Online Appendix for "The Impact of COVID-19 on Japanese Firms: Mobility and Resilience via Remote Work"

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1 More Details about the Data

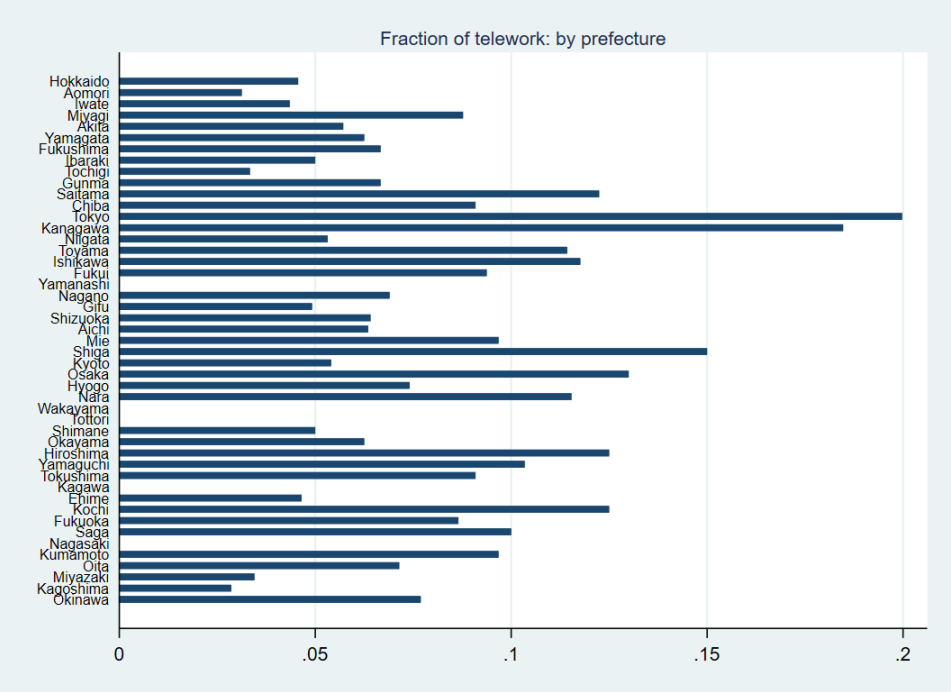
1.1 Heterogeneity in Remote Work Adoptions

WfH firms are spread across prefectures and industries, as shown in Figures 1 and 2, which display the shares of firms in each prefecture and industry-size that adopt the WfH arrangements prior to the COVID-19. There are five prefectures (Yamanashi, Wakayama, Tottori, Kagawa and Nagasaki), where there is no firm that adopted the WfH arrangement and the share of firms adopting WfH is in the range between 3% to 20%. In the size-industry dimension, all industries have both firms that do and do not adopt WfH, but there are industries where no small firms adopted WfH.

We also computed the fraction of firms adopting the WfH for all industry-size-prefecture groups. Figure 3 shows the distribution of firms by the WfH fraction of the group that they belong to. The share of firms whose industry-size-prefecture group has no WfH firm is about 30%, and 50% of firms have the share above 9%.

