Revolution in Progress: The Rise of Remote Work in the UK

Mirko Draca[1], Emma Duchini[2], Roland Rathelot[3], Arthur Turrell[4], Giulia Vattuone[5]

[1/5]Department of Economics, University of Warwick

[2]Department of Economics, University of Essex

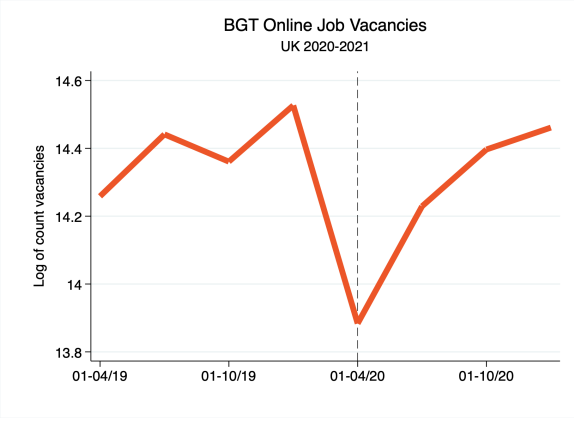
[3]CREST-ENSAE

[4]ONS

RES 2022

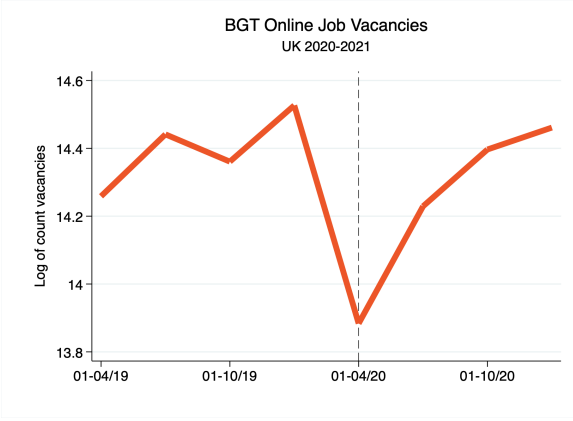
The views expressed do not reflect those of the ONS.

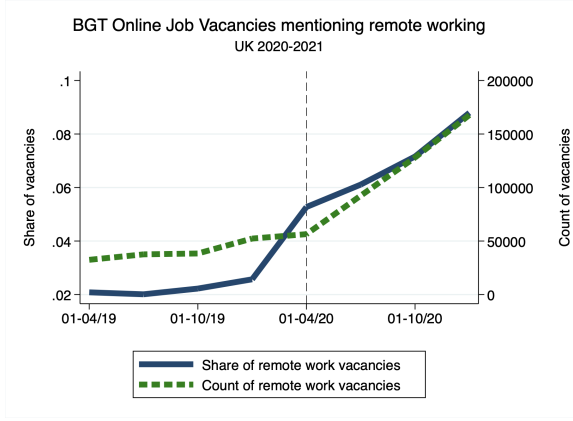
Motivation



- Massive drop in overall labour demand in the aftermath of the Covid19 pandemic

Motivation





- Massive drop in overall labour demand in the aftermath of the Covid19 pandemic
- Massive wave of adoption of remote work (RW) practices in the aftermath of the Covid19 pandemic

The Covid-19 Pandemic was a major shock to the labour market

- Social distancing measures meant that working practices needed to be re-organised
- This adjustment could have unfolded in a number of ways
  1. within occupation
  2. between occupation
  3. across entire workplaces

This paper

- We look at the role of these different mechanisms in the UK's RW expansion
- The analysis shows picture of evolution rather than revolution in RW adoption
  - Minimal shifts (at least in the short-run) in:
    - → Occupational "frontier" of what types of work can go remote
    - → Inter-occupational composition of jobs
  - Higher levels of RW achieved mainly through firm-level increases in RW offering
    - → consistent with changes in organisational practices

Contribution

- Recent research examines the expansion and intensity of RW during the COVID pandemic

