KOCHI UNIVERSITY OF TECHNOLOGY

Social Design Engineering Series *SDES-2025-8*

Online productivity in the Japanese workplace: The role of work formats, task types, and remuneration systems

Kostiantyn Ovsiannikov
Research Institute for Future Design, Kochi University of Technology

Koji Kotani
Research Institute for Future Design, Kochi University of Technology
Urban Institute, Kyushu University
College of Business, Rikkyo University

Hodaka Morita
Institute of Economic Research, Hitotsubashi University

December 23, 2025

School of Economics and Management
Research Institute for Future Design
Kochi University of Technology

Online productivity in the Japanese workplace: The role of work formats, task types, and remuneration systems

Kostiantyn Ovsiannikov[*] Koji Kotani[*,†,‡,§] Hodaka Morita[¶]

December 24, 2025

Abstract

The rapid expansion of telework during the COVID-19 pandemic has prompted extensive research on remote work practices. However, the implications of telework for productivity across different task types and work formats remain underexplored. This study investigates how perceived productivity in an online environment varies by (1) work formats (individual vs. group), (2) task types (routine vs. creative) and (3) remuneration systems (seniority-based vs. performance-based), with a focus on the Japanese workplace. Drawing on a stratified survey of 500 employees across diverse industries, we examine comparative perceptions of online versus face-to-face productivity. Our findings reveal three key patterns. First, online productivity is significantly lower for group work than for individual work. Second, within group format, creative tasks are associated with lower perceived productivity compared to routine ones. Third, organizations operating under seniority-based wage system report consistently lower online productivity than those using performance-based system. Together, these findings point to a "telework dilemma," wherein employees value telework but perceive it to be less effective — especially for collaborative, creative tasks — under traditional organizational structures. The study contributes to the literature on virtual work and organizational design by identifying structural and task-related contingencies that shape the effectiveness of remote work.

Key Words: Telework; Human resource management; Employee attitudes; COVID-19; Knowledge transfer

[*]Research Institute for Future Design, Kochi University of Technology
[†]Urban Institute, Kyushu University
[‡]College of Business, Rikkyo University
[§]Corresponding author, E-mail: kojikotani757@gmail.com. We do not have any conflict of interest.
[¶]Institute of Economic Research, Hitotsubashi University

Contents

Nomenclature

CGP creative group productivity

CIP creative individual productivity

D-PPOE perceived productivity difference between routine and creative tasks in an online environment as compared to an office environment

ICT Information and Communications Technology

PPOE perceived productivity in an online environment as compared to an office environment

RGP routine group productivity

RIP routine individual productivity

SMEs small and medium-sized enterprises

WCT willingness to continue telework

1 Introduction

Against the background of the ongoing COVID-19 pandemic, our everyday lifestyles as well as working conditions have undergone noticeable changes. Initially, the transition from a face-to-face to an online environment has been dictated by a need of social distancing and was mostly perceived as a temporary concession. However, as entire sectors of economy have started to embrace teleworking in the long run, management, employees as well as environmental advocates and other stakeholders have realized the benefits associated with this format. The most obvious ones include spared cost of transportation and office rent, better opportunities to spend time with family as well as enhanced autonomy and flexibility regarding a workplace routine. At the same time, the costs associated with telework include, among others, extended working hours in front of PC, lack of direct communications as well as supervision challenges. Nowadays, upon questioning net benefits of prolonged telework, numerous companies opt to return to a face-to-face environment (Taskin and Bridoux, 2010, Greer and Payne, 2014). Given this state of affairs, current research empirically addresses the issue of online productivity in a workplace depending on work formats, task types and remuneration systems.

There exists an overwhelming evidence about positive organizational outcomes that telework embodies (Martin and MacDonnell, 2012). Golden (2006), Mahler (2012) and Caillier (2013) report that limited teleworking hours are associated with both high job satisfaction and high productivity. Those who are allowed to telework also display above-average levels of organizational commitment (Mahler, 2012). Positive effect of the transition is magnified for those who used to spend long time commuting to their workplaces (Shabanpour et al., 2018, Lister and Harnish, 2019). Despite taking longer time to carry out tasks in a remote format as compared to a face-to-face format, $76\,\%$ of the U.K. employees report improved work effectiveness, which is mostly due to the absence of office distractions (Baruch, 2000). Telework can also enhance inter-employee communication, provided the sound ICT (Information and Communications Technology) environment and clearly defined performance benchmarks (Bailey and Kurland, 2002, Illegems and Verbeke, 2004, Bosua et al., 2013).

On the other hand, due to the COVID-19 pandemic, many employees have been conducting their work in a solely online environment over a long period of time. After an initial improvement

of a work-life balance, the situation subsequently deteriorated due to the following factors. First, proximity to a family as a result of working from home has often blurred the lines between job responsibilities and domestic chores (Baruch, 2000, Golden et al., 2006, Capecchi et al., 2024). Second, whereas occasional teleworking can ease the burden of formal office communication, an entirely online environment with unclear time horizons may lead to psychological isolation, deterioration of trust among employees and a loss of organizational commitment (Gajendran and Harrison, 2007, Pyöriä, 2011, Galanti et al., 2021, McPhail et al., 2024). While for sectors such as real estate, financial intermediation and education it has been natural to widen the scope of remote activities (Welz and Wolf, 2010), for manufacturing industries such transition appears problematic (Dingel and Neiman, 2020, Etheridge et al., 2020, Okubo, 2020). Other associated obstacles include (i) a lack of proper employee monitoring (Greer and Payne, 2014), (ii) unrealized collaboration possibilities and (iii) security concerns over data transmission (Ruth and Chaudhry, 2008). All in all, management remains skeptical regarding the net benefits of telework.

Recognizing the variety of challenges as well as opportunities that implementation of telework presents for employees and their companies, existing scholarship mostly focuses on online individual productivity, while not sufficiently highlighting the issue of online group productivity (Salas et al., 2008, Lisbona et al., 2020, van der Lippe and Lippényi, 2020). We claim that the major challenge brought by the spread of telework is an impeded group collaboration, especially when working on creative tasks. Addressing this literature gap, we pose the following research question: how did "perceived productivity in an online environment as compared to an office environment" (henceforth "PPOE") change depending on work formats (individual vs. group), task types (routine vs. creative) and remuneration systems (seniority-based vs. performance-based)? Let the PPOE difference between routine and creative tasks be "D-PPOE." To this end, we test the following hypotheses by analyzing the results of a stratified survey: (0) PPOE tends to be high for *individual* as compared to *group* work, (1) *individual* D-PPOE is not significantly different from zero, (2) D-PPOE is positive for *group* work, (3) D-PPOE is positively affected by the "seniority-merit" wage system. The paper proceeds as follows. Section 2 discusses the posed hypotheses, section 3 presents statistical results and section 4 concludes with their implications.

