

Local labour market resilience: the role of digitalisation and working from home

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Motivation

- ▶ Digitalisation has spurred productivity growth & transformed the nature of work
- ▶ Crucial for socioeconomic resilience to crises
(Bertscheck et al., 2019; Perri and Timmer, 2022; Reveiu et al., 2022)
- Spatial digital divide: disparities in regions' ability to resist and recover from a shock.
- ▶ The pandemic shock
 - Remote work widely adopted : 25% of the workforce worldwide use hybrid working arrangements, 45% of workers in jobs amenable to remote work.
 - Digital capital investments
 - 30% of German firms reported that they invested (more) in digital technologies because of the pandemic (Bellmann et al., 2021)
 - Necessary for remote work.
 - Organisational flexibility, better cope with disruption of supply chains
 - Move business online

This paper

How did digital capital and remote work affect local employment responses to the crisis in Germany?

Impact of recessions on local labor markets

- Increase in inequality: Long-term declines in employment in more-affected regions (Yagan, 2019; Hershbein and Stuart, 2020, Furceri et al., 2020; Ma et al., 2020; Hershbein and Kahn, 2018)
- ⇒ Very few studies on what happened with the economic shock and recession due to Covid-19 pandemic.
- ⇒ Role of ICT and remote work for recovery from a shock

This paper

How did digital capital and remote work affect local employment responses to the crisis in Germany?

Impact of recessions on local labor markets

- Covid-19 pandemic had unequal effects on employment across space in the short run (Stantcheva, 2021, Aum et al., 2020; Bauer and Weber, 2020; Böhme et al, 2020; Alipour, Fadinger and Schymik, 2020; Oikonomou et al, 2023)
- ⇒ Extend the time horizon : resistance phase and recovery phase.
- ⇒ Complementarity between digital capital and remote work.
- ⇒ Germany, a country with very different labour market institutions and safety nets than the U.S.
- ⇒ Look at both unemployment and short-time work (STW)

Short-time work

Employment responses in Germany

- Employment data from German Federal Employment Agency
- STW spiked to 18% in April 2020.
- Ranging from 9 to almost 38% across local labour markets.
- Unemployment rate just below 6% in summer 2020 (an increase of 1.2 percentage points relative to summer 2019).
- Changes in unemployment rates differed across regions by up to 2.5 percentage points.

Digital capital potential

▶ Local ICT capital endowment

- No information on actual ICT capital at the local level
- given the technological frontier, variation in ICT capital within industry x region likely endogenous to local firms' characteristics.

▶ Local ICT capital potential

- ICT capital at the industry level: 40 industries in 2019, EU Klems
- Index at the local level based on industry employment composition

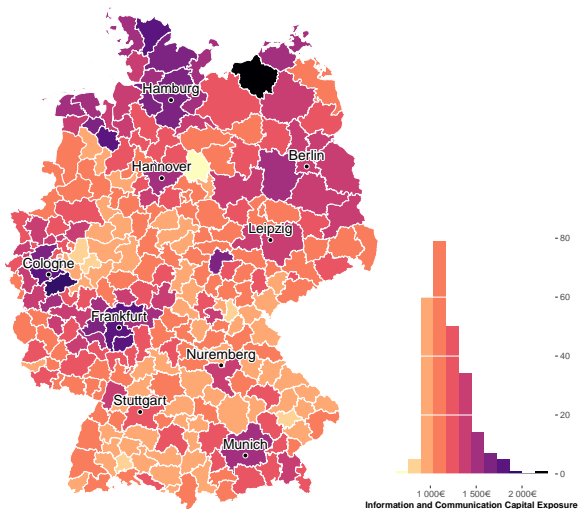
$$K_{ICT,l} = \sum_{i=1}^I \frac{E_{i,l}}{E_l} \times \frac{K_{ICT,i}}{E_i}$$

Variation comes from

- local differences in industry employment structure just before the pandemic.
 - different average ICT-intensity across industries before the pandemic
- ⇒ Local specialisation in ICT-intensive industries