  [Adams-Prassle et al. (2020), Barrero et al. (2020), Bartik et al. (2020), Brynjolfsson et al. (2020), Mongey et al. (2020), Ozimek (2020)]

- We unfold the mechanisms through which firms increased RW
  - depending on the mechanism, different economic consequences

Outline

Data

Occupation-level analysis

Firm-occupation-level analysis

Outline

Data

Occupation-level analysis

Firm-occupation-level analysis

Data

- Burning Glass Technologies (BGT) online vacancy data
  - Scraped from online job boards and company websites (duplicates removed)
  - Job ad text, date, occupation code (**95%**), employer name (∼**50%**)
  - 13.5 million vacancies over our period of interest (Apr 2019 - Mar 2021)

- We classify each vacancy as offering RW if specific expressions found in the job ad:
  - Timewise, ACAS (Duchini et al. (2020)), and manual classification Expressions & Validation

- We proxy the *ex ante* RW potential using an occupation-level measure (**HLR score**)
  - Average share of daily hours worked at home when employed in given occupation
  - Developed by Hensvik, Le Barbanchon, and Rathelot (2020)

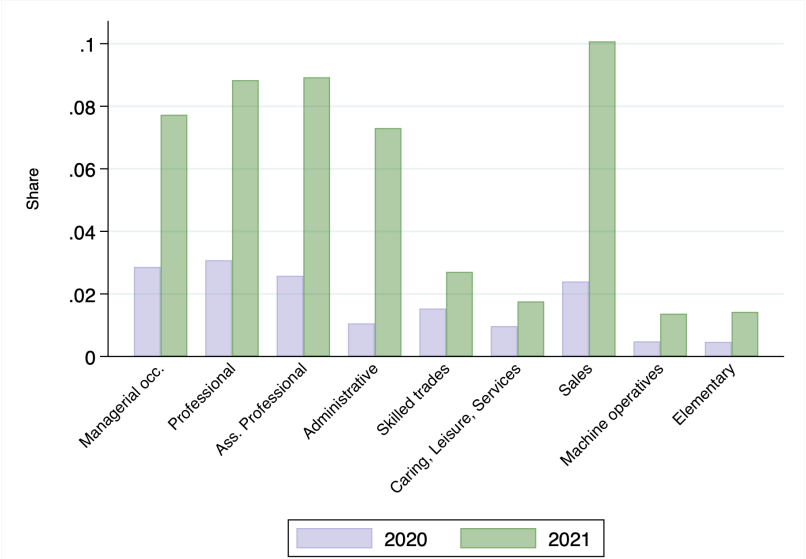
Outline

Data

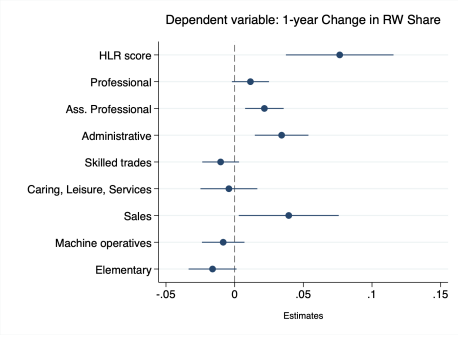
Occupation-level analysis

Firm-occupation-level analysis

Occupation-level analysis

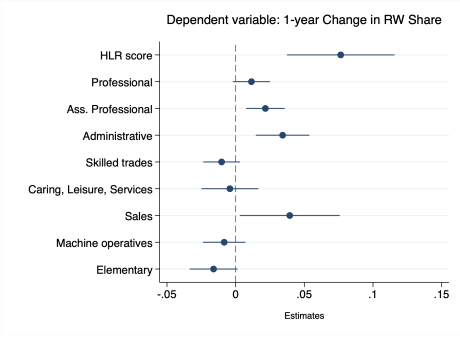


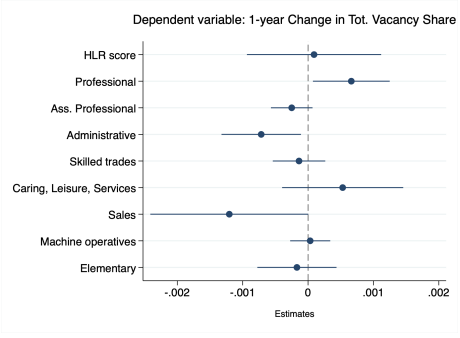
Within and between occupational changes



- Widespread within-occupation increase in RW
- Closely in line with pre-pandemic patterns of RW feasibility

