**ARTICLE**

# An Empirical Study of the Effects of Telework During the COVID-19 Pandemic in Japan Using Panel Data

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## Abstract

This study aims to examine the effects of telework on some kinds of satisfaction during the COVID-19 pandemic in Japan. The hypotheses are: (1) the positive relationship between job/life satisfaction and telework exists, (2) the optimum frequency of telework exists, (3) the effects of telework are different among regular and non-regular employees, and (4) telework can increase the satisfaction of childcare, but its effects are different among male and female employees. One of the most comprehensive panel data, including the frequency of telework and some kinds of satisfaction, is used. The method of statistical analysis is a random-effects ordered probit regression model, because the variables of telework are possibly endogenous. One of the contributions of this study is to consider telework as endogenous. The main results of statistical analysis indicated: (1) a positive relationship between job satisfaction and the frequency of telework was observed as well as life satisfaction, (2) the effect of telework on the job and life satisfaction was the largest in the case that its frequency was less than 50%, (3) the job and life satisfactions of regular employees were affected by the frequency of telework in all case, and for non-regular employees, its effects were observed in the lower frequency cases of less than 50% and irregular, and (4) the increase of the childcare satisfaction by telework was observed in male employees rather than in female employees.

**Keywords** Telework · Job satisfaction · Life satisfaction · Childcare

## 1 Introduction

The current global pandemic caused by COVID-19 has dramatically influenced economic activity and lifestyles in many countries. The COVID-19 pandemic, at the beginning of 2020, represented a huge challenge not only for the health systems but also for the working world [7]. The spread of COVID-19 forced employers and

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employees to perform telework in Japan. The Japanese government asked companies to allow their employees to work at home. Companies implemented telework to ensure their employees' safety and maintain economic activity during the COVID-19 pandemic [4].

Telework is a referred to a flexible workstyle, especially in developed countries, before this pandemic. However, the spread of COVID-19 strongly drove the implementation of telework in Japan. The necessity of continuing business and protecting employees are the main reasons why companies in Japan quickly adopted teleworking.

This study examines the effects of telework on certain types of life satisfaction during the COVID-19 pandemic in Japan. First, the relationship between job/ life satisfaction and the frequency of telework is examined. The relationship is positive if telework is considered a measure to ensure employees' safety and stable employment.

Second, an optimum frequency may exist, if the pros and cons of telework suggested by the previous studies [2, 26] are considered. Wilton et al. [26], for example, summarized the pros and cons of telework, and found that the pros included productivity, less interruption, convenience, flexibility, reduced stress, better family life, and better work/life balance. The cons were work-related interactions, social interaction/isolation, over-working, data, technology problems, and distractions. This study empirically examines how often telework should be performed to maximize job and life satisfaction.

Third, this paper examines whether the effects of teleworking are different between regular and non-regular employees. If Japanese companies value regular employees more than non-regular employees, the non-regular employees may be fired and not be protected by telework. Non-regular employees are considered vulnerable in Japan's social insurance programs; therefore, this study highlights this theme.

Fourth and finally, the effects of teleworking on childcare are examined. The division of labor by gender has followed the traditional lines in Japanese society. In other words, compared to men, women generally are more concerned with family duties [22]. This study examines how telework affects the traditional differences in gender related to childcare satisfaction.

Section 2 summarizes the previous studies, and in Sect. 3, statistical analysis is conducted. Section 4 discusses the implications of the analysis and Sect. 5 concludes this paper.

## 2 Previous Studies

Telework has a variety of definitions and has been identified in many ways. As one definition of telework, Fitzer [11] defined telework as a work arrangement in which employees perform their regular work at a site other than the ordinary workplace, supported by technological connections. According to the Eurofound and International Labor Organization, telework is defined as the use of information and communications technologies (ICT), such as smartphones,

tablets, laptops, and/or desktop computers, for work that is performed outside the employer's premises [10].

It is important to note that this study does not include self-employed people, because they have different satisfaction characteristics from people employed directly by a company or organization.

The basic factor of telework is flexibility. Flexibility is associated with task independence and job discretion. Teleworking employees have greater freedom to structure their work activities and decide when, where, and how they engage with work [6, 13, 20, 23]. Employees gain flexibility from telework to support their work-life balance; therefore, telework usually improves their work/life satisfaction. This study focuses on several kinds of satisfaction that flexibility can bring.

