

Master's Thesis

The Role of Teleworkability on Employment in The Time of COVID-19

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Field of Study 38.04.01 Economics

Educational Programme: Economics and Economic Policy

Introduction

Research question and Hypotheses

Telework, a form of work widely adopted under the impact of COVID-19, to mitigate the effects of anti-COVID-19 policies.

The purpose of this study is to analyze whether the teleworkability had an impact on employment and working hours in the time of COVID-19.

- Research question:
 1. How does teleworkability affect employment?
 2. What is the impact of teleworkability on working hours?
- Hypotheses:
 1. Teleworkability will positively affect employment.
 2. Teleworkability will increase the working hours in the time of COVID-19.

Literature review

COVID-19 and anti-COVID-19 policy had negative effect on economic activity and labour market.	<i>Mou (2020), Lokshin et al. (2020), Gourinchas (2020), Coibion et al. (2020), Forsythe et al. (2020), Ludvigson et al. (2020)</i>
Remote work mitigated the negative effect on employment during the pandemic.	<i>Kotyrlo (2022), Brodeur et al. (2023), Aum et al. (2021), Lewandowski (2022), Adams et al. (2020), Yasenov, (2020)</i>
Gender, age, education show differences in employment during the pandemic.	<i>Kartseva (2020), Aum et al. (2021), Kugler et al. (2021), Adams et al. (2020),</i>
Occupations were classified to identify which jobs could be done remotely. Around 40% - 50% of jobs could be performed remotely.	<i>Sostero et al. (2020), Dingel et al. (2020), Bloom (2020), Avdiu et al, Alipour et al. (2023), Adams et al. (2022), Gallacher et al. (2020)</i>

Data and Variables

Overview

- **Individual and Household Data (2019-2020)** - The Russia Longitudinal Monitoring Survey (**RLMS**).
- 17342 observations.
- Outcomes:
 1. Dummy variable: employment or unemployment.
 2. Continues variable: monthly working hours.
- Treatment: teleworkability
- Covariates: gender, age, education, children, non-labour income

Data and Variables

Covariates - gender, age, children, education

- ***gender*** = 1, *if male*
= 0, *if female*
- ***age_group*** = 1, *if $45 \leq \text{age} < 72$.*
= 0, *if $15 < \text{age} < 45$.*
- ***children*** = 1, *if with children*
= 0, *if without children*
- ***edu*** = 1, *if primary education*
= 2, *if secondary education*
= 3, *if higher education*

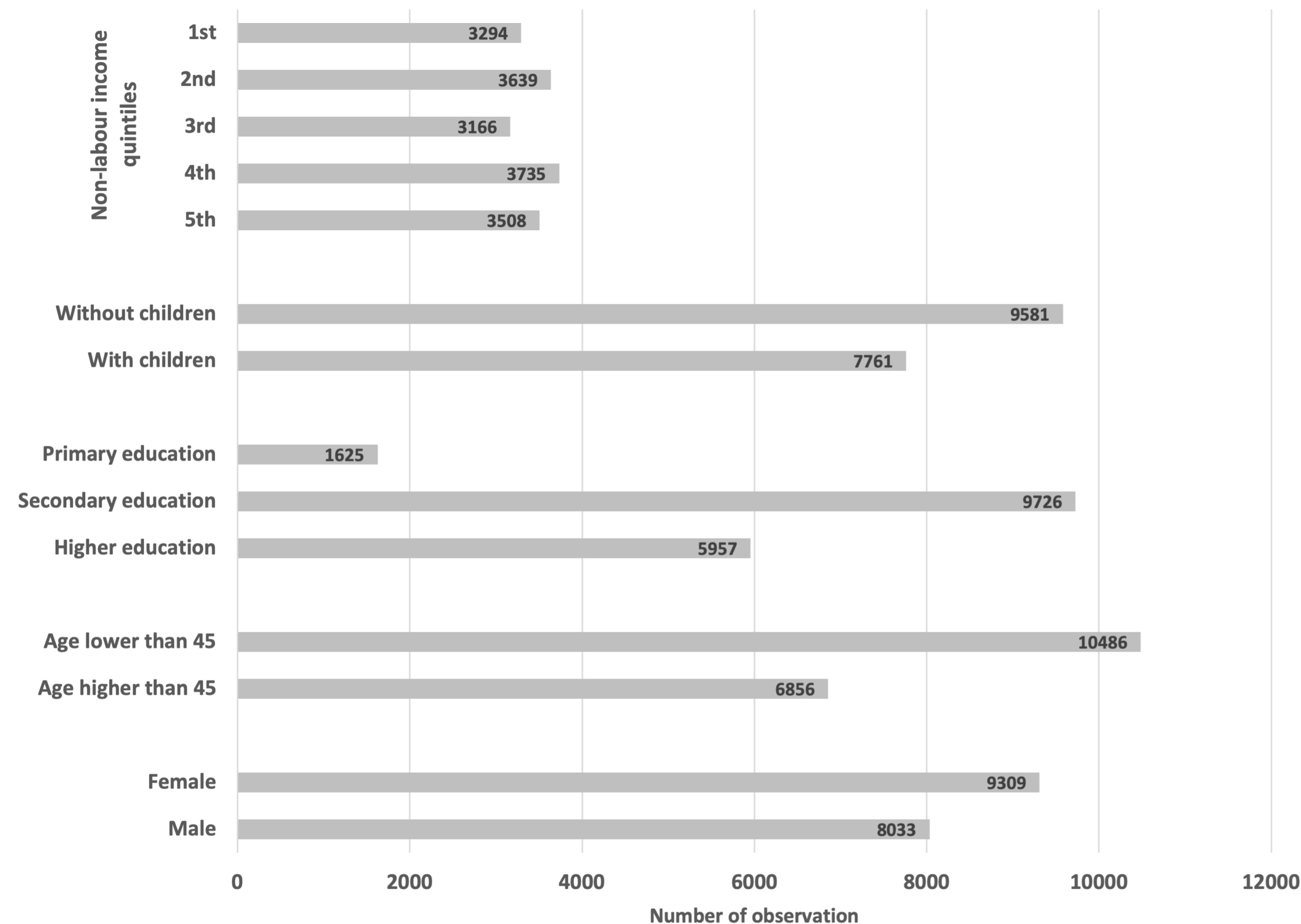
Data and Variables

Covariates - non labour income

Non-labour income = (household income - wage) / number of family member

- ***nli_quintile*** = 1, first quintile - the lowest non-labour income from 0% - 20%
 - = 2, *second quintile*
 - = 3, *third quintile*
 - = 4, *fourth quintile*
 - = 5, *fifth quintile* - the highest non-labour income from 80% - 100%