Within and between occupational changes





- Widespread within-occupation increase in RW
- Closely in line with pre-pandemic patterns of RW feasibility

- No between-occupation substitution in overall labour demand based on RW feasibility

Outline

Data

Occupation-level analysis

Firm-occupation-level analysis

How did firms increase their remote working?

- Multiple mechanisms:
  1. occupations (even within same firm) asymmetrically changed their remote-workability
  2. firms changed their portfolio of vacancies (even if occupational RW content unchanged)
  3. firms asymmetrically changed their RW offer (even with same portfolio of vacancies)
  4. the pandemic affected all firms/occupations equally with no structural imbalances

- We compare firm-level RW rates before and after the pandemic:
  - firm-level RW rates assumed to depend on a number of factors that enable us to disentangle the role of each mechanism

Assumptions

- Y_{jkt}: count of RW vacancies in occupation j posted by firm k in year t
- Assume it is distributed as a Poisson with mean:

$$\lambda_{jkt} = v_{jkt} \exp(\beta_t + \gamma_{jt} + \alpha_{kt})$$

  - v_{jkt}: the total number of vacancies posted in occupation j by firm k in year t
  - The probability for a vacancy to go remote assumed to be separable in three components
    - → β_t: log of average share of vacancies with RW in year t
    - → γ_{jt}: occupation-year RW propensity
    - → α_{kt}: firm-year RW propensity
- We focus on a subsample of firms details

Firm-level remote working rate

- Obtain $\hat{\lambda}_{jkt}$: estimate of the expected number of RW vacancies in j-k-t
- Define the predicted RW rate for firm k in year t:

$$\hat{\lambda}_{kt} = \frac{\sum_j \hat{\lambda}_{jkt}}{\sum_{j'} v_{j'kt}} = \sum_j \frac{v_{jkt}}{\sum_{j'} v_{j'kt}} \exp(\hat{\beta}_t + \hat{\gamma}_{jt} + \hat{\alpha}_{kt})$$

  - expected number of RW vacancies of firm k in year t divided by the total vacancies of k in t
- Which factor is driving the change between pre-covid ($\hat{\lambda}_{k0}$) and post-covid ($\hat{\lambda}_{k1}$) firm-level RW rates?

  → build a series of **counterfactuals**

Tracing the evolution of remote working

- $\hat{\lambda}_{k0} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j0} + \hat{\alpha}_{k0})$

- $\hat{\lambda}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_1 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$

Tracing the evolution of remote working

- $\hat{\lambda}_{k0} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j0} + \hat{\alpha}_{k0})$
- $\diamond$ $\tilde{\lambda}^{o}_{k1} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$

- $\hat{\lambda}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_1 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$

Tracing the evolution of remote working

- $\hat{\lambda}_{k0} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j0} + \hat{\alpha}_{k0})$
  - $\tilde{\lambda}^{o}_{k1} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$
  - $\tilde{\lambda}^{o,c}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$

- $\hat{\lambda}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_1 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$

Tracing the evolution of remote working

- $\hat{\lambda}_{k0} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j0} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o}_{k1} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o,c}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o,c,f}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$
- $\hat{\lambda}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_1 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$