2 Working environment and productivity

Being well-suited for an individual format (Taskin and Devos, 2005), telework has also been known for impeding inter-personal communications at a workplace. This is important, as the quality of shop-floor interactions exerts a substantial influence on group work (Allen et al., 2015). In particular, it impacts group cohesiveness, motivation and productivity (Hackman, 2012, Salas et al., 2015). As inter-group connections build up incrementally, even highly-efficient individuals require a well-designed environment to become a productive team (Salas et al., 2008, Okubo, 2020, Umishio et al., 2022). This is all the more relevant for "virtual teams" (Hackman, 2012, de Leede and Nijland, 2016). Although they enjoy benefits of asynchronicity, flexible schedules and enhanced multimedia tools (Garro-Abarca et al., 2021), flawless interaction necessitates the creation of a virtual environment closely replicating an in-person format (Mak and Kozlowski, 2019). At the end, the lack of unmediated communication appears to suppress group PPOE, irrespective of whether tasks are routine or creative. As opposed to a group format, individual work does not hinge upon communication quality and hence can be performed online as productively as face-to-face (Ishii-Kunz, 2025). We assume that this also holds true uniformly, i.e. both for routine and creative tasks.

Hypothesis 0 *PPOE is higher for individual work than for group work irrespective of whether a task is routine or creative.*

Classifying job assignments into "routine" and "creative" warrants further clarification. While routine tasks are based on systematized prescriptions, creative ones imply non-standard ways of thinking. According to the common definition of a workplace creativity, it is about the production of useful and novel ideas or solutions to challenging problems (Amabile et al., 1996) that can range from incremental improvements to radical innovations (Zhou and Shalley, 2011). There exist different views on whether or not teleworking is beneficial for carrying out creative tasks. On one hand, online environment enables well-organized employees to gear their schedules to individual needs. Absence of commuting combined with casual working atmosphere are likely to help workers feel less reserved in carrying out their creative pursuits remotely. Based on the laboratory experiment, Dutcher (2012) finds that while a face-to-face format is beneficial for routine

tasks, telework is associated with high creative performance.[1] Martínez-Sánchez et al. (2007) and Umishio et al. (2022) also come up with the evidence of an online environment being appropriate for carrying out creative tasks. On the other hand, Vega et al. (2015) and Mercier et al. (2021) find that an overall positive individual PPOE is mostly driven by routine-tasks' enhanced productivity. Likewise, one of the pioneering studies on telecommuting by DuBrin (1991) shows that telework is better geared for structured and repetitive than for creative tasks. Such contradictory evidence regarding individual PPOE is likely to be observed due to the following. By definition, individual assignments can be effectively carried out in the absence of interaction with other co-workers. Hence, online environment, with its supposedly negative (see hypothesis 0) impact on group work, would not harm (or enhance thereof) individual productivity, irrespectively of whether it is a routine or a creative task.

Hypothesis 1 *For individual work, the difference between routine and creative PPOE is not significantly different from zero.*

Group work is indispensable from communications between co-workers and the accompanying knowledge-sharing (Kozlowski and Klein, 2000, Salas et al., 2015). Contrary to "explicit knowledge" that can be articulated and conceptualized, it is predominantly *"tacit knowledge"* that proliferates at a shop-floor level (Nonaka, 2007). According to Polanyi (1966) who coined the term, "tacit knowledge" is about innate or acquired abilities (e.g. swimming or bicycle-riding) our physiology possesses without being able to analytically describe the underlying mechanism. Tacit knowledge is key for maintaining group cohesiveness which, in turn, facilitates organizational productivity (Cohen and Bailey, 1997, Hodzic et al., 2024). While tacit knowledge is reinforced in a face-to-face format thanks to physical co-location of team members (Roberts, 2000), its quality and transferability inevitably deteriorate online (Khalifa and Davison, 2000, Overmyer, 2011, Allen et al., 2015). However, this decay is not uniform. Due to a lesser role that communication plays for routine tasks as compared to creative tasks, it is still feasible for team-members to perform routine work in an online format (Martins and Shalley, 2011). As for creative assignments, digital knowledge-sharing turned out to be an important factor for their successful completion

[1]The author implemented experimental design not least because of the fact that, until recently, employees were endogenously assigned to telecommute based on their credibility and/or occupational compatibility with an online format. In contrast, the COVID-19 pandemic has prompted non-discriminatory telework transition, enabling researchers to capture differences in productivity as compared to office format.

during the COVID-19 era (Tønnessen et al., 2021). At the same time, when benchmarking online group productivity against office standards, creative tasks tend to be impeded by communication hurdles (Han et al., 2017, van der Meulen et al., 2019, Waizenegger et al., 2020, Brucks and Levav, 2022). In a nutshell, against an overall envisaged decline in group PPOE (see hypothesis 0), we assume further differences for a group format in respect to routine and creative tasks.

Hypothesis 2 *For group work, the difference between routine and creative PPOE is positive.*

In addition to disentangling PPOE into "group" and "individual," we are also interested in the factors influencing it. It is widely known that employee productivity and creativity are closely linked to a supervision style. Although, despite its developed taxonomy, supervision is difficult to quantify, it can nevertheless be proxied by the type of remuneration system. We suggest "seniority-merit pay" as a proxy for a supervision style largely relying on tacit knowledge, and "performance-based pay" – as a proxy for a supervision style largely relying on explicit knowledge.[2] On one hand, performance-based pay is rooted in short-term environment-agnostic criteria, providing effective incentives for workers to stay productive under remote working conditions (Cira and Benjamin, 1998, Hon, 2012). On the other hand, criteria for evaluating recipients of seniority-merit wages reflect the need to maintain employer-employee organizational commitment by mutually upholding long-term loyalty and trust (Lazear, 2000, Bayo-Moriones et al., 2010, Cadsby et al., 2017). Recipients of seniority-merit wages habitually prove their value through a series of shop-floor interactions – beyond the scope of prescribed duties. As a result, a tacit ecosystem in which they exist is likely to crumble once its nodes become physically disconnected.