Information and Communication Capital Exposure

Information and communication capital per worker in 2019



working from home potential

- ▶ Local working from home usage
 - No information on actual ICT capital at the detailed local level in 2020 ...
 - Given the technological frontier, adoption of WfH arrangements within jobs x region likely endogenous to local characteristics.
- ▶ **Local working from home potential**
 - At occupational level 2018, BiBB/BauA Employment Survey
 - Different indexes based on pre-crisis usage or teleworkable tasks
 - Index at the level of local labour markets based on occupational composition

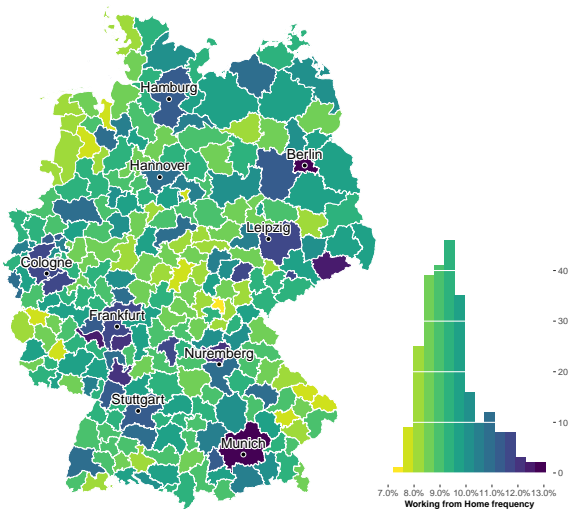
$$WfH_r = \sum_{o=1}^O \frac{E_{o,r}}{E_{total,r}} \times \frac{WfH_o}{E_{o,national}}$$

Variation comes from

- local differences in occupation structure just before the pandemic.
 - different average WfH feasibility across occupations
- ⇒ Local specialisation in jobs amenable to WfH

Working from Home frequency

Share of frequent/always teleworkers in pre-period



Identification strategy

- Difference-in-Differences with a continuous treatment and one shock
- Intensity of the treatment depends on a region's digital capital potential and working from home potential.
- Dose-response framework : as the intensity increases, the effect size should grow.
- Dichotomize into “high” and “low” groups or present average linear effects are intuitive and parsimonious.
- Exploiting fully the continuous measure is more informative.
- Examine for non-monotonicities in the policy exposure measure.
- We do not need random assignment of digitalisation intensity.

Identifying assumption # 1

i Strong parallel trends assumption

Employment of regions with different digitalisation intensity would have trended similarly in the absence of pandemic.

- Empirically show the pre-trends at all levels of treatment.

Identifying assumption # 2

ii Conditional independence assumption

Conditionally on covariates, no unobserved selection into specific levels of digitalisation potential.

- Need exogeneity of the local employment shares conditional on covariates.
- Control for systematic differences across regions using a propensity score weighting procedure
- Non-parametric covariate balancing generalised propensity score (npCBGPS) methodology by Fong et al. (2018)
- Estimate the effect of digitalisation on a pseudo-population of regions without relationship between local digital potential and other observable characteristics.

Covariates

Identifying assumption #3

iii Stable unit treatment value assumption

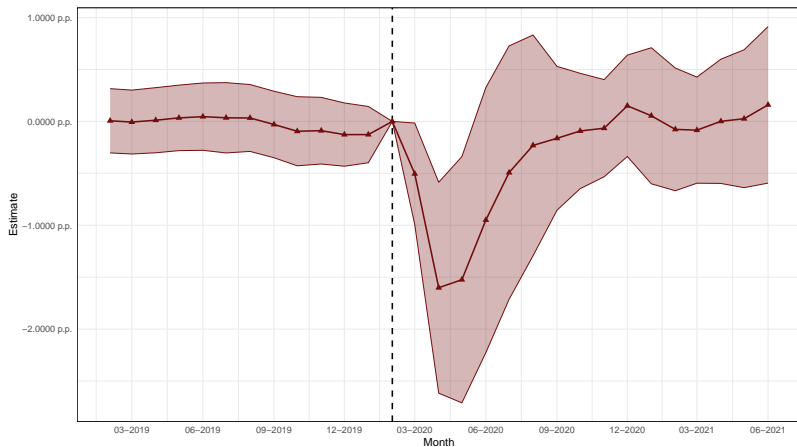
The level of digitalisation in one region should not have employment effects in another region.