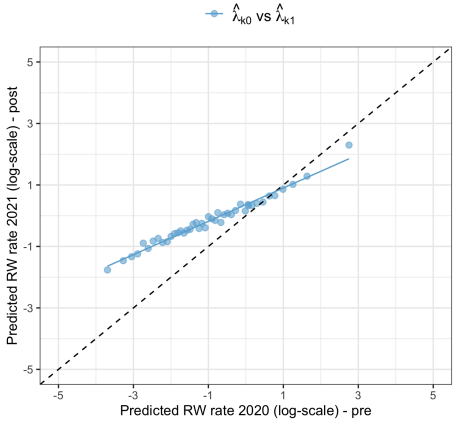
Tracing the evolution of remote working

- $\hat{\lambda}_{k0} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j0} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o}_{k1} = \sum_j \frac{v_{jk0}}{\sum_{j'} v_{j'k0}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o,c}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k0})$
- $\tilde{\lambda}^{o,c,f}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_0 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$
- $\hat{\lambda}_{k1} = \sum_j \frac{v_{jk1}}{\sum_{j'} v_{j'k1}} \exp(\hat{\beta}_1 + \hat{\gamma}_{j1} + \hat{\alpha}_{k1})$

→ Plot series of binscatters with $\hat{\lambda}_{k0}$ on x-axis and $\tilde{\lambda}^{o}_{k1}$, $\tilde{\lambda}^{o,c}_{k1}$, $\tilde{\lambda}^{o,c,f}_{k1}$, $\hat{\lambda}_{k1}$ on y-axis

Tracing the evolution of remote working

Pre-covid ($\hat{\lambda}_{k0}$) and post-covid ($\hat{\lambda}_{k1}$) firm-level RW rates

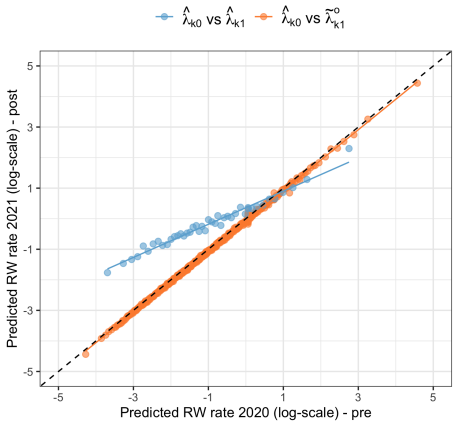


- The predicted RW rate has increased more in firms with low pre-pandemic RW rate
- Slope is 0.54
  - → **Catch-up effect**: firms with lower pre-pandemic RW rates increased their RW offer relatively more compared to firms with higher pre-pandemic RW rates

Who are these firms?

Tracing the evolution of remote working

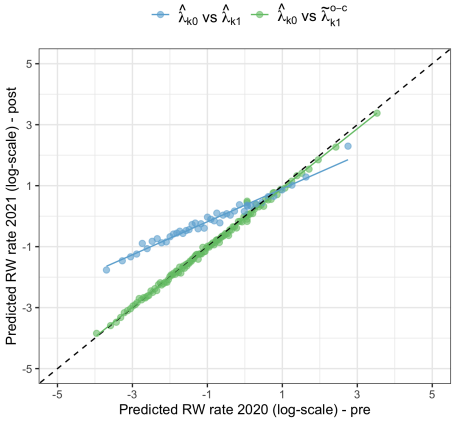
If only the occupational RW propensity ($\hat{\gamma}_{jt}$) were to change



- If only the occupation RW propensity were to change between the pre and post period, we would virtually see no change in the predicted firm-level RW rate

Tracing the evolution of remote working

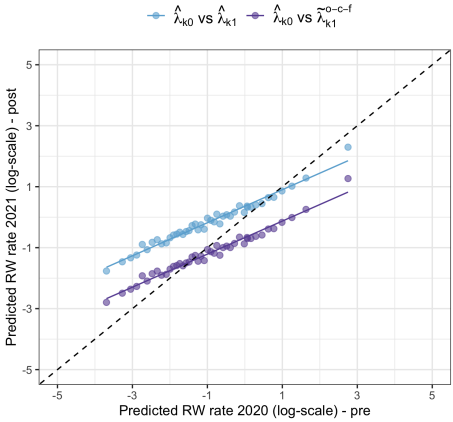
If only $(\hat{\gamma}_{jt})$ *and the vacancy structure* $\left(\frac{v_{jkt}}{\sum_{j'} v_{j'kt}}\right)$ *were to change*



- If only the occupation RW propensity and vacancy structure were to change between the pre and post period, we would virtually see no change in the predicted firm-level RW rate.