Hypothesis 3 *For group work, "seniority-merit" wage system magnifies the positive difference between routine and creative PPOE.*

Based on the above, our hypothesis-testing is organized as follows. First, by comparing an individual and a group working formats, we inquire about their overall merits and demerits for PPOE. Next, we conduct the comparative analysis for each of those formats (individual and group) by examining the respective differences between routine and creative productivity, which we denote as D-PPOE. Finally, we run multiple regressions with individual- and group-D-PPOE as dependent variables to understand the D-PPOE's main drivers.

[2]Other studies like the one by Hodzic et al. (2024) use self-reported measurement of knowledge types.

3 Results

Our data set was sourced from the registered participants' pool of a web-based questionnaire survey conducted by the Japan-based research organization Cross Marketing Inc in December 2020. During that time, the memories of the emergency lockdown caused by the spread of the COVID-19 virus were still vivid, as the state of emergency in 19 out of 47 Japan's prefectures had only been lifted in early October of the same year. Furthermore, numerous employees had kept working remotely, and the prospects of returning to office were unclear.[3] In fact, all our survey subjects experienced both face-to-face and online working conditions. Our sample consists of 500 participants, which is partly determined by the budget and time constraints we face. Among the respondents of the survey 200 are females and 300 – males. While $44\,\%$ of male subjects are ordinary employees and $56\,\%$ are managers, the respective distribution for females is $78\,\%$ vs. $22\,\%$. This inter-gender discrepancy partially reflects the real population phenomenon, whereby a relatively small share of women occupy advanced corporate posts. Half of the respondents are employed in SMEs (small and medium-sized enterprises) of "$300\sim1000$" workers, and another half is equally divided between firms of "$1000\sim4999$" and "5000 or more" workers. While the survey subjects belong to different employment types ranging from regular ($53\,\%$) to dispatch workers ($14\,\%$), all of them have full-time contracts. Besides the questions about demographic- and lifestyle-characteristics, our survey concentrates on the work satisfaction and productivity, focusing on the perceptional differences between pre-pandemic era and COVID-19 period.

As seen from table 1 that includes summary statistics, most of the variables are ordered factors taking integer values between "1" (negative extreme) and "5" (positive extreme). This corresponds to the 5-point Likert scale of subjective perceptions related to online working environment. For example, possible responses to the questions about the perceived productivity in an online environment as compared to an office environment (PPOE) range from "productivity has significantly decreased" (= 1) to "productivity has significantly increased" (= 5). The numeric variables include "Age," "Pre-COVID income," "Pre-COVID sleeping hours," "Pre-COVID working hours" and "Pre-COVID commuting hours." Respondents' age distribution is displayed in figure B1. According to it, the mode value is 61 years old and the median value is 50.5 years old. This picture

[3] At the same time, teleworking ratio among Japanese employees due to the COVID-19 outbreak was the lowest among the OECD states, standing at about $30\,\%$ as of July 2020 (Mori, 2021).

Table 1: Descriptive statistics

	Definition	N	Mean	Median	Min	Max	St. Dev.
Age	A variable that represents the age of a respondent.	500	48.462	50.5	23	69	11.965
Gender	A dummy variable that takes 1 if a respondent is male, otherwise 0.	500	1.4	1	1	2	0.490
FirmSize	A categorical variable that represents the size of a company.	500	2.546	2.5	1	4	1.076
Pre-COVID commuting hours	A variable that represents average daily commuting hours of a respondent before COVID-19 pandemic.	500	0.978	1	0	2.5	0.432
Education	A categorical variable that shows a respondent's educational level.	500	5.566	6	1	7	1.364
Pre-COVID income	A categorical variable that represents an annual salary of a respondent before COVID-19 pandemic. It ranges from "less than 1 million Japanese yen" (1) to "more than 10 million Japanese yen" (6).	500	4.148	4	1	6	1.090
Pre-COVID working hours	A variable that represents average daily working hours before COVID-19 pandemic.	500	8.495	8	2	20	1.400
Pre-COVID sleeping hours	A variable that represents average daily sleeping hours before COVID-19 pandemic.	500	6.138	6	1	8	1.104
Well-being	A composite variable that assesses the degree of respondent's well-being.	500	3.834	4	1	7	1.243
RIP	A variable that represents respondent's routine individual productivity in an online environment.	500	2.922	3	1	5	0.970
CIP	A variable that represents respondent's creative individual productivity in an online environment.	500	2.952	3	1	5	0.907
RGP	A variable that represents respondent's routine group productivity in an online environment.	500	2.732	3	1	5	0.877
CGP	A variable that represents respondent's creative group productivity in an online environment.	500	2.664	3	1	5	0.856
TeleProductivity	A variable that represents respondent's overall productivity in an online environment.	500	2.942	3	1	5	0.908
TeleComfort	A variable that represents the degree of respondent's comfort associated with working in an online environment.	500	3.408	3	1	5	1.004
WCT	A variable that represents the degree of respondent's willingness to continue teleworking upon the lifting of COVID-19-related restrictions.	500	3.566	4	1	5	1.241

resembles the real working population tendencies, whereby, as of 2020, most of the country's workforce belonged to the age category of "45-54" years old, accounting for $16.26\,\%$ of Japan's population (e-Stat, 2020). There are some notable links between our variables, as presented in table 2. Among others, it shows high correlation ($r = 0.7$) between overall online productivity and RIP (routine individual productivity). As expected, comfort of online environment is highly correlated with the willingness to continue telework (WCT) in the aftermath of the pandemic ($r = 0.67$) and with being more productive when working remotely ($r = 0.53$). In addition, we can observe significant positive correlations between different domains of telework. Along with demographic variables as well as the measurements of online productivity and satisfaction, we also inquire about the type of remuneration system.

According to the results of the exploratory analysis, general perception of telework can be described as follows. As figure 1(a) demonstrates, both men and women clearly find it comfortable to work remotely. In agreement with this, figure 1(b) shows a strong positive trend in the WCT even if the COVID-19 restrictions are lifted. The WCT is particularly high among females, $34\,\%$ of whom choose the most affirmative answer. The respective figure of $24.7\,\%$ for males is also high. Moreover, additional $24.5\,\%$ of females and $31.3\,\%$ of males express their WCT as "positive." Similar tendencies are observed when disaggregating the sample into ordinary and managerial ranks. In the context of the overall-positive assessement of remote work, it is interesting that subjective perception of labor productivity is rather mixed, as figure 1(c) shows. In case of women, it can be described as "ambivalent," with $27\,\%$ of female respondents holding an opinion that PPOE has decreased, and $30.5\,\%$ thinking the opposite. Regarding men, the perception is negative, with $30.6\,\%$ of male respondents being critical regarding PPOE, and only $20.6\,\%$ holding a positive opinion. All in all, it can be said that despite enjoying working remotely, most of the respondents report decreased PPOE.