On the other hand, face-to-face communication with colleagues and informal communication in an office setting does not exist in most telework and this lack of face-to-face communication may create a sense of isolation. A lack of informal communication among teleworkers and colleagues ceases organizational identification with the organization's values and goals [1, 8, 21]. Isolation is one drawback of telework [5, 12]. In contrast, face-to-face communication may cause distractions when workers attempt to concentrate on their jobs. Telework may lead to overwork, because the boundary between working time and time for life activities becomes ambiguous when schedule management is lacking.

Telework possibly negatively affects employees' health. The main hazards for the health of teleworkers are the unavailability of ergonomic work equipment and a dedicated working area, the risk of overwork, and the psychosocial implications of working from home [7]. Little consensus existed among studies on how telework arrangements affected organizational communications [9].

The relationship between the time spent teleworking and outcomes is not linear, as indicated by Golden and Veiga [14], Kazekami [16], Minetaki [18], and Gajendran and Harrison [13].

Demographic factors are also associated with telework. Many previous studies referenced gender considerations [3, 16, 17, 19, 21, 22]. Though no statistically significant relationship is found between gender and the adoption of part-day home-based e-working, females tend to be more likely to engage in whole-day home-based e-working [17]. Job category and gender also showed a significant difference between telecommuters and non-telecommuters [3]. The effect of teleworking depends on the employees, their jobs and characters, values, age, gender, and level of education [25]. Gender, age, and academic background are used as the control variables for estimations of satisfaction in Sect. 3.

Childcare has also been addressed as a factor in motivating telework. Sener and Reeder [24] discuss a result that indicates a positive impact for the presence of children (aged less than 16 years) on telecommuting adoption choice because of childcare responsibilities. Individuals with children less than 5 years old have a more favorable attitude toward telecommuting [15]. Previous studies indicate that employees having children need flexibility in working time and place because of caring for their children. However, satisfaction with childcare has not been examined yet in studies of telework job/life satisfaction.

## 3 Statistical Analysis

This study utilizes the 2nd, 3rd, and 4th Survey on Changes in Attitudes and Behaviors in Daily Life under the Influence of Novel Coronavirus Infection, provided by the Japanese Cabinet Office. This survey is one of the most comprehensive surveys in Japan when examining the outcomes of telework by panel data. This survey collects various data on lifestyle, healthcare, the status of marriage, workstyle including telework, emotion, the possibility of changing jobs, life satisfaction, social relationship, etc., during COVID-19, and includes more than 10,000 samples. The 2nd survey was conducted in December 2020. The 3rd and 4th were, respectively, conducted in April/May and September/October 2021. The Japanese Cabinet Office conducted this survey twice a year after April 2020; four surveys are available for study now. This study utilizes the 2nd, 3rd, and 4th surveys because of the continuity of the questionnaire.

The descriptive statistics are shown in Table 1. Variables except for age are ordinal numbers. The number of observations, mean, standard deviation, max, and min are shown in Table 1. Variables are divided into dependent, explanatory, and control variables in the results. This study's outcomes include job satisfaction, life satisfaction, and childcare satisfaction. The effects of the frequency of telework on those outcomes are examined in this section.

The results are conducted using panel data for December 2020, April/May, and September/October 2021 in all cases. The results are based on a random-effects ordered probit regression model that accommodates endogenous covariates in all cases, because the frequency of telework, which is the primary explanatory variable, is affected by other variables. Continuous, binary, and ordinal endogenous covariates are allowed.

This study investigates four types of frequency of telework: (1) almost 100%, (2) 50% or more, (3) less than 50%, and (4) irregular. Four types of telework frequency are considered explanatory variables for outcomes such as job satisfaction, life satisfaction, and satisfaction of childcare, and dependent variables are affected by demographic factors, such as gender, age, and academic background, which were also discussed in the previous studies mentioned in this paper. Variables of employment status, occupation, and industry are controlled to estimate the frequency of telework.

