# Remote work, wages, and hours worked in the United States
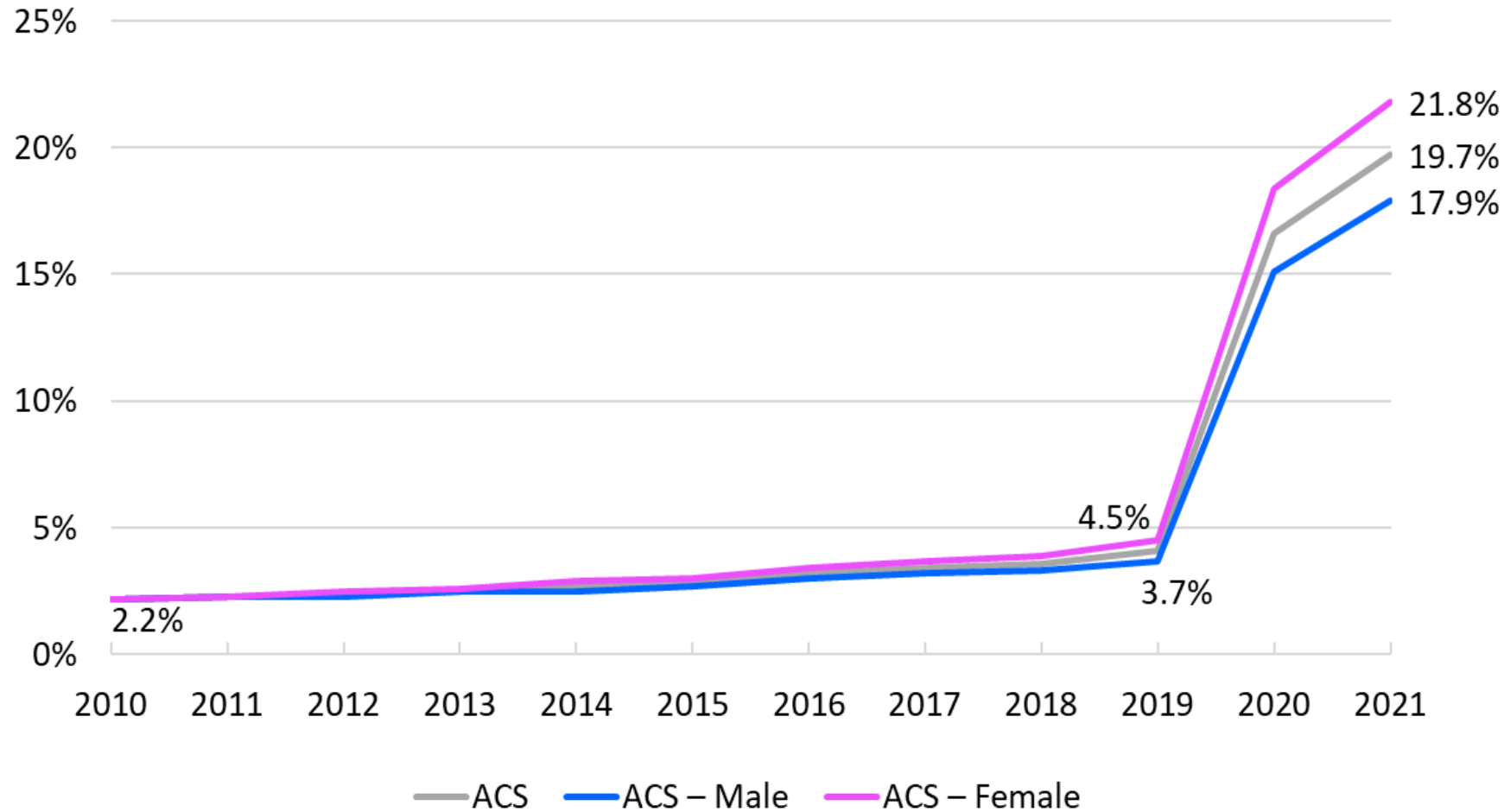
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# Percentage of full-time full-year employees working from home

Remote = primarily work from home



Source: American Community Survey (ACS) 2010–2021 from IPUMS USA version 22.0 (Ruggles et al. 2022).