Next, we analyze productivity levels pertaining to different types of assignments in an online environment as formulated in hypotheses 0, 1 and 2. In the context of hypothesis 0, as seen from table 1 and figure 2, average individual PPOE is higher than average group PPOE, irrespectively of the type of assignment. In order to verify that these differences are also statistically consistent across the analyzed subjects, we run the Wilcoxon signed-rank test designed for a non-parametric paired comparison of measurements taken from the same subjects. The null-hypothesis of the

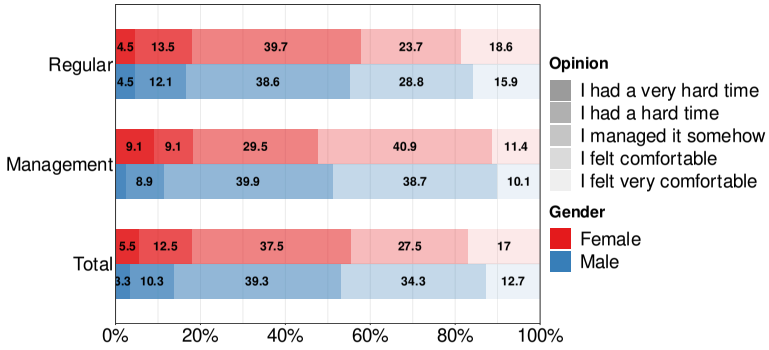
Table 2: Pearson correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age															
2. Gender	0.11*														
3. FirmSize	0.02	-0.05													
4. Pre-COVID commuting hours	0.06	0.14**	-0.05												
5. Education	-0.12**	0.26***	-0.02	0.02											
6. Pre-COVID income	0.18***	0.34***	0.09*	0.03	0.23***										
7. Pre-COVID working hours	-0.19***	0.14**	0.02	0.05	0.19***	0.21***									
8. Pre-COVID sleeping hours	-0.11*	0.09	-0.03	-0.19***	0.07	0.01	-0.17***								
9. RIP	-0.07	-0.07	-0.06	0.04	0.05	0.00	0.00	-0.09*							
10. CIP	-0.03	-0.01	0.00	-0.04	0.05	0.00	0.04	-0.10*	0.50***						
11. RGP	-0.08	-0.02	0.06	-0.08	0.03	0.03	0.00	0.00	0.35***	0.28***					
12. CGP	-0.03	-0.01	0.04	-0.01	0.01	-0.03	0.00	-0.07	0.36***	0.46***	0.48***				
13. Productivity	-0.10*	-0.08	-0.05	-0.05	0.05	0.02	0.02	-0.06	0.70***	0.51***	0.49***	0.50***			
14. TeleComfort	-0.07	0.02	0.03	-0.02	0.04	0.13**	0.04	-0.05	0.52***	0.38***	0.29***	0.29***	0.53***		
15. WCT	-0.17***	-0.05	0.07	0.06	0.13**	0.12**	0.12**	-0.11*	0.49***	0.37***	0.26***	0.28***	0.53***	0.67***	
16. Well-being	0.07	0.03	0.05	-0.07	0.00	0.13**	-0.08	0.14**	0.00	0.04	-0.05	-0.02	0.07	0.17***	0.02

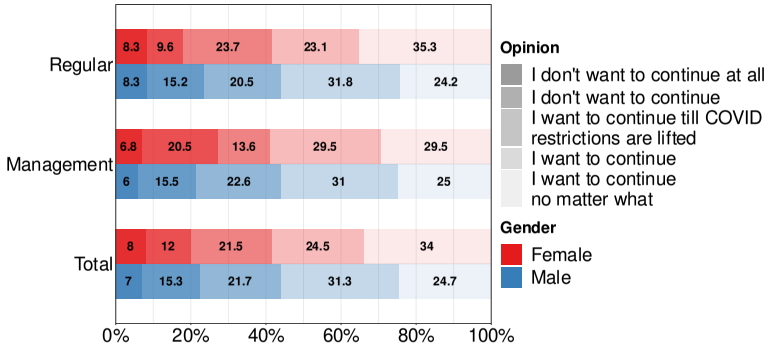
Note: $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Figure 1: Subjective perceptions of telework

(a) Telework-related comfort



(b) Willingness to continue telework



(c) Telework productivity

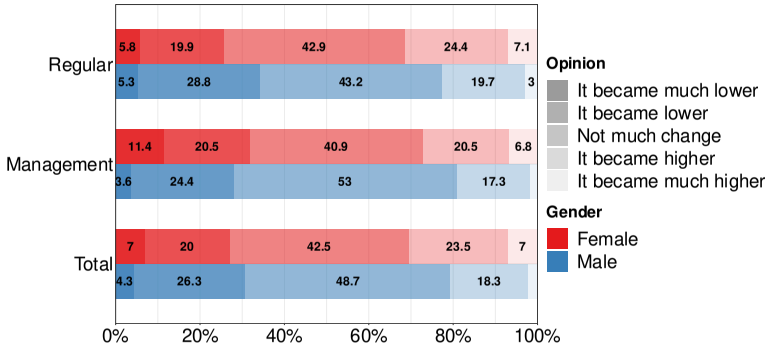
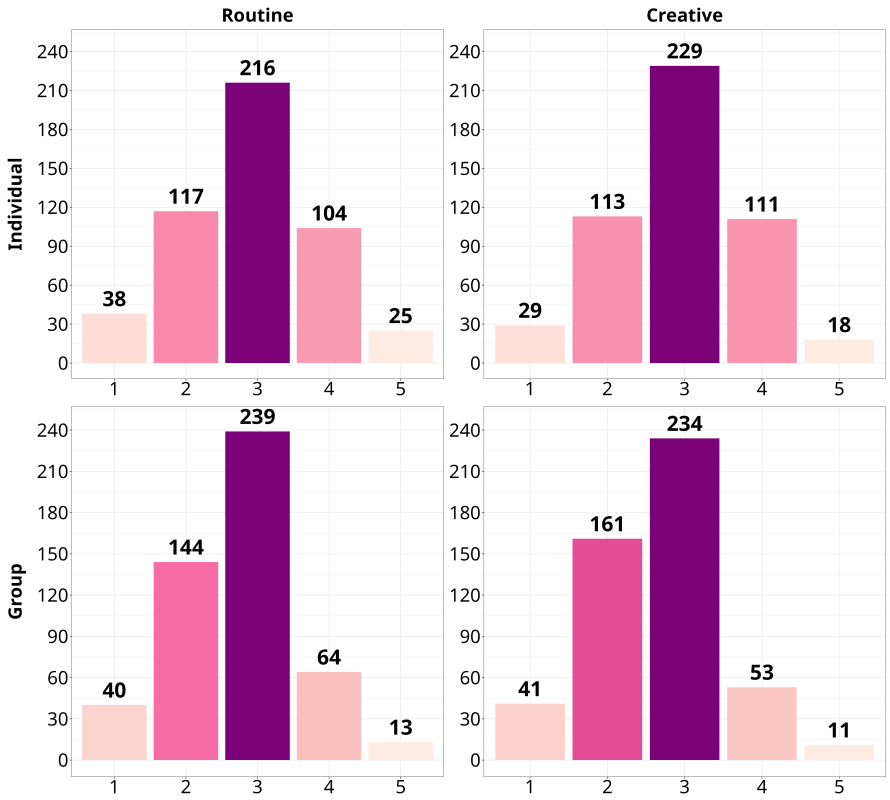