The effects of telework on Job satisfaction are statistically analyzed in Table 2. The dependent variable job satisfaction is on an 11-point Likert scale. All coefficients of the frequency of telework were positive ([2] [3] [4]: $< 0.01$, [1]: $< 0.05$). In addition, the estimation results indicated that the effect of telework on job satisfaction was the largest in the case of less than 50% ([3]).

The estimation results of life satisfaction are shown in Table 3. The dependent variable life satisfaction is on an 11-point Likert scale which is controlled by gender, age, living alone, married or not, and use of SNS. Those variables possibly influenced life satisfaction. The negative coefficient of the use of SNS (1: using everyday ~ 5: not using) suggested that it was positively correlated with the frequency of telework.

**Table 1** Descriptive statistics

| | Observations | Mean | Std. dev | Min | Max |
|---|---|---|---|---|---|
| Frequency of telework: almost 100% (yes: 1, no: 0) | 20,179 | 0.0549 | 0.2278 | 0 | 1 |
| Frequency of telework: 50% or more (yes: 1, no: 0) | 20,179 | 0.0603 | 0.2381 | 0 | 1 |
| Frequency of telework: less than 50% (yes: 1, no: 0) | 20,179 | 0.0730 | 0.2602 | 0 | 1 |
| Frequency of telework: irregular (yes: 1, no: 0) | 20,179 | 0.0962 | 0.2949 | 0 | 1 |
| Job satisfaction (unsatisfied = 1, very satisfied = 11) | 30,338 | 6.2426 | 2.4090 | 1 | 11 |
| Life satisfaction (unsatisfied = 1, very satisfied = 11) | 30,338 | 6.5258 | 2.2771 | 1 | 11 |
| Childcare satisfaction (unsatisfied = 1, very satisfied = 11) | 30,338 | 6.1133 | 2.3538 | 1 | 11 |
| Living alone (yes: 1, no: 0) | 30,338 | 0.2041 | 0.4030 | 0 | 1 |
| Living with children (less than 18 years of age) (yes: 1, no: 0) | 30,338 | 0.2009 | 0.4007 | 0 | 1 |
| Living with children (over 18 years of age) (yes: 1, no: 0) | 30,338 | 0.1512 | 0.3583 | 0 | 1 |
| Living with grandchildren (yes: 1, no: 0) | 30,338 | 0.0086 | 0.0924 | 0 | 1 |
| Married person (yes: 1, no: 0) | 51,255 | 0.0105 | 0.1020 | 0 | 1 |
| Academic background (junior high-school = 1, Ph.D. degree = 6) | 27,826 | 3.7772 | 1.4053 | 1 | 6 |
| Usage of SNS (1: using everyday, 5: not using) | 30,338 | 1.8137 | 1.1301 | 1 | 4 |
| Gender (male = 1, female = 2) | 30,338 | 1.5002 | 0.5000 | 1 | 2 |
| Age | 30,338 | 45.0671 | 16.9767 | 15 | 89 |
| Regular employee (yes: 1, no: 0) | 51,255 | 0.2416 | 0.4280 | 0 | 1 |
| Non-regular employee (yes: 1, no: 0) | 51,255 | 0.1051 | 0.3066 | 0 | 1 |
| Manager (yes: 1, no: 0) | 51,255 | 0.0336 | 0.1802 | 0 | 1 |
| Sales job (yes: 1, no: 0) | 51,255 | 0.0362 | 0.1867 | 0 | 1 |
| Accounting (yes: 1, no: 0) | 51,255 | 0.0127 | 0.1119 | 0 | 1 |
| Human resource, general affairs (yes: 1, no: 0) | 51,255 | 0.0158 | 0.1246 | 0 | 1 |
| Other clerical (yes: 1, no: 0) | 51,255 | 0.0461 | 0.2097 | 0 | 1 |
| Medical service, welfare, nursing care (yes: 1, no: 0) | 51,255 | 0.0402 | 0.1965 | 0 | 1 |