- Local labour markets definition minimises commuting across local labour markets
- Large migration or capital transfer would only happen over a longer time horizon in Germany
- Stawarz et al. (2022) even document a drop in inter-county migration in 2020.

Event-study framework

$$\text{STW-RATE}_{lt} = \sum_{t=1, t \neq 0}^T \beta_t \text{DIGITAL POTENTIAL}_l \times \text{TIME}_t + \sum_{t=1, t \neq 0}^T \gamma_t \text{TIME}_t + \alpha_l + \varepsilon_{lt}.$$

Digital capital reduced short-time work



More on pre-trends

Digital capital reduced short-time work

Digital capital potential

	(1)	(2)	(3)	(4)	(5)
TREATMENT ×	Linear	Over 10th p.	Over 20th p.	Over 40th p.	Over Median
... BEFORE FEB 2020	-0.094 (0.156)	0.133 (0.204)	-0.008 (0.098)	0.029 (0.094)	-0.060 (0.106)
... MARCH TO JUNE 2020	-1.147** (0.469)	-3.924*** (0.773)	-1.901*** (0.661)	-1.753*** (0.543)	-1.267** (0.623)
... JULY TO OCTOBER 2020	-0.245 (0.429)	-2.507*** (0.609)	-1.484** (0.581)	-0.707* (0.416)	-0.334 (0.400)
... NOV 2020 TO FEB 2021	0.016 (0.265)	-0.629 (0.527)	-0.659** (0.330)	-0.480* (0.322)	-0.752** (0.366)
... MARCH TO JUNE 2021	0.026 (0.303)	-0.311 (0.415)	-0.587* (0.346)	-0.354 (0.275)	-0.733** (0.333)
Time-fixed effects	YES	YES	YES	YES	YES
Region-fixed effects	YES	YES	YES	YES	YES
N	5397	5397	5397	5397	5397
Adjusted R^2	0.75	0.75	0.75	0.75	0.75

Digital capital potential

- ▶ Digital capital potential is more exogenous than actual digital capital
- ▶ No variation in digital capital within detailed industry across local labour markets, likely endogenous to other regional characteristics.
- ▶ Depends on industry mix of a region, conditional on observables covariates
- ▶ Additional IV results for digital capital
 - ▶ Local share of jobs intensive in routine tasks in 1979 that would be replaced by computers later on: “computerizable tasks”.
 - Autor et al. (2003) use it for the US to study how the computerization of routine tasks affected labour demand.
 - ▶ Local share of computers in 1979
 - ▶ BiBB BAuA Employment survey on Qualification and Working Conditions in Germany

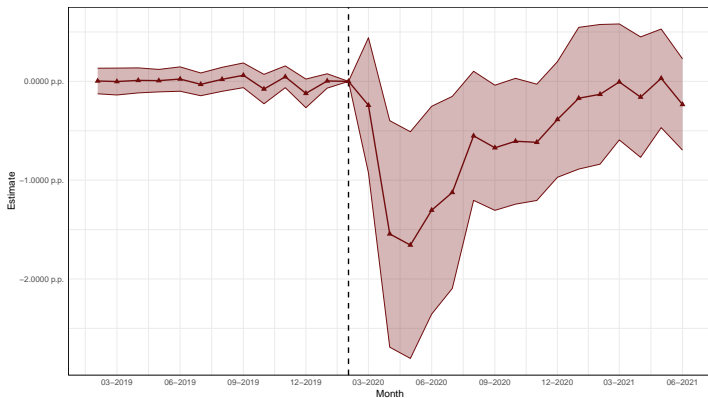
Historical IV for digital capital potential