Figure 2: Perceived online productivity: variations across main domains (“1” — lowest score, “5” — highest score)



one-tailed Wilcoxon test states that individual PPOE is less or equal to group PPOE. The results show that the null hypothesis of the Wilcoxon signed-rank test is rejected at $1\,\%$ level both for the comparisons between routine (RIP vs. RGP) and creative (CIP vs. CGP) assignments. In other words, individual PPOE is greater than group PPOE irrespective of the type of task, hence the hypothesis 0 is confirmed. On the subject of hypothesis 1, we run the two-tailed Wilcoxon signed-rank test with the following null-hypothesis: individual D-PPOE is not significantly different from zero. As the null-hypothesis cannot be rejected ($p > 0.1$), hypothesis 1 is confirmed, meaning that for individual work, there is no significant difference between routine and creative PPOE. Moving on to hypothesis 2, in order to verify, whether the positive mean value for group D-PPOE inferred from table 1 is statistically significant, we run one-tailed Wilcoxon signed-rank test with the following null-hypothesis: group D-PPOE is less or equal to zero. The results of the test show that the null hypothesis is rejected at $5\,\%$ level, meaning that group D-PPOE is statistically greater than zero, confirming hypothesis 2. In other words, for group work, creative PPOE is statistically lower than routine PPOE.

The obtained results invite further inquiry about the factors responsible for positive group D-PPOE as well as for individual D-PPOE being not significantly different from zero. Based on this, we run linear regressions with group and individual D-PPOE as dependent variables respectively, presenting the results in table A1. According to it, only few predictors are suited to explain the D-PPOE. Namely, an additional pre-COVID commuting hour corresponds to 0.21-point increase in individual D-PPOE when holding other independent variables fixed. In addition, when controlling for other covariates, females register 0.17-point higher individual D-PPOE than males. Finally, respondents with high pre-COVID income levels also tend to display high group D-PPOE. Overall, the independent variables at our disposal are clearly not enough to adequately interpret the variance within D-PPOE. Among others, we do not see any significant influence of a remuneration system on group D-PPOE, hence hypothesis 3 is not confirmed.

Since we do not find significant determinants of D-PPOE, we run additional regressions for each PPOE separately, reporting the results in table 3. First, as expected, employees that experienced few sleeping hours prior to the pandemic display high levels of individual PPOE. Second, following up on hypothesis 3, our most notable finding is that, irrespective of the assignment type, employees under a "seniority-merit" wage system display consistently lower levels (more than 0.2 points on the 5-point Likert scale) of PPOE compared to the "performance-based" wage system.

As described above, despite reporting low PPOE, respondents nevertheless display high WCT. Table 4 provides insights into the factors associated with WCT regardless of the pandemic-related restrictions. First, along with our expectations, WCT is pronounced among females and young people. Second, as we anticipated, employees who enjoyed less sleeping hours before the COVID-19 pandemic tend to report high levels of WCT. Third, high WCT is pronounced among respondents with relatively high educational degrees and income levels.

Since telework is associated with deterioration of inter-employee communications, this naturally leads to difficulties for performing tasks in a group format, as argued in the hypothesis 0. At the same time, our analysis does not show significantly positive or negative individual D-PPOE, as postulated in the hypothesis 1. This reverberates the mixed evidence of online working environment being either a booster or an impedance for individual creativity (Liu et al., 2021). Provided the challenges for virtual teams, we find that the detrimental effect of transition to telework is positively mediated for groups who perform routine tasks, as postulated in hypothesis 2. Since

Table 3: PPOE regressions

	RIP	CIP	RGP	CGP
Wage system *(base group =“Performace-based”)*				
Seniority-merit	-0.25^{***}	-0.22^{***}	-0.23^{***}	-0.23^{***}
	(0.09)	(0.09)	(0.08)	(0.08)
Other	-0.15	-0.10	-0.17	-0.19
	(0.20)	(0.18)	(0.18)	(0.17)
Gender *(base group = “Female”)*	-0.16	0.02	0.03	0.04
	(0.10)	(0.09)	(0.09)	(0.09)
Pre-COVID sleeping hours	-0.08^{*}	-0.10^{***}	-0.01	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)
Education	0.05	0.05	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)
Employment rank *(base group =“Managerial”)*				
Regular	0.08	0.00	0.17^{*}	0.12
	(0.10)	(0.10)	(0.09)	(0.09)
Marital status *(base group =“Single”)*				
Married	-0.03	-0.11	-0.12	-0.02
	(0.10)	(0.09)	(0.09)	(0.09)
Well-being	0.02	0.06^{*}	-0.03	0.00
	(0.04)	(0.03)	(0.03)	(0.03)
Age	-0.01	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Pre-COVID income	0.03	-0.01	0.07	-0.02
	(0.05)	(0.04)	(0.04)	(0.04)
Pre-COVID commuting hours	0.09	-0.12	-0.16^{*}	-0.05
	(0.10)	(0.10)	(0.09)	(0.09)
Intercept	3.30^{***}	3.53^{***}	2.97^{***}	3.15^{***}
	(0.46)	(0.43)	(0.42)	(0.41)
R^2	0.04	0.04	0.04	0.03
Adj. R^2	0.02	0.02	0.02	0.01
Num. obs.	500	500	500	500