Descriptive Statistics of Covariates



- Number of observations which Without children is higher than With children
- Number of observations in Primary group is lower than that in Secondary and Higher Secondary is the highest
- Number of younger observations are higher than older
- Female is higher than male

Data and Variables

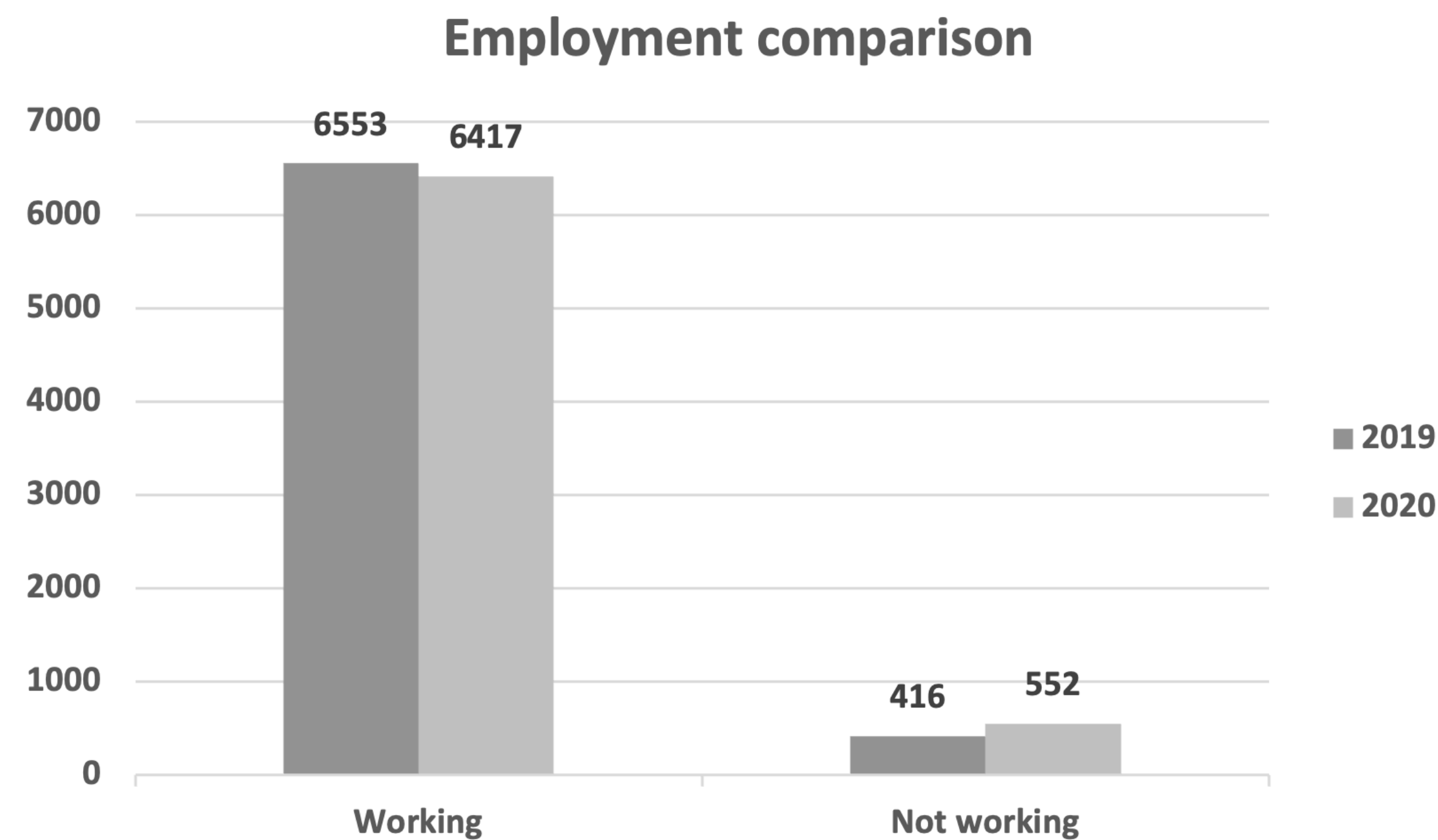
Outcome - employment

<i>IYWRKNOW</i>	J1.	Let's talk about your primary work at the present. Tell me, please:	
		You are currently working	1
		You are on paid leave (maternity leave or taking care of a child under 3 years of age).....	2
		You are on another kind of paid leave	3
		You are on unpaid leave.....	4
		You are not working	5 → [SKIP TO 56. ON 18]
		<i>DOESN'T KNOW</i>	7 → [SKIP TO 56. ON 18]
		<i>REFUSES TO ANSWER</i>	8 → [SKIP TO 56. ON 18]

- ***working* = 1 if J1=1**
- ***working* = 0 if J1=5**

Note: Individuals who did not work in both periods and who were on leave were excluded.