**Table 1** (continued)

| | Observations | Mean | Std. dev | Min | Max |
|---|---|---|---|---|---|
| Production (yes: 1, no: 0) | 51,255 | 0.0264 | 0.1602 | 0 | 1 |
| IT professional (yes: 1, no: 0) | 51,255 | 0.0176 | 0.1316 | 0 | 1 |
| Engineer in construction, machinery (yes: 1, no: 0) | 51,255 | 0.0153 | 0.1227 | 0 | 1 |
| Other engineer, professional (legal affairs, design, others) (yes: 1, no: 0) | 51,255 | 0.0293 | 0.1687 | 0 | 1 |
| Sales, serving customers, etc., at stores (yes: 1, no: 0) | 51,255 | 0.0324 | 0.1770 | 0 | 1 |
| Other service (yes: 1, no: 0) | 51,255 | 0.0546 | 0.2271 | 0 | 1 |
| Construction (yes: 1, no: 0) | 51,255 | 0.0179 | 0.1325 | 0 | 1 |
| Manufacturing (yes: 1, no: 0) | 51,255 | 0.0640 | 0.2447 | 0 | 1 |
| Wholesale (yes: 1, no: 0) | 51,255 | 0.0131 | 0.1137 | 0 | 1 |
| Retail trade (yes: 1, no: 0) | 51,255 | 0.0302 | 0.1710 | 0 | 1 |
| Finance, insurance, real estate (yes: 1, no: 0) | 51,255 | 0.0274 | 0.1631 | 0 | 1 |
| Transportation (yes: 1, no: 0) | 51,255 | 0.0183 | 0.1340 | 0 | 1 |
| Telecommunication industry (yes: 1, no: 0) | 51,255 | 0.0219 | 0.1462 | 0 | 1 |
| Electricity, gas, water supply (yes: 1, no: 0) | 51,255 | 0.0053 | 0.0724 | 0 | 1 |
| Public service (yes: 1, no: 0) | 51,255 | 0.0270 | 0.1620 | 0 | 1 |
| Education industry (yes: 1, no: 0) | 51,255 | 0.0186 | 0.1352 | 0 | 1 |
| Medical service, welfare (yes: 1, no: 0) (yes: 1, no: 0) | 51,255 | 0.0466 | 0.2109 | 0 | 1 |
| Childcare (yes: 1, no: 0) | 51,255 | 0.0046 | 0.0674 | 0 | 1 |
| Other service industry (personal service) (yes: 1, no: 0) | 51,255 | 0.0496 | 0.2171 | 0 | 1 |
| Other service industry (business service) (yes: 1, no: 0) | 51,255 | 0.0245 | 0.1545 | 0 | 1 |

**Table 2** Estimation results of job satisfaction

| Dependent variable: Job satisfaction | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Estimation method: random-effects ordered probit regression model | | | | |
| Frequency of telework | 0.8665** | 1.5197*** | 3.3045*** | 1.5219*** |
| | (0.3685) | (0.3393) | | |
| Dependent variable: frequency of telework | | | | |
| Gender | 0.0054 | −0.0011 | 0.0028 | −0.0228*** |
| | (0.0043) | (0.0047) | (0.0041) | (0.0061) |
| Age | 0.0001 | 0.0003* | 0.0011*** | −0.0002 |
| | (0.0002) | (0.0002) | (0.0001) | (0.0003) |
| Academic background | 0.0084*** | 0.0160*** | 0.0112*** | 0.0177*** |
| | (0.0014) | (0.0015) | (0.0015) | (0.0018) |
| Number of observations | 18,286 | 18,286 | 18,286 | 18,286 |
| Number of groups | 10,657 | 10,657 | 10,657 | 10,657 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 5.53 | 20.06 | 97.03 | 18.77 |
| Prob>chi2 | 0.02 | 0.00 | 0.00 | 0.00 |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

