Public servants (=1)	0.08	0.27	0.08	0.27	0.08	0.27	0.09	
Others (=1)	0.00	0.05			0.00	0.05		
Size of the firm								
1–29 workers (=1)	0.26	0.44	0.20	0.40	0.27	0.45	-2.48	**
30–99 workers (=1)	0.16	0.36	0.11	0.31	0.17	0.37	-2.49	**
100–499 workers (=1)	0.21	0.40	0.18	0.39	0.21	0.41	-0.96	
500+, public sector (=1)	0.38	0.49	0.51	0.50	0.35	0.48	4.39	***
Housing characteristics								
Owner-occupied housing (=1)	0.86	0.34	0.86	0.35	0.87	0.34	-0.40	
No. of rooms (=1)	4.76	1.46	4.57	1.37	4.79	1.47	-2.10	**
No. of rooms, 4 and above (=1)	0.82	0.39	0.78	0.41	0.83	0.38	-1.51	
No. of empty rooms (=1)	0.87	1.48	0.76	1.38	0.89	1.50	-1.28	
One or more empty rooms (=1)	0.56	0.50	0.58	0.49	0.56	0.50	0.66	
Two or more empty rooms (=1)	0.30	0.46	0.27	0.44	0.31	0.46	-1.31	

Housing space (m2)	96.03	69.56	85.26	41.48	98.21	73.79	-3.56	***
Housing space missing (=1)	0.10	0.30	0.09	0.29	0.10	0.31	-0.71	
Age of housing (years)	17.92	12.77	16.74	11.33	18.16	13.03	-1.62	
Less than 5 (=1)	0.15	0.35	0.17	0.37	0.14	0.35	0.98	
Less than 10 (=1)	0.34	0.47	0.33	0.47	0.34	0.48	-0.34	
Detached housing (=1)	0.77	0.42	0.72	0.45	0.78	0.41	-1.99	**
Condominium (=1)	0.20	0.40	0.26	0.44	0.19	0.39	2.34	**
Owner-occupied housing with 4 or more rooms (=1)	0.76	0.43	0.71	0.46	0.77	0.42	-1.90	*
Owner-occupied housing with 1 or more empty room (=1)	0.51	0.50	0.52	0.50	0.51	0.50	0.29	
Owner-occupied detached housing (=1)	0.76	0.43	0.69	0.46	0.77	0.42	-2.25	**
Owner-occupied condominium (=1)	0.11	0.32	0.17	0.37	0.10	0.30	2.34	**
Commuting time (exceeds 1 hour) (=1)	0.21	0.41	0.44	0.50	0.17	0.37	7.54	***
Owner-occupied housing with commuting time exceeding one hour (=1)	0.19	0.39	0.39	0.49	0.15	0.36	6.81	***
Owner-occupied housing built less than 10 years ago (=1)	0.32	0.47	0.30	0.46	0.32	0.47	-0.47	
Survey month								
Feb. (=1)	0.36	0.48	0.11	0.31	0.41	0.49	-11.57	***
Apr. (=1)	0.34	0.48	0.56	0.50	0.30	0.46	7.05	***
Sep. (=1)	0.30	0.46	0.33	0.47	0.29	0.45	1.19	
No. of new infections in prefecture	625.47	1167.60	1205.25	1430.23	507.97	1069.97	6.76	***
City size								
Major cities (=1)	0.34	0.47	0.44	0.50	0.32	0.46	3.48	***
Other cities (=1)	0.58	0.49	0.54	0.50	0.59	0.49	-1.33	
Regions								
Hokkaido (=1)	0.03	0.16	0.01	0.10	0.03	0.17	-2.48	**
Tohoku (=1)	0.05	0.22	0.02	0.15	0.06	0.23	-2.66	***
Kanto (=1)	0.34	0.47	0.52	0.50	0.30	0.46	5.90	***
Chubu (=1)	0.21	0.41	0.16	0.37	0.23	0.42	-2.18	**
Kansai (=1)	0.19	0.39	0.21	0.41	0.19	0.39	0.63	
Chugoku (=1)	0.04	0.21	0.01	0.10	0.05	0.22	-4.50	***
Shikoku (=1)	0.04	0.19	0.01	0.12	0.04	0.21	-2.97	***
Kyushu (=1)	0.10	0.29	0.06	0.23	0.10	0.31	-2.62	***
No. of observations	1,270		214		1,056			