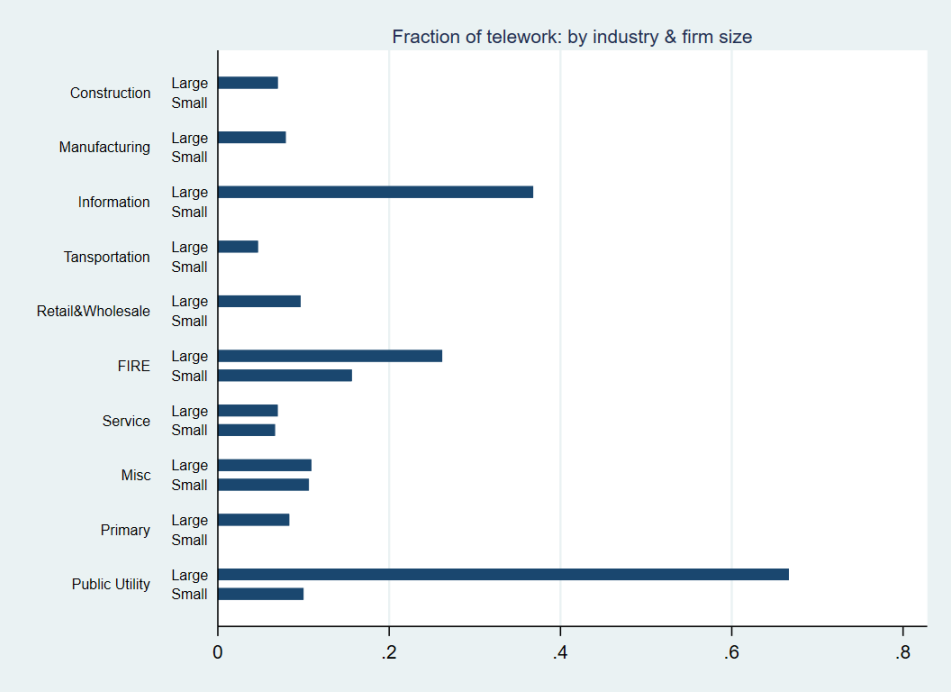
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Figure 1: Fraction of Firms Adopting WfH (By Prefecture)



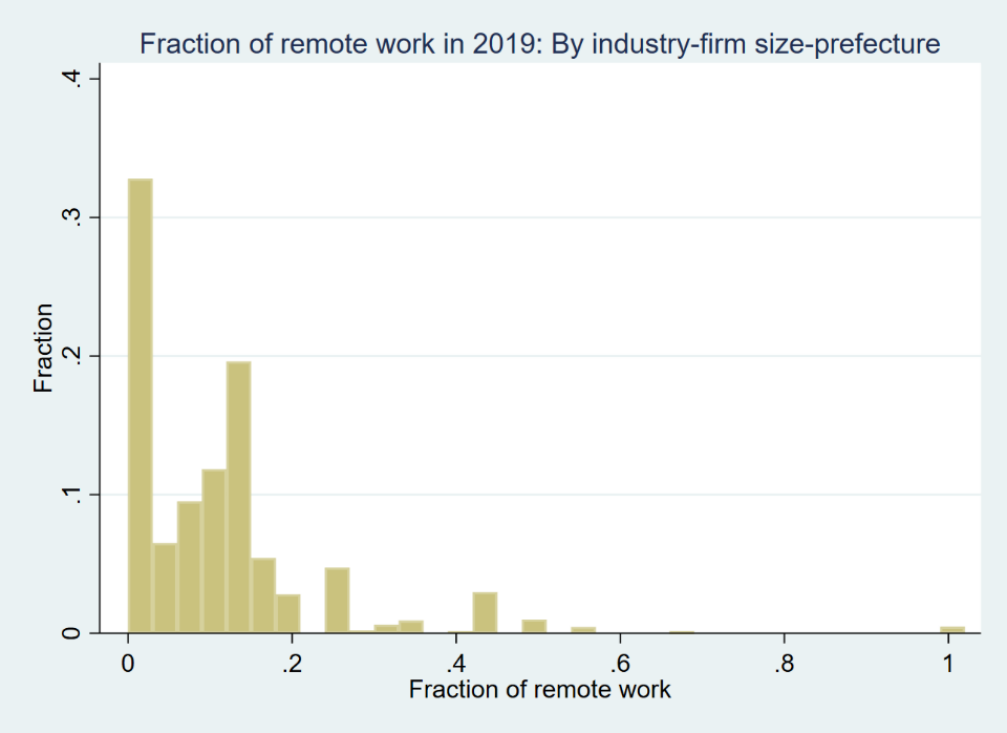
Source: TSR-CREPE survey.