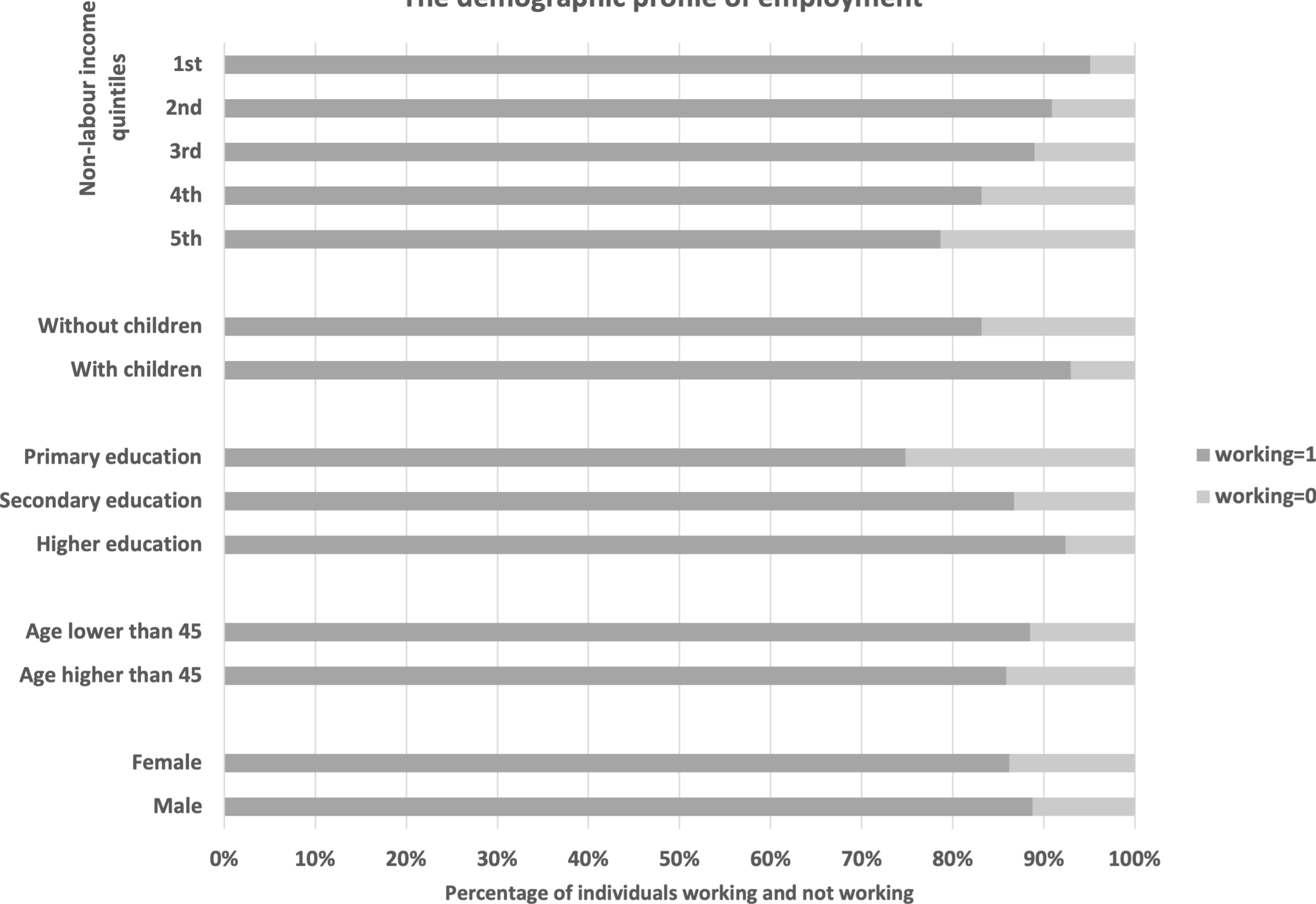
Outcome - employment



Comparing with 2019: Number of unemployed observations were increased by 25% in 2020, and employed observations were decreased

Outcome - employment

The demographic profile of employment



- Non-labour income and employment show a decreasing trend
Groups with higher non-labour income have less employed observations
- The percentage of employed individuals who Without children is lower than that With children
- Education and employment show a increasing trend
Groups with higher education level have more employed observations
- Younger employed individuals is higher than older
- Employed female is lower than male

Data and Variables

Outcome - monthly working hours

IYHOURLM **J8.** How many hours did you actually work at your primary job in the last 30 days?

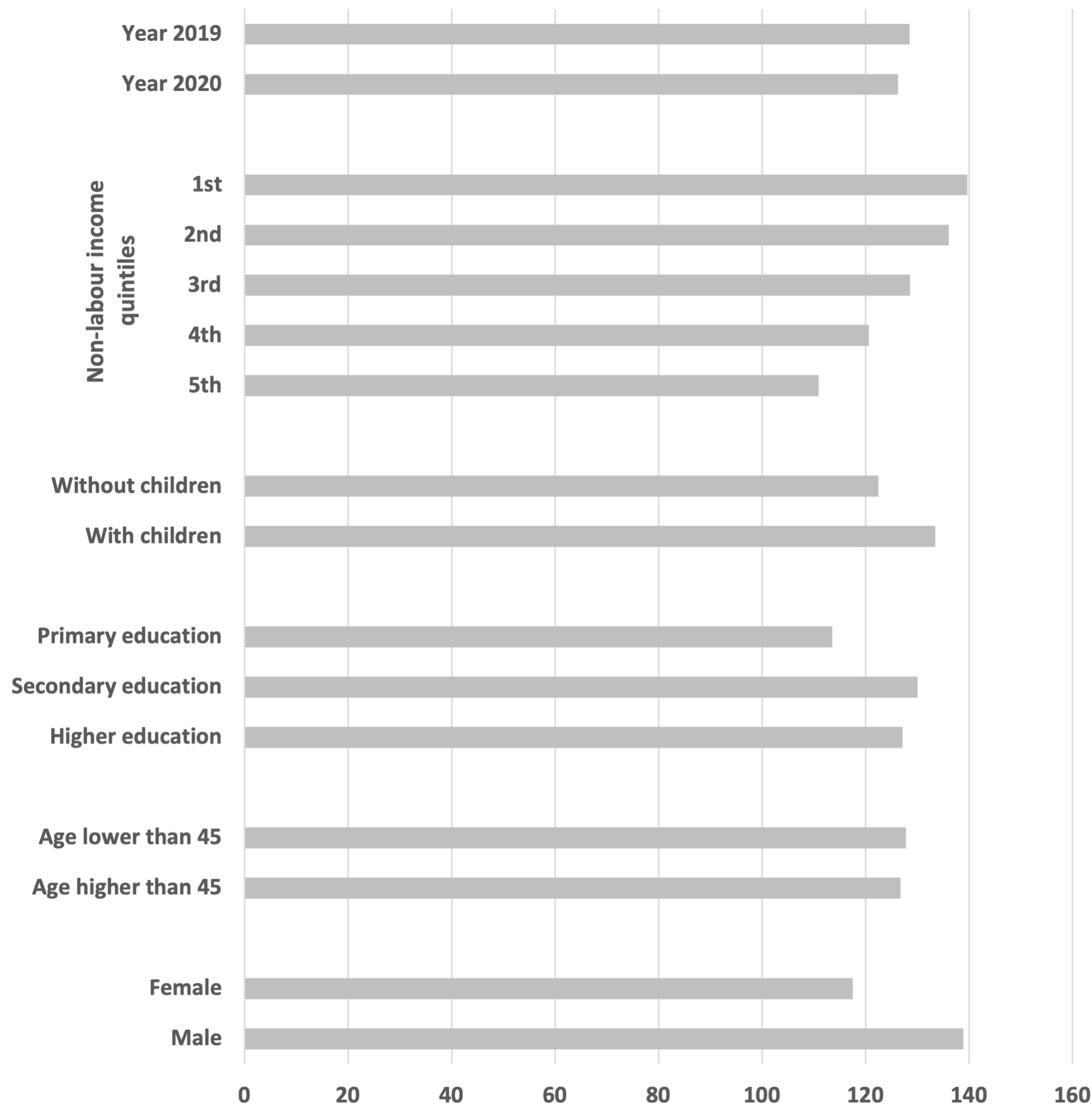
_____ *HOURS*
DOESN'T KNOW.....997
REFUSES TO ANSWER.....998