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table 4: WCT regressions

	Model 1	Model 2	Model 3
Wage system *(base group =“Performace-based”)*			
Seniority-merit	-0.13	-0.13	-0.17
	(0.11)	(0.11)	(0.11)
Other	-0.27	-0.27	-0.10
	(0.25)	(0.25)	(0.24)
Gender *(base group = “Female”)*	-0.22^{*}	-0.22^{*}	-0.27^{**}
	(0.12)	(0.13)	(0.13)
Pre-COVID sleeping hours	-0.13^{**}	-0.13^{**}	-0.13^{***}
	(0.05)	(0.05)	(0.05)
Education	0.14^{***}	0.14^{***}	0.10^{**}
	(0.04)	(0.04)	(0.04)
Employment rank *(base group =“Managerial”)*			
Regular		-0.00	0.09
		(0.12)	(0.13)
Marital status *(base group =“Single”)*			
Married		-0.04	0.03
		(0.12)	(0.12)
Well-being			0.04
			(0.05)
Age			-0.02^{***}
			(0.00)
Pre-COVID income			0.19^{***}
			(0.06)
Pre-COVID commuting hours			0.16
			(0.13)
Intercept	3.75^{***}	3.77^{***}	3.92^{***}
	(0.38)	(0.40)	(0.57)
R^2	0.04	0.04	0.09
Adj. R^2	0.03	0.03	0.07
Num. obs.	500	500	500

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

only few predictors at our disposal are able to explain the variance in D-PPOE, we run four individual regressions corresponding to each PPOE type. Among the most prominent factors behind each PPOE domain is *seniority-merit* wage system that proxies tacit-knowledge-based supervision style. Differently from the initially postulated hypothesis 3 about the adverse effect of seniority-merit wages on group creative performance, the recipients of seniority-merit wages experience greater drop in productivity compared to those under a "performance-based" system *uniformly*.

Despite the decline in PPOE across all domains, transition to an online working environment has been welcomed by most of the employees, translating into high WCT. Following factors are important in this regard. First (i), WCT is pronounced among females, which can be explained by their high involvement in domestic chores and childcare. Second (ii), respondents with high educational degrees and income also display high WCT, which might be due to their hitherto high pre-COVID telecommuting frequency (Noonan and Glass, 2012) that safeguarded them from potentially stressful experiences upon the mandatory telework transition post-2019. Finally, in line with Gerold et al. (2024), workers who had few sleeping hours prior to the pandemic show high levels of both WCT and individual PPOE. We identify the discrepancy between high WCT and low PPOE as a "telework dilemma." On one hand, our results speak to the importance of maintaining employees' physical and mental health for enhancing their job satisfaction (Lister and Harnish, 2019). Granting the legacy of long working hours in countries like Japan (Mizunoya, 2002), at least a partial transition to an online environment provides a favorable ground for tailoring an optimal work-life balance (Bosua et al., 2013). On the other hand, our results demonstrate clear challenges associated with carrying out group work remotely. Both the ubiquitous decrease in PPOE among recipients of seniority-merit wages and the decline in group PPOE vis-à-vis individual PPOE point at the essential role of designing alternative ways of online knowledge transfer (Cabrera and Cabrera, 2005, Taskin and Bridoux, 2010, Aksnes et al., 2023), which includes advance implementation of digital technologies (Greer and Payne, 2014, Yoshino and Hendriyetty, 2020).

4 Conclusion

In this paper, we pose the question of how "perceived productivity in an online environment as compared to an office environment" (PPOE) changed depending on work formats (individual vs. group), tasks types (routine vs. creative) and remuneration systems (seniority-based vs. performance-based). Let the PPOE difference between routine and creative tasks be "D-PPOE." To this end, we test the following hypotheses: (0) PPOE tends to be high for *individual* as compared to *group* work, (1) *individual* D-PPOE is not significantly different from zero, (2) D-PPOE is positive for *group* work, (3) D-PPOE is positively affected by the seniority-merit wage system. By running non-parametric Wilcoxon signed-rank test, we obtain the following findings. First, in relation to hypothesis 0, PPOE is higher for individual than for group work. Next, in respect to hypothesis 1 we establish that individual D-PPOE is not significantly different from zero. Furthermore, in the context of hypothesis 2, we find that D-PPOE is positive for group work. These results have the following implications. Under normal circumstances, group work, especially creative one, is carried out most effectively in a face-to-face environment. However, due to COVID-19-inflicted transition to telework, customary inter-employee interactions were disrupted, leading to decreased group PPOE. At the same time, employees were able to maintain decent levels of individual PPOE that appears equally resilient for routine and creative assignments. Finally, in respect to hypothesis 3, although we find no evidence of seniority-based pay explaining positive D-PPOE for group work, we discover that PPOE *unequivocally* drops among the recipients of seniority-merit wages. We include this remuneration system as a proxy of a tacit-knowledge-based supervision, and argue that it is difficult to sustain this type of oversight in an online environment. Additionally, we find that, despite displaying overall low levels of PPOE, respondents express their willingness to continue teleworking (WCT), which leads to a so-called "telework dilemma." It invites the development of a mixed-format working system, in which employees can remain productive remotely at least as much as in an office, even when performing collaborative, creative tasks.

Lastly, we note the limitations of the current study and the prospects for future research. Subjective self-assessment of online productivity that we use would be more credible, had it been combined with evaluation from corporate superiors. Furthermore, as our paper identified the problem

of conducting group work in an online environment, it would be logical to include the variables related to horizontal (between employees of a same rank) and vertical (between managers and ordinary employees) communication quality. This would align the prospective study with the recommendation by Salas et al. (2008) to use context-specific measurements of team performance. On top of this, while distinguishing between the types of online assignments, our paper would benefit from additionally covering industrial differences as well as degrees of corporate digitalization.

References

Aksnes, S., Underthun, A., and Hansen, P. (2023). Constructing new organizational identities in a post-pandemic return: Managerial dilemmas in balancing the spatial redesign of telework with workplace dynamics and the external imperative for flexibility. In Bergum, S., Peters, P., and Vold, T., editors, *Virtual Management and the New Normal: New Perspectives on HRM and Leadership since the COVID-19 Pandemic*, pages 59–78. Springer International Publishing, Cham.

Allen, T., Golden, T., and Shockley, K. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological science in the public interest*, 16:40–68.

Amabile, T., Amabile, T., Collins, M., Conti, R., Phillips, E., Picariello, M., Ruscio, J., and Whitney, D. (1996). The meaning and measurement of creativity. In *Creativity in Context*, pages 19–40. Routledge.