Figure 2: Fraction of Firms Adopting WfH (By Industry and Size)



Source: TSR-CREPE survey.

Figure 3: Fraction of Firms Adopting WfH (By Industry-Size-Prefecture)



Source: TSR-CREPE survey.

1.2 Characteristics of Firms Adopting WfH

Table 1 summarizes the characteristics of the firms before COVID-19 by the adoption of WfH. Firms that adopted WfH prior to the pandemic are larger, in terms of number of employees and total sales, and relatively younger, while the differences in profit margins and credit scores were marginal and insignificant.

Table 1: Characteristics of Firms Adopting WfH in 2019

	(1)		
	Mean (Remote=1)	Mean (Remote=0)	Difference
Firm age	36.639	44.162	-7.523***
Number of employees	632.384	94.005	538.378***
Log(sales)	14.195	13.944	0.252***
Log(sales per employee)	7.863	7.940	-0.078***
Profit margin	0.019	0.023	-0.004
Sales growth	0.052	0.036	0.016**
Credit score	54.328	54.101	0.228*

Source:TSR-CREPE survey and TSR credit file
Note: All firm characteristics are from latest available financial statements before the pandemic. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2 Robustness Analysis

2.1 Effects of Pre-COVID-19 Flexibility

The mitigation effect of WfH entails not only being able to continue the same operations remotely, but also making the production process more efficient with the help of new technology. In particular, the mitigation effect of WfH may include the effect of the digital transformation, which reflects the firms' flexibility and readiness to adopt new ways of working that presumably help them to be more adaptive to emergency situations. Although it is difficult to completely isolate the effect, we estimate the model that controls for the dummy variable, which indicates the presence of Business Continuity Plan (BCP) prior to the pandemic. The idea is to look at the potential bias caused by the unobserved tendency to adapt to emergency situations,

As shown in Table 2, quantitative results are not affected much by the inclusion of the dummy variable and the potential bias by the firm's unobserved business adaptability to emergency appears to be limited.

Table 2: Impact by Adoption of Remote Work and BCP Implementation Before COVID-19

	(1) All	(2) Low contact	(3) High contact	(4) All	(5) Low contact	(6) High contact
Panel A: Sales Growth						
Change in Mobility	0.277***	0.258***	0.316***	0.277***	0.257***	0.314***
	(0.021)	(0.024)	(0.030)	(0.022)	(0.023)	(0.033)
Change in Mobility × Remote 2019	-0.153***	-0.194***	-0.024	-0.152***	-0.194***	-0.024
	(0.041)	(0.047)	(0.063)	(0.041)	(0.047)	(0.063)
Remote 2019	-0.015	-0.011	-0.023	-0.014	-0.010	-0.022
	(0.012)	(0.013)	(0.020)	(0.012)	(0.013)	(0.019)
BCP 2019				0.007	0.006	0.010
				(0.008)	(0.011)	(0.026)
R2	0.12	0.09	0.17	0.12	0.09	0.17
Panel B: Employment Growth						
Change in Mobility	0.012**	0.012*	0.010*	0.012**	0.012*	0.010
	(0.005)	(0.006)	(0.006)	(0.005)	(0.007)	(0.006)
Change in Mobility × Remote 2019	0.004	0.008	-0.010	0.004	0.008	-0.010
	(0.013)	(0.020)	(0.020)	(0.013)	(0.020)	(0.020)
Remote 2019	-0.008**	-0.011***	-0.001	-0.008**	-0.011***	-0.000
	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)	(0.007)
BCP 2019				0.000	-0.002	0.003
				(0.002)	(0.005)	(0.007)
R2	0.13	0.11	0.16	0.13	0.11	0.16
Panel C: Hours Growth						
Change in Mobility	0.212***	0.207***	0.221***	0.212***	0.207***	0.218***
	(0.009)	(0.013)	(0.011)	(0.009)	(0.013)	(0.012)
Change in Mobility × Remote 2019	-0.073***	-0.079***	-0.046	-0.073***	-0.079**	-0.046
	(0.027)	(0.030)	(0.036)	(0.027)	(0.030)	(0.036)
Remote 2019	-0.004	-0.004	-0.004	-0.003	-0.004	-0.002
	(0.007)	(0.010)	(0.011)	(0.007)	(0.010)	(0.011)
BCP 2019				0.007	0.003	0.017**
				(0.006)	(0.009)	(0.008)
R2	0.13	0.11	0.18	0.13	0.11	0.18
Industry FE	3-digit	3-digit	3-digit	3-digit	3-digit	3-digit
Est Size FE	Yes	Yes	Yes	Yes	Yes	Yes
N	29,056	19,264	9,792	29,056	19,264	9,792