- hours = J8
- hours = 0, *if not working*

if hours < 120

if hours > 400
- ***ln_hours*** = $\ln(\text{hours} + 1)$

Comparison of Average monthly working hours



- Comparing with 2019: Average working hours were decreased in 2020
- Non-labour income and working hours show a decreasing trend
Groups with higher non-labour income had lower average working hours
- Average working hours in group that Without children is lower than that With children
- Average working hours in Primary group is lower than Secondary and Higher
Secondary is the highest
- Average working hours in Female group is lower than Male

Data and Variables

Treatment: teleworkability

To define variable *telework*, two indices were combined:

1. Technical teleworkability - occupation level. *Sostero et al. (2020)*

ISCO08 code	Occupation title	Technical teleworkability
111	Legislators and senior officials	1.00
112	Managing directors and chief executives	1.00
121	Business services and administration managers	1.00
122	Sales, marketing and development managers	1.00
131	Production managers in agriculture, forestry and fisheries	0.00
132	Manufacturing, mining, construction, and distribution managers	0.18
133	Information and communications technology service managers	1.00

Data and Variables

Treatment: teleworkability

To define variable *telework*, two indices were combined:

2. Ability of using internet for work - individual level

J125.2	INTERNET FOR WORK L12M?	1	Yes
		2	No
		99999997	DOES NOT KNOW
		99999998	REFUSES TO ANSWER
		99999999	NO ANSWER

- Internet = 1, if $J125.2 = 1$
= 0, else

Data and Variables

Treatment: teleworkability

To define variable *telework*, two indices were combined:

telework = 1, *if technical telework ability* > 0.4 & *internet* = 1

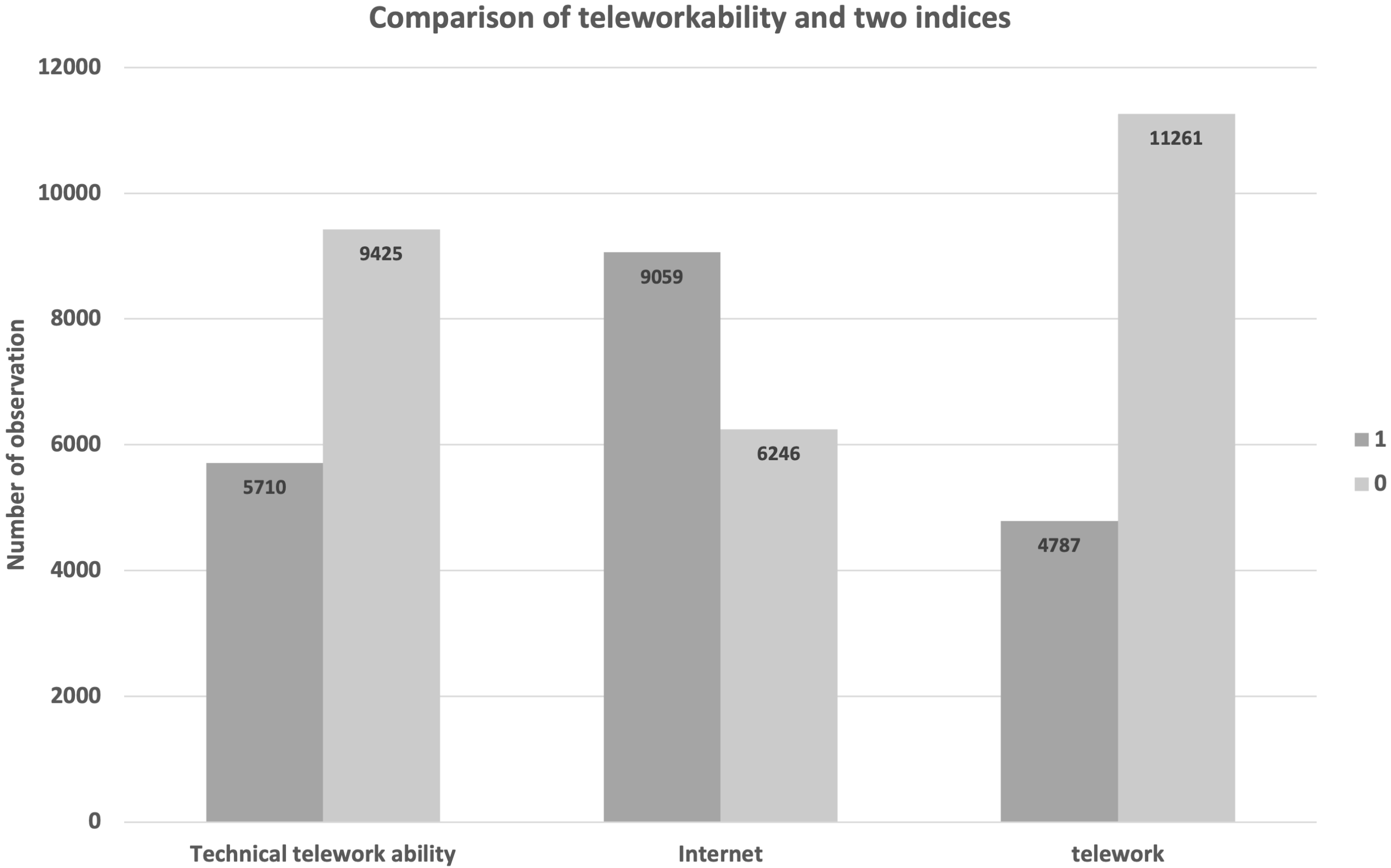
= 0, *if technical telework ability* > 0.4 & *internet* = 0