	(1)	(2)	(3)
SECOND STAGE: LINEAR EFFECT			
Before March 2020	-0.057*** (0.013)	-0.064*** (0.012)	-0.068*** (0.012)
March to June 2020	-1.263*** (0.392)	-1.538*** (0.363)	-1.663*** (0.36)
July to October 2020	-0.584*** (0.212)	-0.823*** (0.195)	-0.932*** (0.193)
Nov 2020 to Feb 2021	-0.235 (0.182)	-0.184 (0.168)	-0.16 (0.167)
March to June 2021	0.051 (0.169)	0.078 (0.157)	0.09 (0.156)
FIRST STAGE			
Constant	2.873*** (0.339)	1.464** (0.459)	0.944 (0.628)
Computer use in 1979	0.526*** (0.065)		-0.283 (0.233)
Share of routine employment in 1979		0.567*** (0.063)	0.839*** (0.233)
First stage N	184	184	184
First stage R ²	0.27	0.31	0.32
F-statistics	9.88	12.22	6.27

Channels of impact

- Possibility to work remotely
- Organisational flexibility and faster adaptation
 - faster sharing of information
 - improve decision-making within organisations
 - Reshaping supply chains
- Move (part) business online

WfH potential reduced short-time

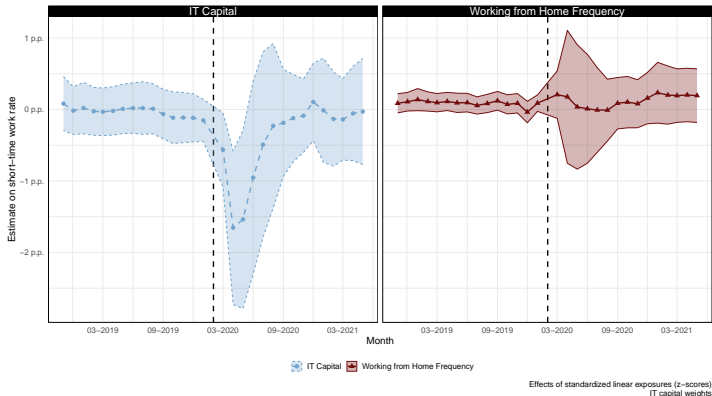


[More on pre-trends](#)

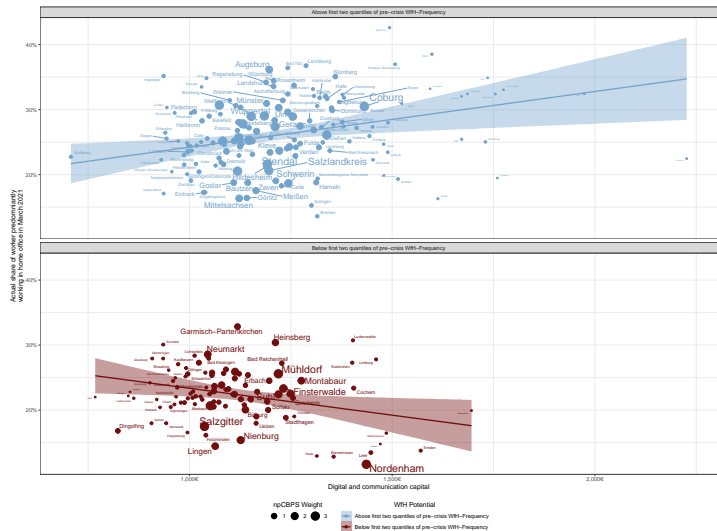
Working from home reduced short-time work