**Table 3** Estimation results of life satisfaction

| | [5] | [6] | [7] | [8] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Dependent variable: life satisfaction | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Gender | −0.1163*** | −0.0753*** | −0.0293 | 0.0244 |
| | (0.0277) | (0.0289) | (0.0289) | (0.0301) |
| Age | 0.0050*** | 0.0050*** | 0.0033*** | 0.0063*** |
| | (0.0010) | (0.0010) | (0.0010) | (0.0009) |
| Living alone | −0.2482*** | −0.2450*** | −0.1936*** | −0.2104*** |
| | (0.0319) | (0.0313) | (0.0286) | (0.0283) |
| Married person | −0.0019 | −0.0105 | −0.0250 | −0.0185 |
| | (0.0941) | (0.0921) | (0.0751) | (0.0811) |
| Usage of SNS | −0.0586*** | −0.0564*** | −0.0445*** | −0.0476*** |
| | (0.0119) | (0.0117) | (0.0102) | (0.0104) |
| Frequency of telework | 1.1265*** | 1.5907*** | 2.4931*** | 2.0680*** |
| | (0.2728) | (0.2424) | (0.3101) | (0.1932) |
| Dependent variable: frequency of telework | | | | |
| Gender | 0.0055 | −0.0032 | −0.0068 | −0.0306*** |
| | (0.0042) | (0.0047) | (0.0049) | (0.0056) |
| Age | 0.0000 | 0.0000 | 0.0004** | −0.0007*** |
| | (0.0001) | (0.0002) | (0.0002) | (0.0002) |
| Academic background | 0.0090*** | 0.0161*** | 0.0118*** | 0.0176*** |
| | (0.0013) | (0.0015) | (0.0015) | (0.0017) |
| Number of observations | 18,286 | 18,286 | 18,286 | 18,286 |
| Number of groups | 10,657 | 10,657 | 10,657 | 10,657 |

**Table 3** (continued)

| | [5] | [6] | [7] | [8] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 158.63 | 199.72 | 360.76 | 346.41 |
| Prob>chi2 | 0.00 | 0.00 | 0.00 | 0.00 |

***: $p<0.01$, **: $p<0.05$, *: $p<0.1$

Robust standard errors are in parentheses

All coefficients of the frequency of telework were positive ([5]–[8]: < 0.01). The effect of telework was the largest in the case where the frequency of telework was less than 50% ([7]). This result was the same as job satisfaction.

The results obtained in the estimations of job and life satisfaction indicated that the optimum frequency of telework was the case in less than 50% ([3] in Table 2; [7] in Table 3).

The effects of telework on job satisfaction were analyzed exclusively in the case of regular employees (Table 4) and the case of non-regular employees (Table 5). Comparing regular and non-regular employees, the effects of implementing telework could be well observed in regular employees. The coefficient of frequency of telework was the largest, and every four cases were statistically significant ([10] [11] [12]: < 0.01, [9]: < 0.05) in the case of regular employees (Table 4).

In the case of non-regular employees, only [15][16] were statistically significant (: < 0.1) in Table 5. Implementing telework possibly increased job satisfaction in the low frequency of telework (less than 50%, irregular), not in the high frequency.

Life satisfaction of regular employees was estimated by the frequency of telework, controlled by gender, age, living alone, married or not, and the use of SNS (Table 6).

All coefficients of the frequency of telework were positive ([17]–[20]: < 0.01). The effect of telework was the largest in the case where the frequency of telework was less than 50% ([19]); however, it was almost the same as the case where the frequency of telework was irregular ([20]).

Life satisfaction of non-regular employees was estimated by the frequency of telework, controlled by gender, age, living alone, married or not, and the use of SNS (Table 7).

In the case of non-regular employees, only [23][24] were statistically significant (: < 0.1) in Table 7. Implementing telework could increase life satisfaction in the low frequency of telework (less than 50%, and irregular), not in the high frequency, the same as in the case of non-regular job satisfaction in life satisfaction.

The effect of telework on the satisfaction of childcare determined by gender was examined in Tables 8 and 9. Every case, except for the case where the frequency of telework was less than 50%, showed statistically significant ([21]: < 0.05, [22]: < 0.01, and [24]: < 0.1) and in males (Table 8). The largest effect of telework was seen in the case of 50% or more (Table 8). In females, only the case of less than 50% was statistically significant ([31]: < 0.01) (Table 9). The estimation results were entirely different by gender.

## 4 Discussion

The results show that the effects of the frequency of telework on job/life satisfaction have an inverted U-shaped curve where the optimum frequency was in the case of less than 50% telework. Comparing the results gained in this study with similar previous studies, the remarkable point is clarified.