= 0, *if technical telework ability* < 0.4 & *internet* = 1

= 0, *if technical telework ability* < 0.4 & *internet* = 0

$$\text{teleworkability} = \begin{cases} 1, & \text{if technical telework ability} \times \text{internet} \geq 0.4 \\ 0, & \text{if technical telework ability} \times \text{internet} < 0.4 \end{cases}$$

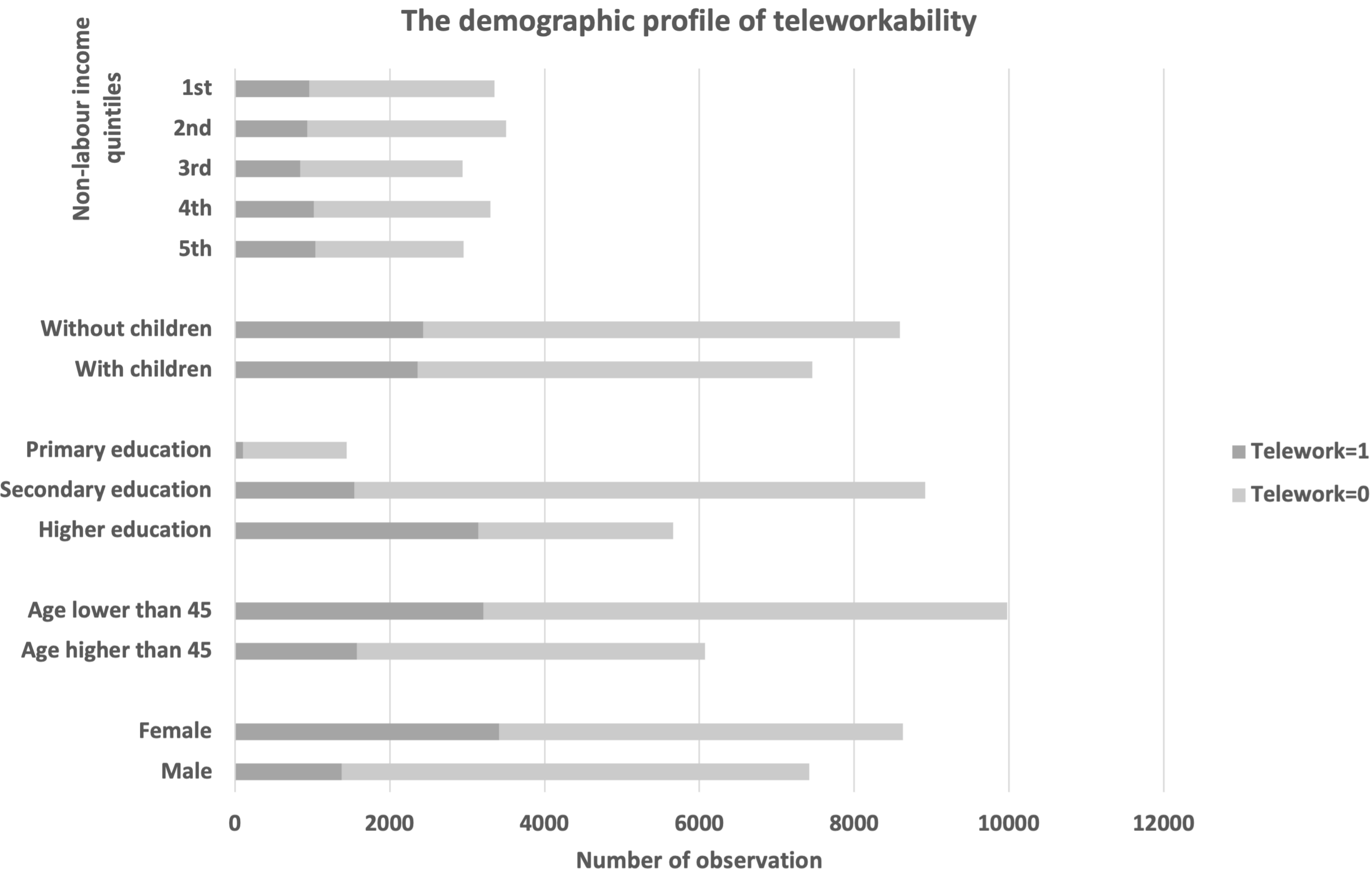
Treatment: teleworkability



- 5710 observations technical teleworkability higher than 0,4
- 9059 observations use internet for work
- 4787 observations have the ability to work remotely, which is our treated observations
- 11261 untreated observations