	Working from home potential				
	(1)	(2)	(3)	(4)	(5)
TREATMENT ×	Linear	Over 10th p.	Over 20th p.	Over 40th p.	Over Medi
... BEFORE FEB 2020	-0.018 (0.052)	-0.056 (0.130)	0.052 (0.091)	-0.011 (0.069)	-0.058 (0.083)
... MARCH TO JUNE 2020	-1.189*** (0.441)	-1.261* (0.762)	-1.151** (0.564)	-0.998 (0.694)	-0.484 (0.635)
... JULY TO DECEMBER 2020	-0.567** (0.267)	-0.242 (0.533)	-0.251 (0.384)	-0.146 (0.348)	-0.096 (0.380)
... JANUARY TO JUNE 2021	-0.112 (0.277)	0.325 (0.543)	-0.269 (0.626)	-0.015 (0.450)	0.348 (0.377)
Time-fixed effects	YES	YES	YES	YES	YES
Region-fixed effects	YES	YES	YES	YES	YES
N	5397	5397	5397	5397	5397
Adjusted R^2	0.75	0.75	0.75	0.75	0.75

Digital capital and WfH potential together



Digital capital potential predicts actual working from home



Take-away

Digital capital was

- essential for employment during the pandemic
- necessary for working from home to help reduce short-time work enabled to save jobs
- smoothed the employment shock beyond the ability to work remotely.
- Other likely channels similar to the ones linking ICT and productivity.
- Effect in the short/medium run: 8 months after outbreak
- Effect diminished when labour markets started to recover.

Discussion

- Spatial digital divide brought further employment inequalities with the pandemic but only in the short to medium run.
- Short-time work likely powerful in cushioning negative shock in local labour markets with low digital capital.
- Consistent with literature on STW (Giupponi et al., 2022; Kopp and Siegenthaler, 2021, Giupponi and Landais, 2022)
- No higher unemeployment in low digital local labour markets.
- Job transitions out of hardly hit sectors (Arntz et al., 2023)

Discussion

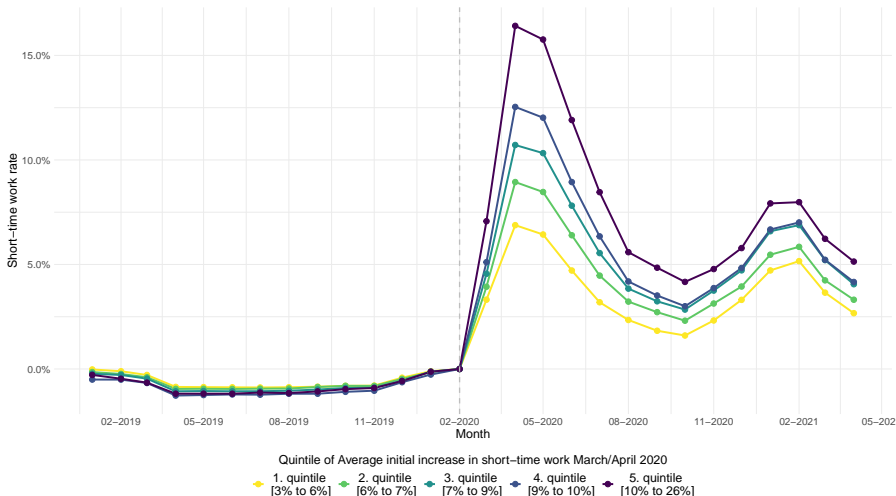
- No persistent effect of digitalisation after a year
- Adoption of ICT during the pandemic & heterogeneity across space.
- Firm heterogeneity in ICT adoption (Gathmann et al., 2023, Barth et al., 2022, Rückert et al., 2020)
- Regional data on digital capital : regional convergence during/after the pandemic ?
- Firm data : how the dispersion in firms' adjustments will affect spatial inequality?

Short time work schemes STW

- Shield workers from job loss and firms from job match destruction.
- Instead of firing employees, firms could apply for STW and reduce their employees' hours.
- The government compensate employees for the wage loss due to the involuntary decrease in working hours.
- Germany: if 10% or more of a firm's workforce, including temporary employees, were affected by a reduction in hours.
- for up to 24 months.