Golden and Veiga [14] showed that the relationship between the extent of telecommunication and job satisfaction was specified as curvilinear in an inverted

**Table 4** Estimation results of job satisfaction: case of regular employees

| | [9] | [10] | [11] | [12] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Dependent variable: job satisfaction | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Frequency of telework | 0.7950** | 1.4773*** | 2.6109*** | 1.9801*** |
| | (0.3082) | (0.2987) | (0.4860) | (0.2675) |
| Dependent variable: frequency of telework | | | | |
| Gender | 0.0122** | 0.0003 | −0.0030 | −0.0260*** |
| | (0.0053) | (0.0059) | (0.0058) | (0.0074) |
| Age | 0.0002 | 0.0005** | 0.0009*** | −0.0002 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0003) |
| Academic background | 0.0089*** | 0.0187*** | 0.0112*** | 0.0206*** |
| | (0.0017) | (0.0019) | (0.0019) | (0.0023) |
| Number of observations | 12,382 | 12,382 | 12,382 | 12,382 |
| Number of groups | 7371 | 7,371 | 7371 | 7371 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 6.65 | 24.47 | 28.86 | 54.79 |
| Prob>chi2 | 0.01 | 0.00 | 0.00 | 0.00 |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

**Table 5** Estimation results of job satisfaction: case of non-regular employees

| | [13] | [14] | [15] | [16] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Dependent variable: job satisfaction | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Frequency of telework | −6.7246 | −2.1994 | 4.9315*** | 5.6295*** |
| | (15.1130) | (3.5873) | (0.2154) | (0.5481) |
| Dependent variable: frequency of telework | | | | |
| Gender | −0.0189 | −0.0206** | 0.0090*** | 0.0067* |
| | (0.0172) | (0.0083) | (0.0032) | (0.0035) |
| Age | −0.0010*** | −0.0007 | 0.0008*** | 0.0007*** |
| | (0.0002) | (0.0006) | (0.0002) | (0.0002) |
| Academic background | −0.0005 | 0.0050 | 0.0054*** | 0.0059 |
| | (0.0138) | (0.0045) | (0.0020) | (0.0039) |
| Number of observations | 5385 | 5385 | 5385 | 5385 |
| Number of groups | 3227 | 3227 | 3227 | 3227 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 0.20 | 0.38 | 524.20 | 105.48 |
| Prob>chi2 | 0.66 | 0.54 | 0.00 | 0.00 |

***: $p<0.01$, **: $p<0.05$, *: $p<0.1$

Robust standard errors in parentheses

**Table 6** Estimation results of life satisfaction: case of regular employees

| Dependent variable: life satisfaction | [17] | [18] | [19] | [20] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Gender | −0.1146*** | −0.0857** | −0.0563*** | 0.0134 |
| | (0.0341) | (0.0347) | (0.0350) | (0.0344) |
| Age | 0.0007 | 0.0005 | −0.0005 | 0.0021* |
| | (0.0013) | (0.0013) | (0.0012) | (0.0012) |
| Living alone | −0.2572*** | −0.2544*** | −0.2096*** | −0.2104*** |
| | (0.0365) | (0.0358) | (0.0358) | (0.0318) |
| Married person | 0.0771 | 0.0677 | 0.0396 | 0.0533 |
| | (0.1114) | (0.1090) | (0.0936) | (0.0927) |
| Usage of SNS | −0.0572*** | −0.0553*** | −0.0456*** | −0.0450*** |
| | (0.0142) | (0.0139) | (0.0127) | (0.0120) |
| Frequency of telework | 0.8327*** | 1.3628*** | 2.1482*** | 2.0470*** |
| | (0.2687) | (0.2512) | (0.4537) | (0.2003) |
| Dependent variable: frequency of telework | | | | |
| Gender | 0.0124** | 0.0000 | −0.0056 | −0.0342*** |
| | (0.0053) | (0.0061) | (0.0063) | (0.0074) |
| Age | 0.0002 | 0.0003 | 0.0005** | −0.0009*** |
| | (0.0002) | (0.0002) | (0.0002) | (0.0003) |
| Academic background | 0.0094*** | 0.0188*** | 0.0113*** | 0.0202*** |
| | (0.0017) | (0.0019) | (0.0020) | (0.0022) |
| Number of observations | 12,382 | 12,382 | 12,382 | 12,382 |
| Number of groups | 7371 | 7371 | 7371 | 7371 |