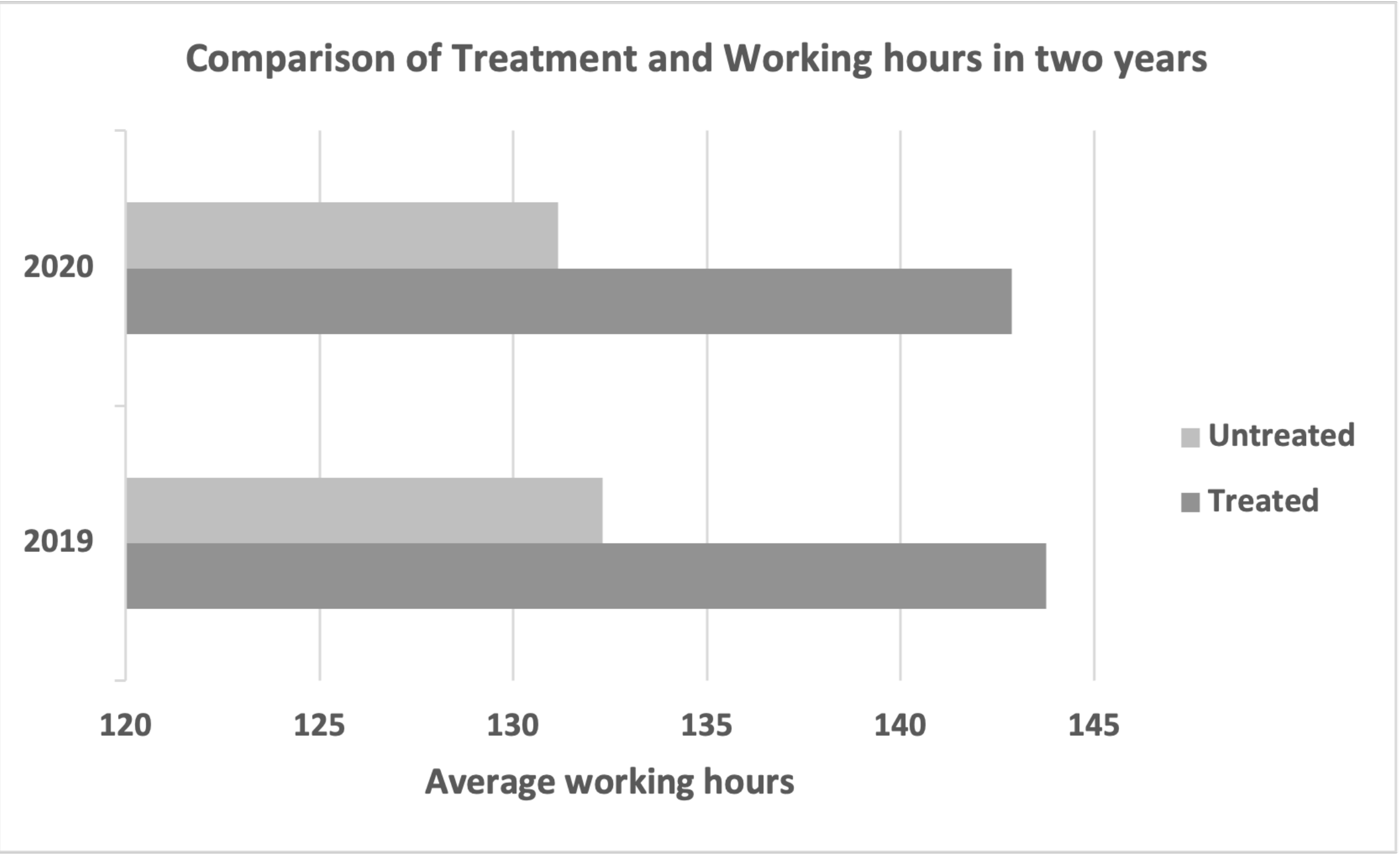
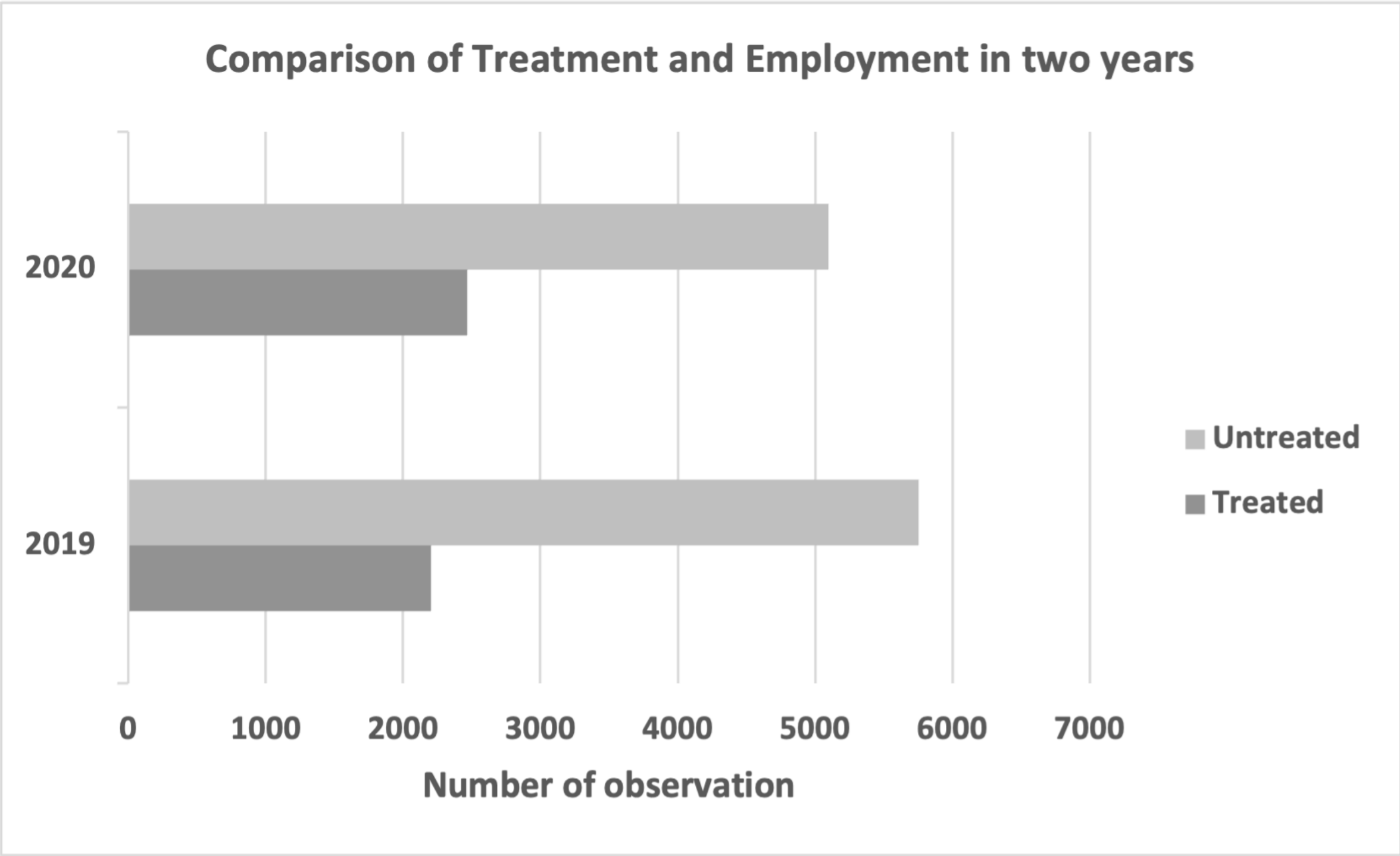
Treatment: teleworkability