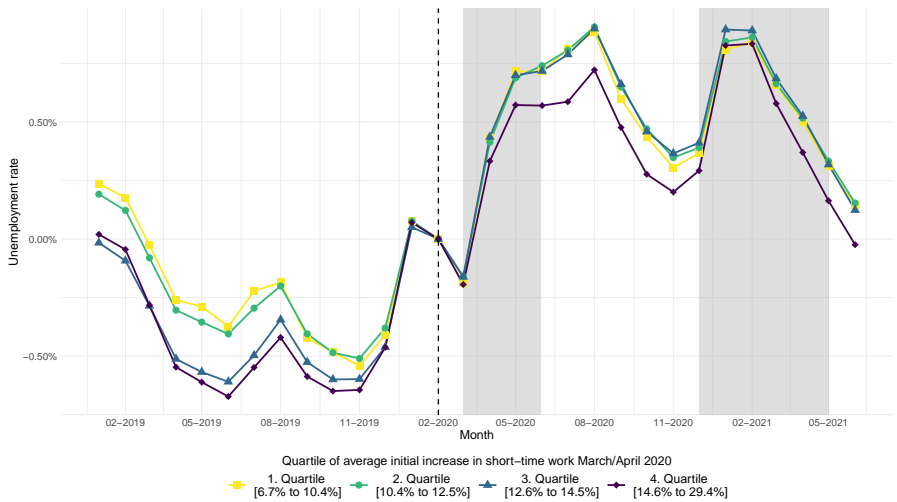
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Short-time work across local labour markets



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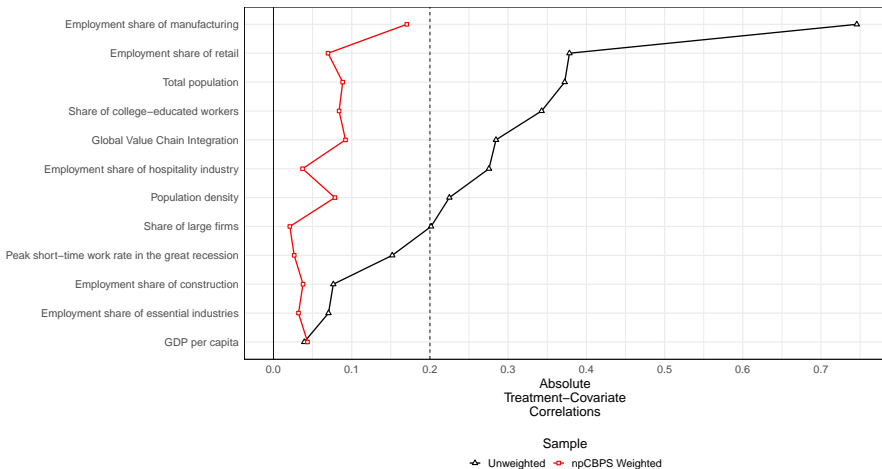
Unemployment rte across local labour markets



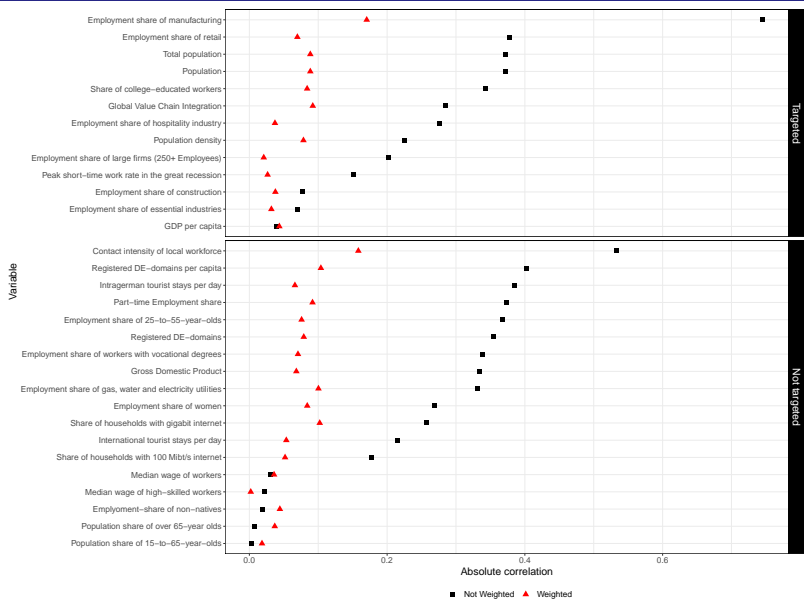
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Identification strategy