**Table 6** (continued)

| | [17] | [18] | [19] | [20] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 91.01 | 118.87 | 176.80 | 261.02 |
| Prob> chi2 | 0.00 | 0.00 | 0.00 | 0.00 |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

**Table 7** Estimation results of life satisfaction: case of non-regular employees

| | [21] | [22] | [23] | [24] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: 50% less than 50% | Frequency of telework: irregular |
| **Dependent variable: life satisfaction** | | | | |
| Gender | −0.0436 | −0.0746 | −0.0042 | −0.0190 |
| | (0.0694) | (0.0652) | (0.0524) | (0.0633) |
| Age | 0.0122*** | 0.0121*** | 0.0055** | 0.0107*** |
| | (0.0019) | (0.0019) | (0.0027) | (0.0020) |
| Living alone | −0.2759*** | −0.2747*** | −0.1717*** | −0.2394*** |
| | (0.0685) | (0.0697) | (0.0618) | (0.0646) |
| Married person | −0.1840 | −0.1927 | −0.1313 | −0.1727 |
| | (0.1803) | (0.1841) | (0.1216) | (0.1626) |
| Usage of SNS | −0.0520** | −0.0538** | −0.0311* | −0.0425** |
| | (0.0226) | (0.0229) | (0.0172) | (0.0210) |
| Frequency of telework | 2.1114 | 0.8424 | 3.8483*** | 2.9525*** |
| | (1.2996) | (0.9874) | (0.6965) | (0.9726) |
| **Dependent variable: frequency of telework** | | | | |
| Gender | −0.0129* | −0.0161** | −0.0083 | −0.0165** |
| | (0.0069) | (0.0068) | (0.0073) | (0.0072) |
| Age | −0.0003 | −0.0003* | 0.0004** | −0.0002 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| Academic background | 0.0076*** | 0.0076*** | 0.0102*** | 0.0103*** |
| | (0.0023) | (0.0023) | (0.0022) | (0.0021) |

**Table 7** (continued)

|  | [21] | [22] | [23] | [24] |
|---|---|---|---|---|
|  | Estimation method: random-effects ordered probit regression model | | | |
| Number of observations | 5385 | 5385 | 5385 | 5385 |
| Number of groups | 3227 | 3227 | 3227 | 3227 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.7 | 1.7 | 1.7 | 1.7 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 75.94 | 72.47 | 255.97 | 114.63 |
| Prob > chi2 | 0.00 | 0.00 | 0.00 | 0.00 |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

**Table 8** The estimation results of satisfaction of childcare: males

| | [25] | [26] | [27] | [28] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Dependent variable: satisfaction of childcare | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of telework: less than 50% | Frequency of telework: irregular |
| Frequency of telework | 1.1400** | 1.5257*** | 0.0959 | 1.3104* |
| | (0.5493) | (0.5388) | (2.3679) | (0.7808) |
| Dependent variable: frequency of telework | | | | |
| Age | −0.0005 | −0.0002 | 0.0013** | −0.0005 |
| | (0.0004) | (0.0005) | (0.0006) | (0.0006) |
| Academic background | 0.0081*** | 0.0219*** | 0.0109* | 0.0209*** |
| | (0.0030) | (0.0035) | (0.0058) | (0.0043) |
| Number of observations | 3991 | 3991 | 3991 | 3991 |
| Number of groups | 2234 | 2234 | 2234 | 2234 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.8 | 1.8 | 1.8 | 1.8 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 4.31 | 8.02 | 0.00 | – |
| Prob>chi2 | 0.04 | 0.00 | 0.97 | – |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