Note: (b)–(c) represents the results for a t-test of equal means between two samples, using Welch's method under the hypothesis of heterogeneity. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

Table A2: Full estimation results of DID models of childcare time per day

Sample	Whole sample		Male sample		Female sample	
Variables	1. Workers with children aged 18 years and below	2. Workers with children aged 7 to 18 years	3. Workers with children aged 18 years and below	4. Workers with children aged 7 to 18 years	5. Workers with children aged 18 years and below	6. Workers with children aged 7 to 18 years
Telework hours per day	0.0253	0.0394	0.0174	0.0269	0.0137	0.0347
	(0.0394)	(0.0395)	(0.0349)	(0.0313)	(0.100)	(0.108)
COVID (Apr. and Sep.) (=1)	0.0181	-0.0891	0.0131	-0.0542	-0.0761	-0.228
	(0.117)	(0.131)	(0.123)	(0.135)	(0.208)	(0.219)
Telework hours per day × COVID (=1)	0.0097	-0.0030	-0.0104	0.0018	0.0590	0.0084
	(0.0376)	(0.0375)	(0.0330)	(0.0302)	(0.101)	(0.111)
Individual characteristics						
Age of respondents (years)						
20–24 (=1)	2.673***		0.157		3.224***	
	(0.962)		(0.789)		(0.835)	
25–29 (=1)	1.897***	4.878***	0.752		2.845***	5.399***
	(0.584)	(0.568)	(0.547)		(0.881)	(0.947)
30–34 (=1)	reference	reference	reference	reference	reference	reference
35–39 (=1)	0.0248	0.506	0.0516	0.271	-0.239	0.945
	(0.244)	(0.389)	(0.283)	(0.473)	(0.469)	(0.663)
40–44 (=1)	-0.647***	-0.0592	-0.348	-0.00206	-0.985**	0.300
	(0.235)	(0.348)	(0.255)	(0.453)	(0.447)	(0.575)
45–49 (=1)	-1.224***	-0.583	-0.846***	-0.511	-1.744***	-0.283
	(0.240)	(0.361)	(0.225)	(0.424)	(0.510)	(0.632)
50–54 (=1)	-1.388***	-0.879**	-0.679**	-0.536	-2.575***	-1.030
	(0.281)	(0.360)	(0.297)	(0.432)	(0.571)	(0.652)
55–59 (=1)	-1.704***	-0.879**	-0.937***	-0.419	-3.022***	-1.161
	(0.385)	(0.423)	(0.298)	(0.463)	(1.031)	(1.027)
60–64 (=1)	-1.478***	-1.115	-0.674	-1.055	-4.141***	-2.884*
	(0.519)	(0.734)	(0.594)	(0.655)	(1.371)	(1.510)
65–69 (=1)	-0.770	-0.551	-0.879	-0.950		
	(0.493)	(0.551)	(0.546)	(0.662)		
Female (=1)	1.365***	1.239***				
	(0.191)	(0.232)				
Married (=1)	0.241	0.0083	0.0914	0.0541	0.0058	-0.266
	(0.542)	(0.559)	(0.541)	(0.523)	(0.750)	(0.754)
College degree (=1)	0.125	0.210	0.0070	-0.122	-0.0550	0.366
	(0.141)	(0.168)	(0.138)	(0.152)	(0.291)	(0.351)
Type of employment						
Self-employment (=1)	0.0794	0.0915	-0.103	-0.0718	0.0942	0.495
	(0.274)	(0.280)	(0.280)	(0.222)	(0.526)	(0.604)