Covariate Balance

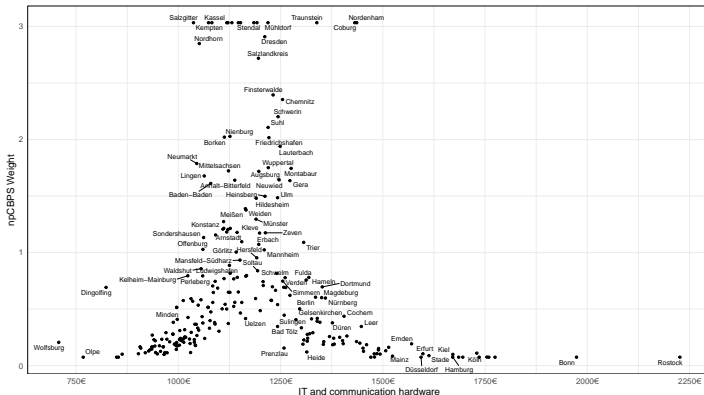


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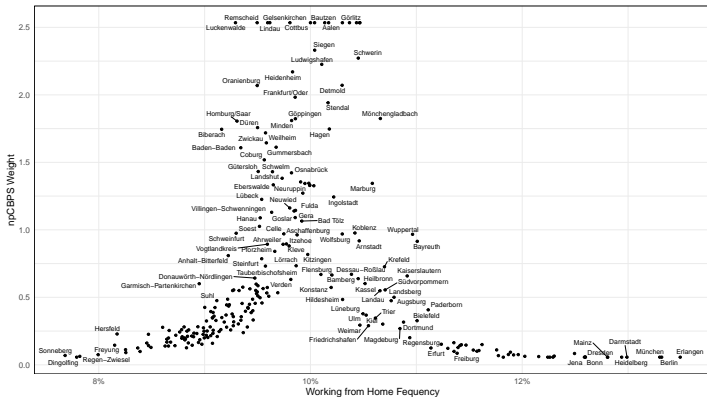


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Weight distribution for the Digital capital exposure

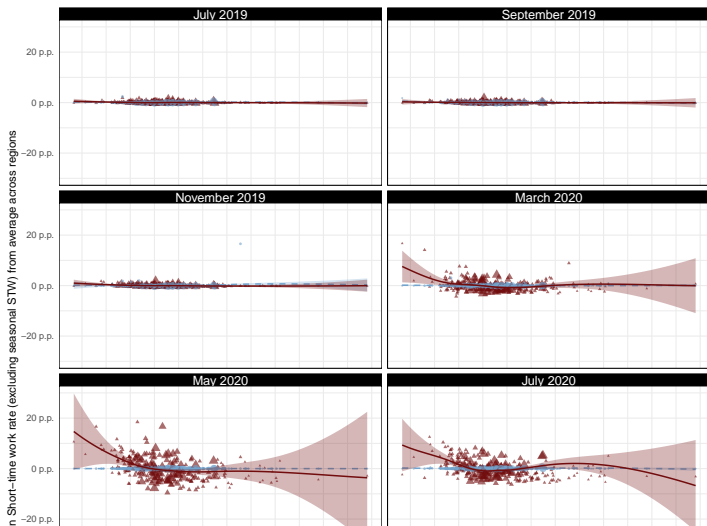


Weight distribution for the Working from Home frequency



Pre-trends

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Pre-trends

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