Tracing the evolution of remote working

If only $(\hat{\gamma}_{jt})$, $\left(\frac{v_{jkt}}{\sum_{j'} v_{j'kt}}\right)$, *and firm RW propensity* $(\hat{\alpha}_{kt})$ *were to change*



- Firm propensity is the main driver of the change in the predicted firm-level RW rate
- The gap between the two lines is the yearly shifter $(\hat{\beta}_1)$

Conclusions

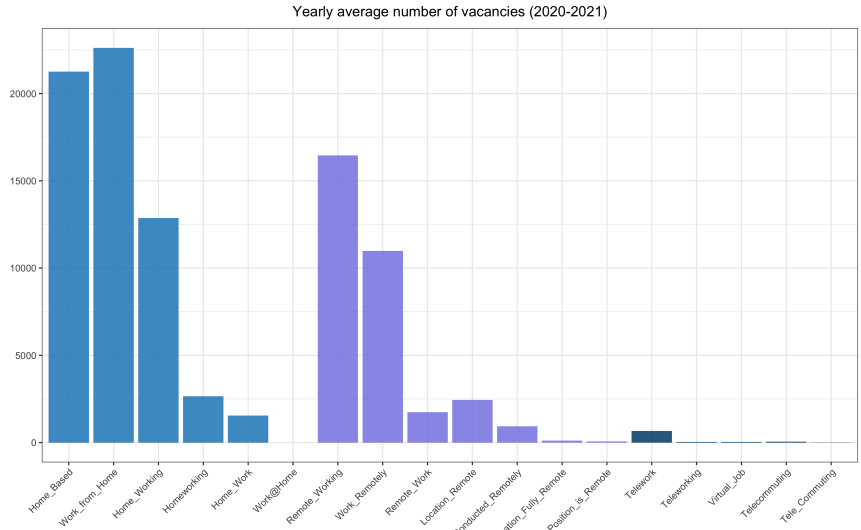
- The pandemic has been accompanied by a massive wave of adoption of remote practices
- We study the mechanisms that have underpinned this process
  - using online vacancy data for the UK
- Adjustments seemed to take place at the level of the entire workplace
  - rather than at the occupation level (across firms)
  - rather than tweaking labour demand towards occupations with higher RW content
- Catch-up effect: firms that were using RW to a lower extent before the pandemic increased their RW offer relatively more compared to firms with higher RW rates