The demographic profile of teleworkability



- More than half of Higher educational individual have the ability to work remotely
Only a few in Primary and Secondary
- The number of treated observations in younger group is higher than older
- The number of treated observations in Female group is higher than Male

Treatment and Outcomes



Comparing with 2019:
More people have the ability to work remotely in 2020.
Observations without the ability to work remotely, were decreased in 2020.

For both treated and untreated group, the average working hours in 2020 are lower than 2019

Model

Doubly Robust Difference-in-Difference

- The method utilized in the study is the Doubly Robust Difference-in-Difference (DRDID) estimation. *Sant'Anna and Zhao (2020)*

DRDID combines two approaches to construct a doubly robust estimate.

1. Outcome Regression (OR) approach. *Heckman et al. (1997)*
2. Inverse propensity score probability weighting (IPW) approach. *Abadie (2005)*

Doubly robust estimation demonstrate better consistency.

- CSDID package was used for ATT estimation. *Callaway and Sant'Anna (2021)*

The restrictions imposed by CSDID on the data are relatively less strict and more suitable for our estimation.

ATT : average treatment effects on treated (with teleworkability)

Model

Assumptions

1. Conditional Independence Assumption (CIA)

Data are independent and identically distributed.

2. Conditional Parallel Trends Assumption (Conditional PTA)

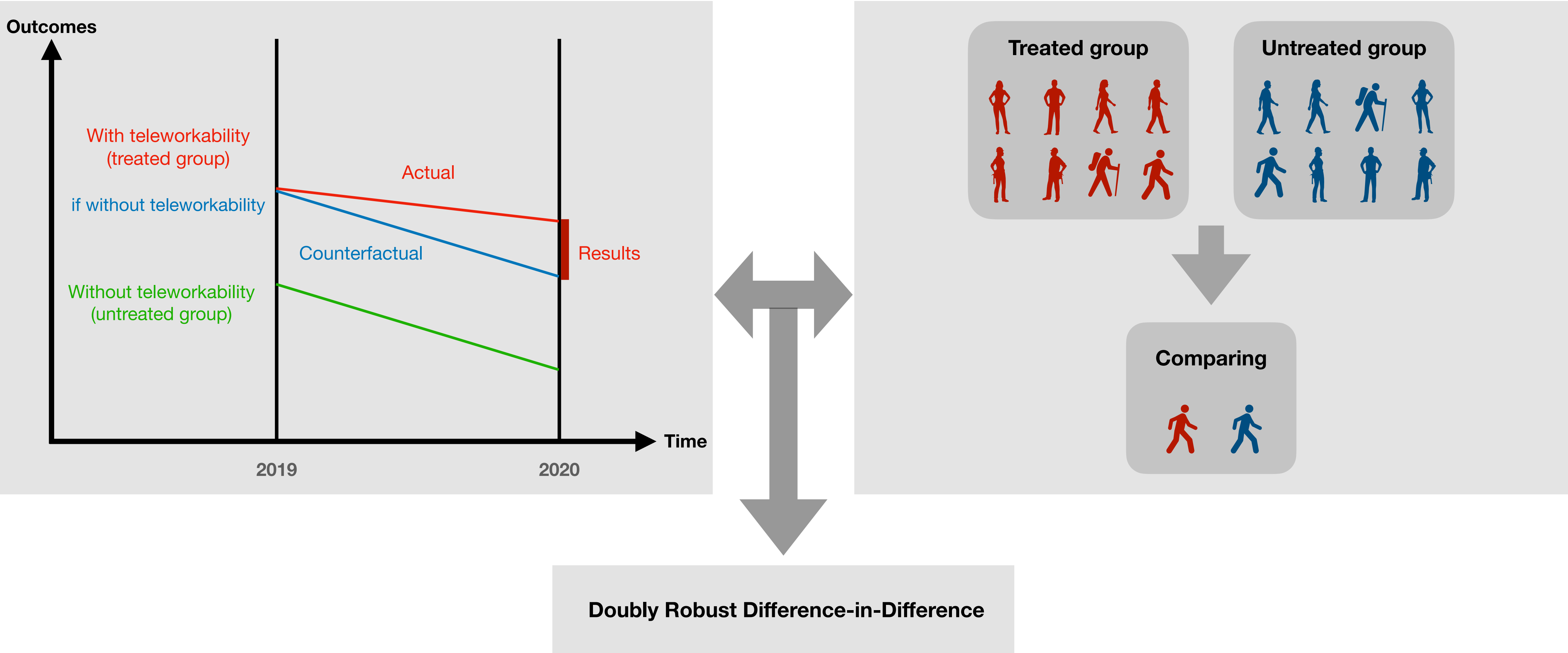
When the covariates are controlled the treated group and the control group will have the same change in outcomes.