**Table 9** The estimation results of satisfaction of childcare: females

| | [29] | [30] | [31] | [32] |
|---|---|---|---|---|
| | Estimation method: random-effects ordered probit regression model | | | |
| Dependent variable: satisfaction of childcare | Frequency of telework: almost 100% | Frequency of telework: 50% or more | Frequency of Telework: less than 50% | Frequency of telework: irregular |
| Frequency of telework | 1.0205 | 0.3700 | 3.4672*** | −0.3719 |
| | (0.6996) | (0.9513) | (1.0881) | (1.4298) |
| Dependent variable: frequency of telework | | | | |
| Age | 0.0003 | −0.0003 | 0.0012*** | −0.0008 |
| | (0.0003) | (0.0004) | (0.0003) | (0.0006) |
| Academic background | 0.0094*** | 0.0075** | 0.0093** | 0.0085** |
| | (0.0027) | (0.0036) | (0.0037) | (0.0041) |
| Number of observations | 2775 | 2775 | 2775 | 2775 |
| Number of groups | 1692 | 1692 | 1692 | 1692 |
| Obs. per group: min | 1.0 | 1.0 | 1.0 | 1.0 |
| Avg | 1.6 | 1.6 | 1.6 | 1.6 |
| Max | 3.0 | 3.0 | 3.0 | 3.0 |
| Wald chi2(5) | 2.13 | 0.15 | 10.15 | 0.07 |
| Prob>chi2 | 0.14 | 0.70 | 0.00 | 0.79 |

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Robust standard errors are in parentheses

U-shape. Kazekami [16] also estimated labor productivity on the assumption of the inverted U-shape.

On the other hand, this study does not assume the inverted U-shape. This point differs from Golden and Veiga [14] and Kazekami [16].

Minetaki [18] stated that the effect of telework on job satisfaction was the strongest in the case that time spent teleworking was more than 10 to 30 h a month, investigating cases where teleworking hours per month were (1) more than 0, (2) more than 10 to 30, (3) more than 30 to 60, and (4) more than 60. Engaging in telework for more than 30 h a month had a negative effect on job satisfaction. The effect of telework on labor productivity was maximized when teleworking for more than 30 to 60 h a month. The common point of this study and Minetaki [18] is to indicate the existence of the optimum frequency or hours of telework which is treated as an endogenous variable in estimation.

Researching the difference between regular and non-regular employees is one of the particularities of this study. Although the results in regular employees were expected, the results that the effects of telework on job and life satisfaction could be observed even in the lower frequency cases in non-regular employees were emphasized. In future studies, it will be necessary to identify what kinds of occupations are suitable for teleworking in non-regular employees.

The effect of telework on childcare satisfaction was found to be different by gender, with a higher percentage frequency in males than in females. The results of this study suggest that the burden of childcare is reinforced in females if the frequency of telework is higher and the satisfaction of childcare does not increase; in contrast, the satisfaction of males increases with a higher frequency of telework, because males were not mainly responsible for childcare before implementing telework in Japan.

## 5 Conclusions

The following conclusions were obtained from the statistical analysis:

(1)  A positive relationship between job/life satisfaction and the frequency of telework was statistically verified.
(2)  The effect of telework on job/life satisfaction was found to be largest in the case where its frequency was less than 50%.
(3)  The job/life satisfaction of regular employees was affected by the frequency of telework in all cases. For non-regular employees, its effects were examined in the lower frequency cases of less than 50% and in the irregular case.
(4)  The increase in childcare satisfaction by telework was examined in male employees, except for the case where the frequency of telework was less than 50. The largest effect of telework was seen in the case of 50% or more. The childcare satisfaction of females did not increase in the case of less than 50%. The results were different by gender.

Those above conclusions can be helpful for policymakers in Japan to promote work-style reform. Such reform is currently being examined by the Japanese government and telework is being implemented. However, as this study clarifies, female employees most likely will not feel job/life satisfaction from telework if childcare responsibilities do not change. The inequality between regular and non-regular employees is also a social problem in Japan. Non-regular employees were shown to enjoy the benefit of telework to some extent. If the Japanese government makes use of the results in this paper, it should approach the companies which have not yet implemented telework for non-regular employees.

This study had several limitations. For example, an analysis by occupation was not done. In this study, occupation is used as a control variable for the frequency of telework and the estimations should be conducted by category of occupation. Also, the data on the number of children and age of children have not yet been utilized for statistical analysis. In future studies, it will be necessary to identify what kinds of occupations are suitable for teleworking in non-regular employees.

## Declarations

**Conflict of Interest**  The author verify that he has no conflict of interest. A conflict of interest does not exist. He does not have a financial or personal relationship with a third party whose interests could be positively or negatively influenced by my article's content.

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