Regular employment (=1)	reference	reference	reference	reference	reference	reference
Non-regular employment (=1)	0.201	0.170	-0.0216	0.0183	0.313	0.212
	(0.249)	(0.267)	(0.311)	(0.304)	(0.338)	(0.372)
Unknown type of employment (=1)	2.343***				2.180***	
	(0.370)				(0.650)	
Type of employment of spouse						
Housework (=1)	-0.329*	-0.563***	-0.447**	-0.442**	0.364	-0.472
	(0.188)	(0.213)	(0.190)	(0.216)	(0.748)	(0.642)
Self-employment (=1)	-0.0284	-0.194	-0.298	-0.310	0.220	-0.352
	(0.287)	(0.291)	(0.293)	(0.287)	(0.550)	(0.552)
Regular employment (=1)	reference	reference	reference	reference	reference	reference
Non-regular employment (=1)	-0.125	-0.104	-0.243	-0.152	0.614	0.869
	(0.179)	(0.208)	(0.173)	(0.190)	(0.504)	(0.754)
Unknown type of employment (=1)	0.461	0.281	-1.087***	-0.772*	2.054*	0.998
	(0.673)	(0.499)	(0.392)	(0.418)	(1.196)	(0.882)
Industry						
Agriculture, fish, woods, and mining (=1)	-0.845**	-1.057***	-1.300***	-1.407***	-1.472***	-2.018***
	(0.414)	(0.370)	(0.300)	(0.293)	(0.558)	(0.603)
Construction and production (=1)	reference	reference	reference	reference	reference	reference
Wholesale and retail (=1)	-0.0093	0.00952	-0.209	-0.0005	0.0209	-0.0846
	(0.209)	(0.222)	(0.196)	(0.173)	(0.454)	(0.509)
Restaurant and Hotel (=1)	-0.834**	-0.464	-1.046***	-0.762***	-0.836	-0.526
	(0.421)	(0.423)	(0.300)	(0.276)	(0.592)	(0.613)
Finance, insurance and real estate (=1)	-0.246	-0.376	0.219	0.415	-0.982	-1.319**
	(0.319)	(0.354)	(0.286)	(0.335)	(0.647)	(0.668)
Transportation (=1)	-0.0583	0.0788	-0.266	-0.258	0.645	0.541
	(0.285)	(0.312)	(0.258)	(0.284)	(1.373)	(1.426)
Information and communication (=1)	-0.173	-0.103	-0.321	-0.226	0.392	-0.111
	(0.227)	(0.255)	(0.228)	(0.239)	(0.597)	(0.703)
Electricity, gas, and water (=1)	0.292	0.871	-0.149	-0.806**	0.933	1.383
	(0.464)	(0.939)	(0.384)	(0.341)	(1.083)	(1.282)
Healthcare (=1)	-0.100	-0.0736	-0.346	-0.380	-0.222	-0.322
	(0.237)	(0.260)	(0.255)	(0.231)	(0.439)	(0.490)
Education (=1)	0.143	0.324	0.493	-0.177	0.0875	0.0399
	(0.320)	(0.354)	(0.513)	(0.229)	(0.517)	(0.594)
Other services (=1)	-0.176	-0.158	0.0134	0.340	-0.360	-0.682