3. Common Support Assumption (CSA)

The treated group and the control group have similar probability of being treated.

Model

Intuitive Explanation



Model

Doubly Robust Difference-in-Difference

- DR DID

$$\tau^{dr,p} = \mathbb{E} \left[\left(w_1^p(D) - w_0^p(D, X; \pi) \right) \left(\Delta Y - \mu_{0,\Delta}^p(X) \right) \right],$$

$w_1^p(D) = \frac{D}{\mathbb{E}[D]}$, where $D = 0, 1$. $D_{it} = 1$ if unit i is treated before 2020, $D_{it} = 0$ else;

$w_0^p(D, X; g) = \frac{g(X)(1-D)}{1-g(X)} / \mathbb{E} \left[\frac{g(X)(1-D)}{1-g(X)} \right]$, for any arbitrary g , where X is covariates;

$\pi(X)$ - an arbitrary model for the true or unknown propensity score;

$\Delta Y = Y_1 - Y_0$, where Y_1 is outcomes that with telework ability, Y_0 without;

$\mu_{d,\Delta}^p(X) \equiv \mu_{d,1}^p(X) - \mu_{d,0}^p(X)$, where $\mu_{d,t}^p(x)$ is the true or unknown outcome regression

$m_{d,t}^p(x) \equiv \mathbb{E}[Y_t | D = d, X = x]$, $d, t = 0, 1$.

Results

Employment

The teleworkability on employment		
	(1) Fixed effect	(2) Doubly robust DD
telework	0.179*** (0.021)	0.172*** (0.021)
Observations	15522	8922

Standard errors are in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

- Teleworkability had a positive effect on employment.
- Except Primary group, all the subsamples show significant and positive effect.
- Individuals with the ability to work remotely had 17.2% higher probability of being employed during the COVID-19 as compared to those without the ability to work remotely.

The teleworkability on employment by subsamples										
	(1) Full	(2) Male	(3) Female	(4) Primary	(5) Secondary	(6) Higher	(7) With	(8) Without	(9) Older	(10) Younger
ATT	0.172*** (0.021)	0.138*** (0.029)	0.195*** (0.030)	0.131 (0.108)	0.103*** (0.024)	0.187*** (0.034)	0.167*** (0.031)	0.180*** (0.030)	0.145*** (0.031)	0.181*** (0.028)
Observations	8922	5014	3908	840	5832	1948	3902	4690	3608	5078

Standard errors are in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

Results

Working hours

The teleworkability on working hours

	(1) Fixed effect	(2) Doubly robust DD
telework	0.779*** (0.144)	0.758*** (0.147)
Observations	16048	9438

Standard errors are in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

- Teleworkability had a positive effect on working hours.
- Except Primary group, all the subsamples show significant and positive effect.

$$\exp(0.758) - 1 = 1.13$$

- Individuals with the ability to work remotely worked 113% more hours per month during COVID-19 time compared to those who without teleworkability.

The teleworkability on working hours by subsamples

	(1) Full	(2) Male	(3) Female	(4) Primary	(5) Secondary	(6) Higher	(7) With	(8) Without	(9) Older	(10) Younger
ATT	0.758*** (0.147)	0.745*** (0.208)	0.755*** (0.204)	-0.509 (0.797)	0.595*** (0.199)	0.899*** (0.231)	0.707*** (0.225)	0.747*** (0.200)	0.685*** (0.219)	0.815*** (0.193)
Observations	9438	5056	4382	868	6052	2200	4362	4720	3646	5554

Standard errors are in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

Conclusion

- The results are consistent with the hypotheses. In the time of COVID-19, the ability to work remotely had a positive effect on employment.
- The government should consider issues related to network infrastructure development and communication technology to address the employment pressure during future emergencies.
- The results might be confusing because of the data limitation:
 1. Data is unbalanced.
 2. Common Support Assumption might be violated. Ability to telework is not random, there are differences in teleworkability by gender, age and education.
 3. Conditional Parallel Trends Assumption might be violated. Since regional factors are not taken into account, there might be differences in the anti-COVID-19 policies in different regions, these differences might cause employment and working hours to not have the same changes when controlling covariates.

Thank you

- OR

$$\hat{t}^{reg} = \bar{Y}_{1,1} - \left[\bar{Y}_{1,0} + n_{treat}^{-1} \sum_{i | D_i=1} \left(\hat{\mu}_{0,1}(X_i) - \hat{\mu}_{0,0}(X_i) \right) \right],$$

$\bar{Y}_{1,1}$ - the sample average outcome among units in treated group in 2020,

$\bar{Y}_{1,0}$ in 2019;

n_{treat} - number of treated observations;

$D_i = 1$ - unit i is treated before 2020;

$\hat{\mu}_{0,1}(X_i)$ - estimator of the true or unknown $m_{d,t}(x) \equiv \mathbb{E}[Y_t | D = d, X = x]$,

for untreated group in 2020, $\hat{\mu}_{0,0}(X_i)$ in 2019;

X_i - covariates.

- IPW

$$\hat{\tau}^{ipw,p} = \frac{1}{\mathbb{E}_n[D]} \mathbb{E}_n \left[\frac{D - \hat{\pi}(X)}{1 - \hat{\pi}(X)} (Y_1 - Y_0) \right],$$

$\mathbb{E}_n[Z] = n^{-1} \sum_i^Z Z_i$ for any arbitrary variable Z ;

$D = 0, 1$. $D_{it} = 1$ if unit i is treated before 2020 and $D_{it} = 0$ else;

$\hat{\pi}(X)$ - estimator of the true, unknown $p(X)$;

$p(X) \equiv \mathbb{P}(D = 1 | X)$ - the true or unknown propensity score;

X - covariates;

Y_1 - outcomes that with telework ability, Y_0 without.