Bailey, D. and Kurland, N. (2002). A review of telework research: Findings, new directions, and lessons for the study of modern work. *Journal of organizational behavior*, 23:383–400.

Baruch, Y. (2000). Teleworking: Benefits and pitfalls as perceived by professionals and managers. *New technology, work and employment*, 15:34–49.

Bayo-Moriones, A., Galdon-Sanchez, J., and Güell, M. (2010). Is seniority-based pay used as a motivational device? Evidence from plant-level data. In W. Polachek, S. and Tatsiramos, K., editors, *Jobs, Training, and Worker Well-being*, volume 30 of *Research in Labor Economics*, pages 155–187. Emerald Group Publishing Limited.

Bosua, R., Gloet, M., Kurnia, S., Mendoza, A., and Yong, J. (2013). Telework, productivity and wellbeing: An Australian perspective. *Telecommunications journal of Australia*, 63:11.1–11.12.

Brucks, M. and Levav, J. (2022). Virtual communication curbs creative idea generation. *Nature*, 605:108–112.

Cabrera, E. and Cabrera, A. (2005). Fostering knowledge sharing through people management practices. *International journal of human resource management*, 16:720–735.

Cadsby, B., Song, F., and Tapon, F. (2017). Sorting and incentive effects of pay for performance: An experimental investigation. *Academy of management journal*, 50:387–405.

Caillier, J. (2013). Satisfaction with work-life benefits and organizational commitment / job involvement: Is there a connection? *Review of public personnel administration*, 33:340–364.

Capecchi, S., Di Iorio, F., and Nappo, N. (2024). Occupational stress, working from home, and job sustainability: Another gender issue? *Social indicators research*, 175:1193–1218.

Cira, D. and Benjamin, E. (1998). Competency-based pay: A concept in evolution. *Compensation and benefits review*, 30:21–28.

Cohen, S. and Bailey, D. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of management*, 23:239–290.

de Leede, J. and Nijland, J. (2016). Understanding teamwork behaviors in the use of new ways of working. In *New Ways of Working Practices*, volume 16 of *Advanced Series in Management*, pages 73–94. Emerald Group Publishing Limited.

Dingel, J. and Neiman, B. (2020). How many jobs can be done at home? *Journal of public economics*, 189:104235.

DuBrin, A. (1991). Comparison of the job satisfaction and productivity of telecommuters versus in-house employees: A research note on work in progress. *Psychological reports*, 68:1223–1234.

Dutcher, G. (2012). The effects of telecommuting on productivity: An experimental examination. The role of dull and creative tasks. *Journal of economic behavior and organization*, 84:355–363.

e-Stat (2020). Population census. Technical report, Statistics Bureau of Japan.

Etheridge, B., Wang, Y., and Tang, L. (2020). Worker productivity during lockdown and working from home: Evidence from self-reports. Working Paper 2020-12, ISER Working Paper Series.

Gajendran, R. and Harrison, D. (2007). The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. *Journal of applied psychology*, 92:1524–1541.

Galanti, T., Guidetti, G., Mazzei, E., Zappalà, S., and Toscano, F. (2021). Work from home during the COVID-19 outbreak. *Journal of occupational and environmental medicine*, 63:426–432.

Garro-Abarca, V., Palos-Sanchez, P., and Aguayo-Camacho, M. (2021). Virtual teams in times of pandemic: Factors that influence performance. *Frontiers in Psychology*, 12.

Gerold, S., Buhl, J., and Geiger, S. M. (2024). How to enhance time wealth? Insights from changes in time use and working conditions during the COVID-19 lockdown in Germany. *Social indicators research*, 171:349–371.

Golden, T. (2006). Avoiding depletion in virtual work: Telework and the intervening impact of work exhaustion on commitment and turnover intentions. *Journal of vocational behavior*, 69:176–187.

Golden, T., Veiga, J., and Simsek, Z. (2006). Telecommuting's differential impact on work-family conflict: Is there no place like home? *Journal of applied psychology*, 91:1340–1350.

Greer, T. and Payne, S. (2014). Overcoming telework challenges: Outcomes of successful telework strategies. *Psychologist-manager journal*, 17:87–111.

Hackman, R. (2012). From causes to conditions in group research. *Journal of organizational behavior*, 33:428–444.

Han, S., Chae, C., Macko, P., Park, W., and Beyerlein, M. (2017). How virtual team leaders cope with creativity challenges. *European journal of training and development*, 41:261–276.

Hodzic, S., Prem, R., Nielson, C., and Kubicek, B. (2024). When telework is a burden rather than a perk: The roles of knowledge sharing and supervisor social support in mitigating adverse effects of telework during the COVID-19 pandemic. *Applied psychology*, 73:599–621.

Hon, A. (2012). When competency-based pay relates to creative performance: The moderating role of employee psychological need. *International journal of hospitality management*, 31:130–138.

Illegems, V. and Verbeke, A. (2004). Telework: What does it mean for management? *Long range planning*, 37:319–334.

Ishii-Kunz, M. (2025). "Shussha kaiki" wa seikai ka? Hataraku basho no imi o kangaeru [Is "returning to the office" the right answer? Considering the meaning of the place of work]. *Nikkei Keizai Shinbun [Japan Economics Newspaper]*.

Khalifa, M. and Davison, R. (2000). Viewpoint: Exploring the telecommuting paradox. *Communications of the ACM*, 43:29–31.

Kozlowski, S. and Klein, K. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In *Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions, and New Directions*, pages 3–90. Jossey-Bass/Wiley, Hoboken, NJ, US.

Lazear, E. (2000). Performance pay and productivity. *American economic review*, 90:1346–1361.

Lisbona, A., Las-Hayas, A., Palací, F., Bernabé, M., Morales, F., and Haslam, A. (2020). Team efficiency in organizations: A group perspective on initiative. *International journal of environmental research and public health*, 17:1926.

Lister, K. and Harnish, T. (2019). Telework and its effects in the United States. In Messenger, J., editor, *Telework in the 21st Century*, chapter 3, pages 128–170. Edward Elgar Publishing.

Liu, L., Wan, W., and Fan, Q. (2021). How and when telework improves job performance during COVID-19? Job crafting as mediator and performance goal orientation as moderator. *Psychology research and behavior management*, 14:2181–2195.

Mahler, J. (2012). The telework divide: Managerial and personnel challenges of telework. *Review of public personnel administration*, 32:407–418.