	(0.256)	(0.281)	(0.208)	(0.253)	(0.496)	(0.532)
Public servants (=1)	0.514*	0.878**	0.395	0.651*	0.183	0.108
	(0.282)	(0.375)	(0.264)	(0.332)	(0.678)	(0.936)
Other industry (=1)	1.192**	1.956***			0.660	2.119**
	(0.544)	(0.590)			(0.854)	(0.909)
Firm size of respondents						
1–29 workers (=1)	reference	reference	reference	reference	reference	reference
30–99 workers (=1)	0.274	0.254	0.0763	0.187	0.666	0.671
	(0.247)	(0.267)	(0.207)	(0.180)	(0.424)	(0.428)
100–499 workers (=1)	0.0240	-0.0053	-0.0059	0.279	0.0204	-0.125
	(0.202)	(0.215)	(0.182)	(0.182)	(0.355)	(0.394)
500+, public sector (=1)	0.0308	-0.111	0.107	0.317	-0.0908	-0.257
	(0.189)	(0.214)	(0.183)	(0.216)	(0.353)	(0.401)
Household characteristics						
No. of household members	0.140	0.154	0.0488	0.0241	0.351	0.331
	(0.119)	(0.127)	(0.0798)	(0.0818)	(0.287)	(0.304)
No. of children	-0.199	-0.0652	-0.139	-0.0242	-0.453	-0.162
	(0.169)	(0.183)	(0.107)	(0.112)	(0.398)	(0.432)
Monthly household income (10,000 yen, ln)	-0.162	-0.239	-0.113	-0.133	-0.401	-0.434
	(0.139)	(0.167)	(0.134)	(0.133)	(0.256)	(0.298)
Missing cases of monthly household income (=1)	-0.268	-0.522	0.0594	0.0424	-1.339	-1.521
	(0.648)	(0.726)	(0.594)	(0.575)	(1.119)	(1.271)
Household saving (10,000 yen, 2010 prices, ln)	0.0020	-0.0137	-0.0128	-0.0218	0.0511	0.0059
	(0.0291)	(0.0327)	(0.0248)	(0.0265)	(0.0673)	(0.0743)
Missing cases of saving (=1)	-0.514	-0.530	0.444	0.331	-0.657	-0.734
	(0.511)	(0.555)	(0.561)	(0.565)	(0.870)	(0.906)
Housing characteristics						
Space (m2, ln)	0.0414	0.0204	0.0943	0.120	-0.0556	-0.0118
	(0.142)	(0.162)	(0.130)	(0.115)	(0.302)	(0.353)
Missing of space (=1)	0.430	0.214	0.383	0.399	0.143	0.272
	(0.703)	(0.789)	(0.735)	(0.651)	(1.421)	(1.659)
Owner-occupied housing (=1)	0.0237	0.140	-0.103	-0.0568	0.101	0.258
	(0.226)	(0.267)	(0.220)	(0.186)	(0.450)	(0.556)
Age of housing	-0.0124**	-0.0141**	-0.0156***	-0.0132***	-0.0191	-0.0253*
	(0.00563)	(0.00585)	(0.00480)	(0.00460)	(0.0122)	(0.0149)
Number of new infections in prefecture	-3.27e-05	-4.47e-05	1.05e-05	-4.54e-06	-2.86e-05	3.12e-05
	(5.91e-05)	(6.68e-05)	(7.02e-05)	(6.64e-05)	(9.24e-05)	(0.00011)
Survey period fixed effects						
Apr. (=1)	0.0514	0.0762	0.119	0.0798	0.0763	0.115
	(0.0947)	(0.100)	(0.107)	(0.105)	(0.167)	(0.179)
City size						

Major cities (=1)	0.871***	0.617**	0.145	-0.145	1.455***	1.016*
	(0.251)	(0.284)	(0.219)	(0.238)	(0.471)	(0.533)
Other cities (=1)	0.689***	0.538**	0.165	-0.155	0.979**	0.873*
	(0.235)	(0.262)	(0.213)	(0.231)	(0.410)	(0.462)
Regional fixed effects						
Hokkaido (=1)	0.122	0.564	-0.371	-0.247	2.003*	1.739
	(0.426)	(0.531)	(0.235)	(0.228)	(1.067)	(1.197)
Tohoku (=1)	0.144	0.219	-0.350	-0.422*	0.506	0.610
	(0.341)	(0.410)	(0.296)	(0.240)	(0.592)	(0.678)
Kanto (=1)	reference	reference	reference	reference	reference	reference
Chubu (=1)	-0.109	-0.255	-0.213	-0.173	-0.0233	-0.315
	(0.200)	(0.222)	(0.194)	(0.193)	(0.397)	(0.451)
Kansai (=1)	0.242	0.242	0.195	0.227	0.115	-0.0647
	(0.211)	(0.227)	(0.216)	(0.204)	(0.422)	(0.482)
Chugoku (=1)	0.207	-0.0258	-0.433	-0.406	0.312	0.0426
	(0.427)	(0.479)	(0.360)	(0.316)	(0.814)	(0.862)
Shikoku (=1)	-0.308	-0.439	-0.111	-0.144	-0.414	-0.522
	(0.332)	(0.334)	(0.340)	(0.278)	(0.538)	(0.589)
Kyushu (=1)	0.187	0.0316	0.216	0.199	0.0108	-0.0980
	(0.272)	(0.297)	(0.265)	(0.252)	(0.517)	(0.539)
Constant	0.875	0.843	1.675*	1.183	3.278**	2.286
	(0.857)	(0.985)	(0.895)	(0.997)	(1.644)	(1.961)
Adjusted R-squared	0.329	0.322	0.254	0.278	0.292	0.263
No. of observations	1,224	970	672	503	552	467

Note: Childcare time per weekday is the dependent variable. The cluster standard errors over respondents are given in parentheses. ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.