Thank you

Appendix

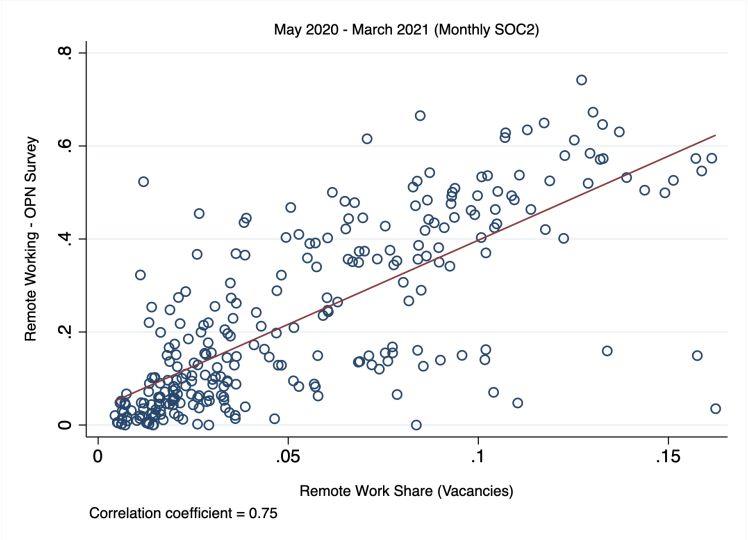
Remote work expressions and validation

back



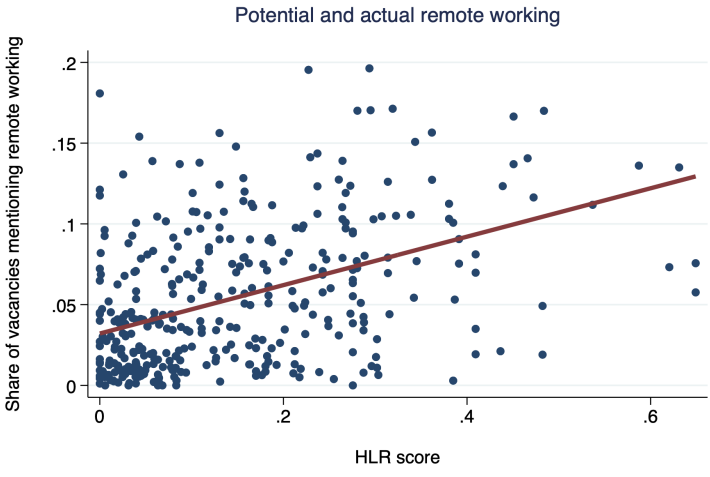
Remote work expressions and validation

back



Remote work expressions and validation

back



How did the occupation-level RW changes translate at the firm-level?

Firm-level remote work potential

- Construct pre-pandemic RW potential of firm k using its occupational composition

$$\text{RWP}_k = \sum_j \left(\frac{v_{jk}}{\sum_{j'} v_{j'k}} \times \text{HLR}_j \right)$$

  - v_{jk}: vacancies posted by firm k in occupation j over pre-pandemic period (04/19-02/20)
  - vacancy-weighted measure of the extent to which a firm's employees can work remotely
- Group firms into Q quantiles based on their RWP_k RWP$_k$ Distribution | Sample description
- Compare the evolution of RW offering across different groups of firms

Comparing the evolution of RW across groups of firms 1/2

- Count of RW vacancies posted by firm k in quarter t assumed $\sim$ Poisson with mean:

$$\lambda_{kt} = v_{kt} \exp\left[\alpha_k + \beta_t + \pi \sum_{q=1}^{Q-1} \mathbb{1}\{k \in q\} \text{ Post}_t\right]$$

  - Firm k, quarter t (Apr-Jun 2019 to Jan-Mar 2021)
  - v_{kt}: total vacancies posted by firm k in quarter t
  - $\mathbb{1}\{k \in q\}$: dummy for whether firm k belongs to RWP quantile q

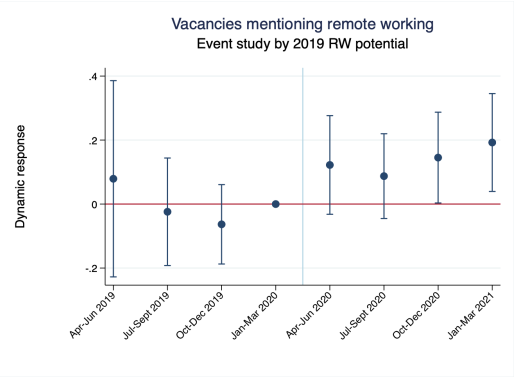
    $\rightarrow$ $q = 1$ bottom quantile, $q = Q$ top quantile (reference group)
  - $\text{Post}_t = \mathbb{1}\{t \geq \text{Apr-Jun 2020}\}$
  - π: parameter of interest. It tells us how and to what extent firms in group q changed their RW offering compared to firms in the reference group after Covid hit

Comparing the evolution of RW across groups of firms 2/2

	(1) Above/Below median	(2) 5 quintiles
Pandemic × RWP (Bottom 50%)	0.154	
	(0.084)	
Pandemic × RWP (quintile 1)		0.088
		(0.109)
Pandemic × RWP (quintile 2)		0.326
		(0.095)
Pandemic × RWP (quintile 3)		-0.024
		(0.111)
Pandemic × RWP (quintile 4)		0.023
		(0.098)
Observations	97763	97763
Employers	16723	16723
Pre-Pandemic Mean	1.16	1.16
Employer FE	✓	✓
Quarter FE	✓	✓