Mak, S. and Kozlowski, S. (2019). Virtual teams: Conceptualization, integrative review, and research recommendations. In Landers, R. N., editor, *The Cambridge Handbook of Technology and Employee Behavior*, Cambridge Handbooks in Psychology, pages 441–479. Cambridge University Press, Cambridge.

Martin, B. and MacDonnell, R. (2012). Is telework effective for organizations? A meta-analysis of empirical research on perceptions of telework and organizational outcomes. *Management research review*, 35:602–616.

Martínez-Sánchez, A., Pérez-Pérez, M., De-Luis-Carnicer, P., and Vela-Jiménez, M. (2007). Telework, human resource flexibility and firm performance. *New technology, work and employment*, 22:208–223.

Martins, L. and Shalley, C. (2011). Creativity in virtual work: Effects of demographic differences. *Small group research*, 42:536–561.

McPhail, R., Chan, X. W. C., May, R., and Wilkinson, A. (2024). Post-COVID remote working and its impact on people, productivity, and the planet: An exploratory scoping review. *International journal of human resource management*.

Mercier, M., Vinchon, F., Pichot, N., Bonetto, E., Bonnardel, N., Girandola, F., and Lubart, T. (2021). COVID-19: A boon or a bane for creativity? *Frontiers in psychology*, 11:601150.

Mizunoya, T. (2002). An international comparison of unpaid overtime work among industrialized countries. Technical report, International Labour Organization.

Mori, T. (2021). The coronavirus pandemic and the increase of teleworking in eight countries. Report, Nomura Research Institute.

Nonaka, I. (2007). The knowledge-creating company. *Harvard business review*, July–August:162–171.

Noonan, M. and Glass, J. (2012). The hard truth about telecommuting. *Monthly labor review*, 135:38.

Okubo, T. (2020). Spread of COVID-19 and telework: Evidence from Japan. *Covid economics*, 32:1–25.

Overmyer, S. (2011). Implementing telework: Lessons learned from four federal agencies. *IBM Center for The Business of Government*, Spring–Summer:99–102.

Polanyi, M. (1966). The logic of tacit inference. *Philosophy*, 41:1–18.

Pyöriä, P. (2011). Managing telework: Risks, fears and rules. *Management research review*, 34:386–399.

Roberts, J. (2000). From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. *Technology analysis & strategic management*, 12:429–443.

Ruth, S. and Chaudhry, I. (2008). Telework: A productivity paradox? *IEEE Internet computing*, 12:87–90.

Salas, E., Cooke, N., and Rosen, M. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human factors*, 50:540–547.

Salas, E., Shuffler, M., Thayer, A., Bedwell, W., and Lazzara, E. (2015). Understanding and improving teamwork in organizations: A scientifically based practical guide. *Human resource management*, 54:599–622.

Shabanpour, R., Golshani, N., Tayarani, M., Auld, J., and Mohammadian, A. (2018). Analysis of telecommuting behavior and impacts on travel demand and the environment. *Transportation research part D*, 62:563–576.

Taskin, L. and Bridoux, F. (2010). Telework: A challenge to knowledge transfer in organizations. *International journal of human resource management*, 21:2503–2520.

Taskin, L. and Devos, V. (2005). Paradoxes from the individualization of human resource management: The case of telework. *Journal of business ethics*, 62:13–24.

Tønnessen, Ø., Dhir, A., and Flåten, B.-T. (2021). Digital knowledge sharing and creative performance: Work from home during the COVID-19 pandemic. *Technological forecasting and social change*, 170:120866.

Umishio, W., Kagi, N., Asaoka, R., Hayashi, M., Sawachi, T., and Ueno, T. (2022). Work productivity in the office and at home during the COVID-19 pandemic: A cross-sectional analysis of office workers in Japan. *Indoor air*, 32:e12913.

van der Lippe, T. and Lippényi, Z. (2020). Co-workers working from home and individual and team performance. *New technology, work and employment*, 35:60–79.

van der Meulen, N., van Baalen, P., van Heck, E., and Mülder, S. (2019). No teleworker is an island: The impact of temporal and spatial separation along with media use on knowledge sharing networks. *Journal of information technology*, 34:243–262.

Vega, R., Anderson, A., and Kaplan, S. (2015). A within-person examination of the effects of telework. *Journal of business and psychology*, 30:313–323.

Waizenegger, L., McKenna, B., Cai, W., and Bendz, T. (2020). An affordance perspective of team collaboration and enforced working from home during COVID-19. *European journal of information systems*, 29:429–442.

Welz, C. and Wolf, F. (2010). Telework in the European Union. In *European Foundation for the Improvement of Living and Working Conditions*, volume EF/09/96/EN, pages 1–28.

Yoshino, N. and Hendriyetty, N. (2020). The COVID-19 crisis: Policy recommendations for Japan. *Economists' voice*, 17:20200017.

Zhou, J. and Shalley, C. (2011). Deepening our understanding of creativity in the workplace: A review of different approaches to creativity research. In *APA Handbook of Industrial and Organizational Psychology, Vol 1: Building and Developing the Organization*, APA Handbooks in Psychology®, pages 275–302. American Psychological Association, Washington, DC, US.

A Supplementary tables

Table A1: D-PPOE regressions

	Individual D-PPOE	Group D-PPOE
Wage system *(base group =“Performace-based”)*		
Seniority-merit	-0.03	0.00
	(0.09)	(0.08)
Other	-0.05	0.01
	(0.19)	(0.18)
Gender *(base group = “Female”)*	-0.17^{*}	-0.01
	(0.10)	(0.09)
Pre-COVID sleeping hours	0.03	0.04
	(0.04)	(0.04)
Education	0.00	-0.00
	(0.03)	(0.03)
Employment rank *(base group =“Managerial”)*		
Regular	0.07	0.05
	(0.10)	(0.09)
Marital status *(base group =“Single”)*		
Married	0.08	-0.10
	(0.10)	(0.09)
Well-being	-0.03	-0.03
	(0.04)	(0.03)
Age	-0.00	-0.00
	(0.00)	(0.00)
Pre-COVID income	0.04	0.08^{*}
	(0.05)	(0.04)
Pre-COVID commuting hours	0.21^{**}	-0.11
	(0.10)	(0.10)
Intercept	-0.23	-0.18
	(0.45)	(0.43)
R^2	0.02	0.02
Adj. R^2	-0.00	-0.00
Num. obs.	500	500

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

B Supplementary figures

Figure B1: Age distribution