Source: Google Community Mobility Report and TSR-CREPE survey
Note: Standard errors robust against prefecture-level clustering are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2.2 Effects of Wholesale and Retail Sectors

There is a concern that the pre-COVID-19 adoption of WfH may be positively correlated with the adoption of e-commerce and that the mitigation effect of WfH may confound the difference between traditional firms and online firms. We do not have information about the share of online business at each firm, but we conjecture that it would be wholesale and retail sectors that are most likely to engage in e-commerce before the COVID-19. To assess the importance of this possible hypothesis, we drop the wholesale and retail sectors

from the model and report the results of the estimation.

As shown in Table 3, the mitigation effect of WfH on sales and hours worked remains robust and in fact even stronger, when wholesale and retail sectors are excluded from the regression sample. Retailers in our sample are mainly high-contact firms that benefited less from WfH, and therefore the confounding effect of e-commerce, if any, appears to be limited in the sample.

Table 3: Robustness Check: Heterogeneous Impact by Adoption of WfH as of 2019 (dropping wholesale and retail industries)

	(1) All	(2) Low contact	(3) High contact
Panel A: Sales Growth			
Change in Mobility	0.298***	0.243***	0.582***
	(0.024)	(0.025)	(0.069)
Change in Mobility × Remote 2019	-0.259***	-0.205***	-0.488***
	(0.041)	(0.045)	(0.122)
Remote 2019	-0.007	-0.008	0.009
	(0.015)	(0.012)	(0.065)
R2	0.14	0.08	0.38
Panel B: Employment Growth			
Change in Mobility	0.007	0.008	0.006
	(0.006)	(0.006)	(0.033)
Change in Mobility × Remote 2019	-0.018	-0.025	0.059
	(0.018)	(0.020)	(0.060)
Remote 2019	-0.007*	-0.004	-0.024
	(0.004)	(0.004)	(0.020)
R2	0.14	0.11	0.22
Panel C: Hours Growth			
Change in Mobility	0.226***	0.200***	0.369***
	(0.009)	(0.011)	(0.033)
Change in Mobility × Remote 2019	-0.124***	-0.106***	-0.163*
	(0.024)	(0.024)	(0.086)
Remote 2019	-0.005	-0.001	-0.034
	(0.010)	(0.011)	(0.025)
R2	0.14	0.11	0.29
Industry FE	3-digit	3-digit	3-digit
Est Size FE	Yes	Yes	Yes
N	20,936	17,824	3,112

Source: Google Community Mobility Report and TSR-CREPE survey
Note: Standard errors robust against prefecture-level clustering are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3 First-Stage Regressions

Table 4 shows the first-stage regression results for the Bartik IV estimation.

Table 4: Heterogeneous Impact by Adoption of Remote Work between December 2019 and May 2020: First-stage of the Bartik IV Regression

	(1)	(2)
	Change in Mobility x Change in WfH	Change in WfH
Change in Mobility × Bartik	0.817***	0.754
	(0.260)	(0.715)
Bartik	-0.134***	0.818***
	(0.025)	(0.088)
N	29056	29056
Kleibergen-Paap F statistic	31.480	31.480

Source: Google Community Mobility Report and TSR-CREPE survey
Note: Standard errors robust against prefecture-level clustering are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$