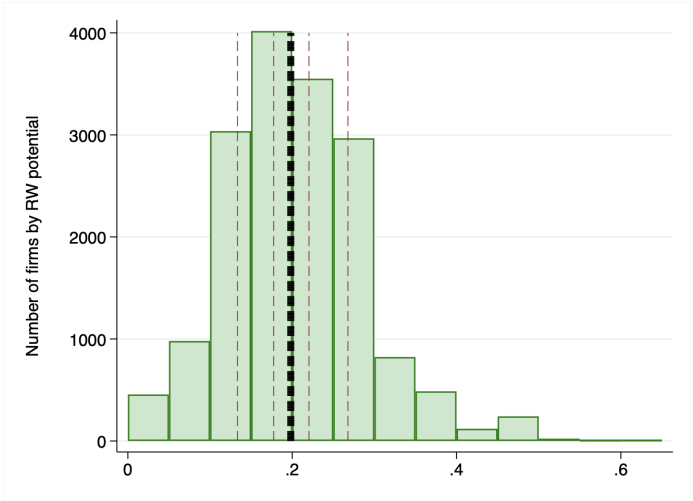
Source: BGT Apr- 2019-March 2021.

Notes: Poisson estimation. Outcome variable: count of RW vacancies. Unit of observation: firm in quarter. The sample includes firms active over fiscal years 2020-2021 and with at least 1 RW vacancy. All regressions include firm and quarter fixed effects. Heteroskedasticity-robust standard errors clustered at firm level in parenthesis.



Firm-level Remote Work Potential distribution

back



Firms by RW potential quintiles

back

	q1		q2		q3		q4		q5	
Avg N Vacancies	128.77	(548.0)	241.91	(4975.6)	134.72	(434.0)	88.09	(282.1)	35.32	(128.0)
Avg N RW Vacancies	1.45	(13.75)	3.19	(31.15)	4.22	(29.58)	3.64	(18.87)	2.44	(23.11)
Avg N Vacancies for high-remotable occ	50.51	(231.6)	169.84	(3852.1)	101.45	(341.2)	74.77	(233.4)	32.50	(117.1)
Avg Share high-remotable	0.42	(0.348)	0.70	(0.185)	0.78	(0.139)	0.89	(0.108)	0.96	(0.0731)
Avg Share RW Vacancies	0.06	(0.192)	0.05	(0.148)	0.06	(0.163)	0.09	(0.209)	0.13	(0.272)
Share Manufacturing	0.05	(0.211)	0.04	(0.187)	0.03	(0.181)	0.02	(0.154)	0.01	(0.119)
Share Distrib. & Hospit.	0.08	(0.274)	0.05	(0.212)	0.04	(0.200)	0.04	(0.185)	0.03	(0.173)
Share Profes. Act.	0.05	(0.213)	0.04	(0.199)	0.06	(0.238)	0.10	(0.301)	0.13	(0.334)
Share Public., Edu., Health	0.16	(0.370)	0.18	(0.388)	0.15	(0.358)	0.10	(0.301)	0.07	(0.262)
N employers	3345		3345		3344		3361		3328	
N vacancies	430728		809177		450504		296071		117551	

Firms by RW potential - Bottom and Top 50%

back

	High RW Potential		Low RW Potential	
Avg N Vacancies	75.84	(279.7)	175.80	(3172.2)
Avg N RW Vacancies	3.29	(23.15)	2.68	(25.20)
Avg N Vacancies for high-remotable occ	63.48	(230.1)	108.24	(2445.7)
Avg Share high-remotable	0.90	(0.115)	0.60	(0.295)
Avg Share RW Vacancies	0.10	(0.232)	0.05	(0.167)
Share Manufacturing	0.02	(0.146)	0.04	(0.197)
Share Distrib. & Hospit.	0.04	(0.184)	0.06	(0.236)
Share Profes. Act.	0.11	(0.307)	0.05	(0.209)
Share Public., Edu., Health	0.10	(0.298)	0.17	(0.377)
N employers	8362		8361	
N vacancies	634148		1469883	

Firm-occupation-year sample selection back

$$\lambda_{jkt} = v_{jkt} \exp(\beta_t + \gamma_{jt} + \alpha_{kt})$$

- In order to estimate γ_{jt}:
  - we use RW variation across firms that hire j in t
- In order to estimate α_{kt}:
  - we use RW variation across occupations hired by k in t

→ We select occupations that offer some RW in a given year

→ We select firms that hire only those occupations, that are active in both years, and that offer some RW in each year

Firm-occupation-year sample selection

back

	Decomposition Sample		Full Sample	
Avg N Vacancies	339.27	(4640.1)	21.54	(832.7)
Avg N RW Vacancies	10.58	(50.42)	0.41	(9.571)
Avg N Vacancies for high-remotable occ	237.76	(3584.6)	14.11	(642.1)
Avg Share high-remotable	0.78	(0.197)	0.63	(0.421)
Avg Share RW Vacancies	0.18	(0.275)	0.02	(0.120)
Share Manufacturing	0.03	(0.165)	0.04	(0.187)
Share Distrib. & Hospit.	0.04	(0.187)	0.09	(0.286)
Share Profes. Act.	0.07	(0.260)	0.04	(0.202)
Share Public., Edu., Health	0.15	(0.353)	0.14	(0.350)
N employers	4872		153249	
N vacancies	1652926		3301422	

Firm-occupation-year sample selection

back

	DiD		Decomposition		Excluded	
Avg N Vacancies	137.89	(2514.0)	339.27	(4640.1)	7.29	(49.33)
Avg N RW Vacancies	3.36	(27.69)	10.58	(50.42)	0.05	(2.784)
Avg N Vacancies for high-remotable occ	94.30	(1940.2)	237.76	(3584.6)	4.29	(29.78)
Avg Share high-remotable	0.75	(0.265)	0.78	(0.197)	0.61	(0.434)
Avg Share RW Vacancies	0.08	(0.201)	0.18	(0.275)	0.01	(0.103)
Share Manufacturing	0.03	(0.174)	0.03	(0.165)	0.04	(0.189)
Share Distrib. & Hospit.	0.05	(0.212)	0.04	(0.187)	0.10	(0.294)
Share Profes. Act.	0.08	(0.264)	0.07	(0.260)	0.04	(0.193)
Share Public., Edu., Health	0.14	(0.342)	0.15	(0.353)	0.14	(0.351)
N employers	16723		4872		136526	
N vacancies	2305889		1652926		995533	

DiD on subsample

Firms that catch up and that do not

back

	Catch-up		No Catch-up	
Avg N Vacancies	274.43	(626.8)	404.11	(6532.2)
Avg N RW Vacancies	2.35	(2.164)	18.80	(70.32)
Avg N Vacancies for high-remotable occ	170.83	(306.4)	304.69	(5059.8)
Avg Share high-remotable	0.72	(0.182)	0.83	(0.197)
Avg Share RW Vacancies	0.04	(0.0527)	0.32	(0.329)
Share Manufacturing	0.04	(0.188)	0.02	(0.138)
Share Distrib. & Hospit.	0.04	(0.206)	0.03	(0.166)
Share Profes. Act.	0.06	(0.235)	0.09	(0.281)
Share Public., Edu., Health	0.18	(0.381)	0.12	(0.320)
N employers	2436		2436	
N vacancies	668521		984405	

DiD analysis on decomposition sample

back

	(1) DiD sample	(2) Decomposition sample	(3) No decomposition sample
Pandemic × RWP (Bottom 50%)	0.154	0.169	-0.021
	(0.084)	(0.108)	(0.081)
Observations	97763	33316	64447
Employers	16723	4872	11851
Pre-Pandemic Mean	1.16	3.07	0.15

Source: BGT Apr- 2019-March 2021.

Notes: Poisson estimation. Outcome variable: count of RW vacancies. Unit of observation: firm in quarter. The table shows DiD estimate results across different subsamples. All regressions include firm and quarter fixed effects. Heteroskedasticity-robust standard errors clustered at firm level in parenthesis.