# Percentage of full-time full-year employees working from home



ATUS: Estimates are % workdays with at least 4 hours of work done exclusively from home among full-time employed
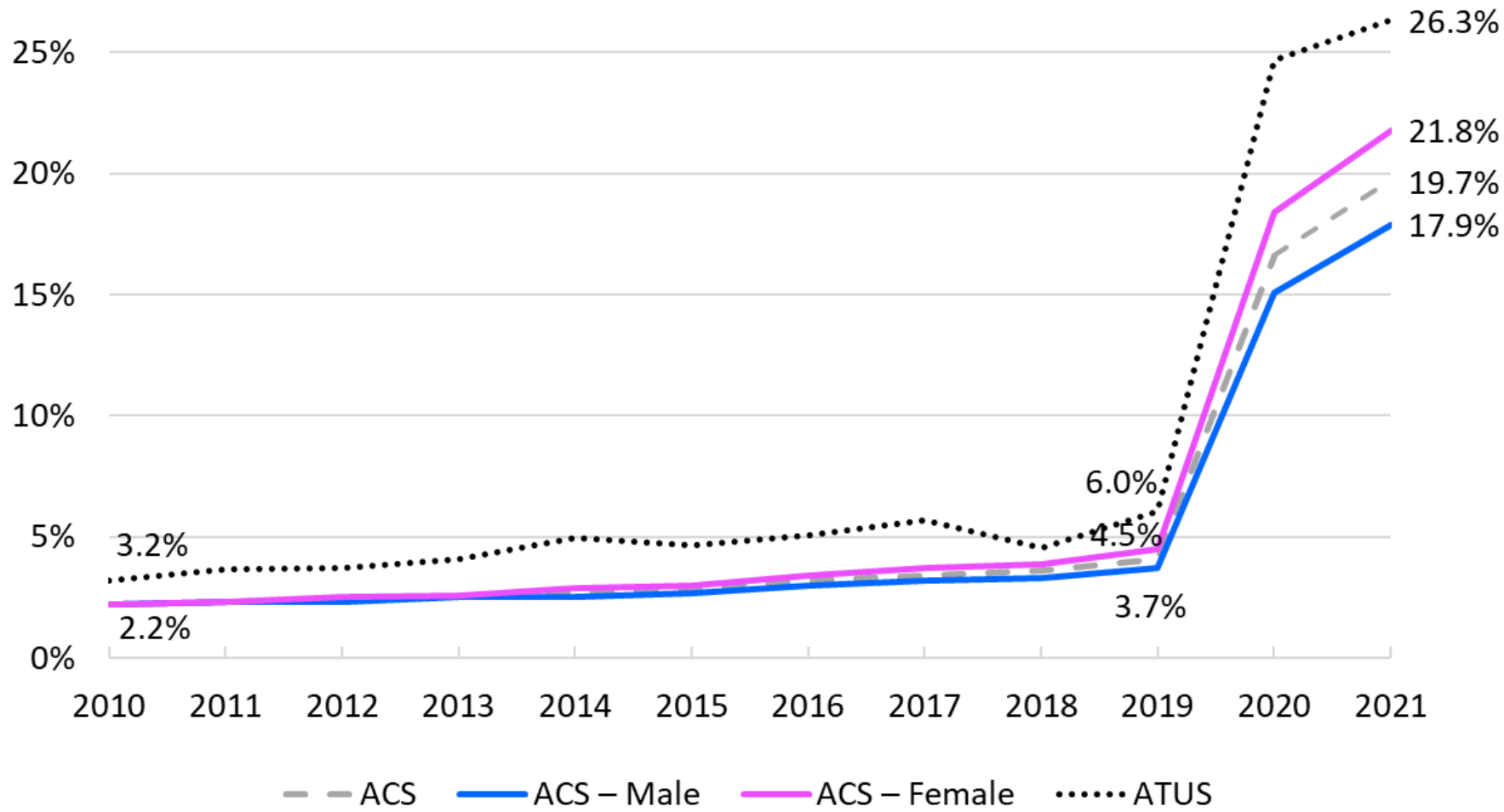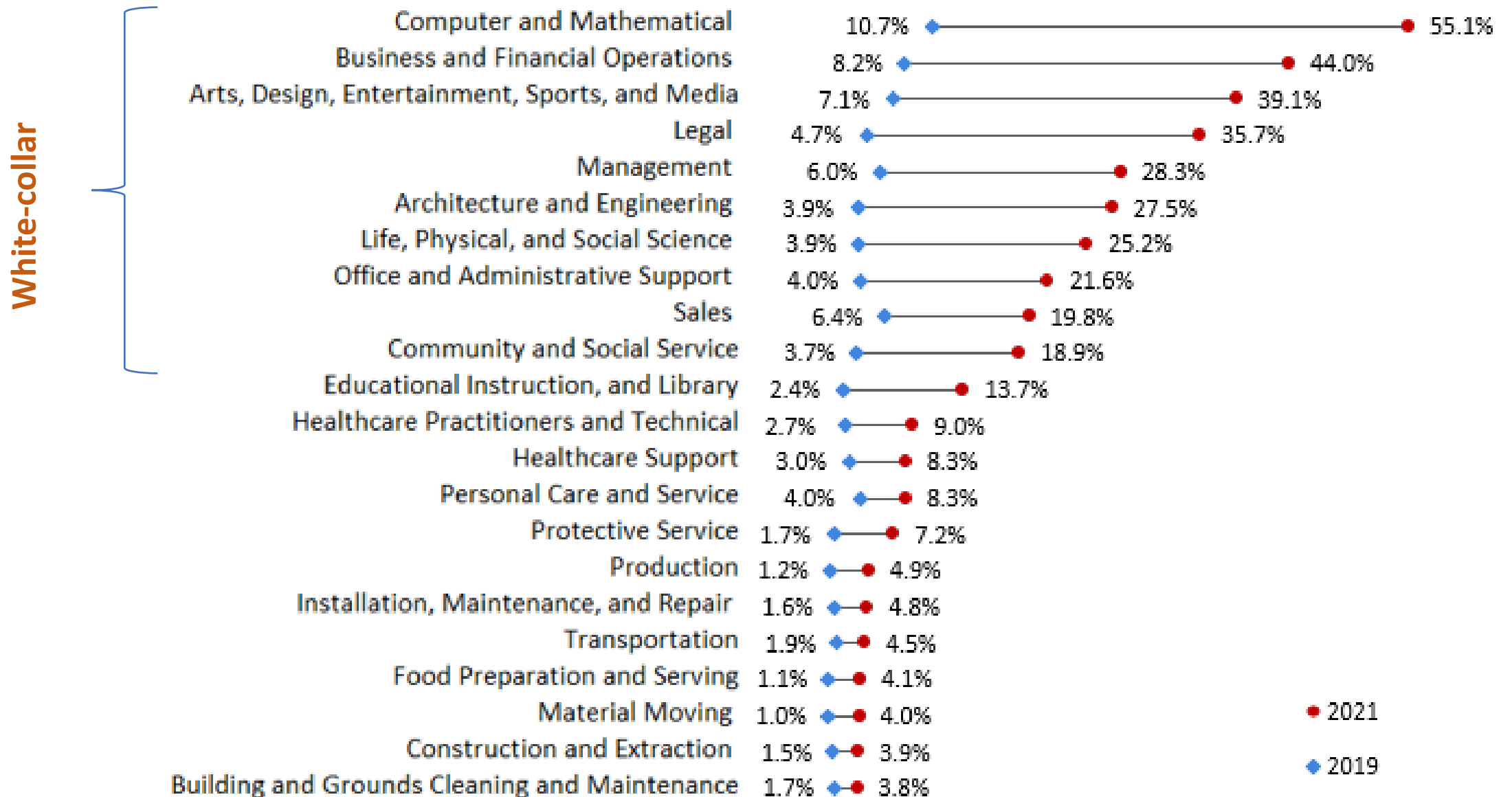
ACS: "How did this person usually get to work LAST WEEK?"

"Worked from home"

Source: American Community Survey (ACS) 2010–2021 from IPUMS USA version 22.0 (Ruggles et al. 2022); American Time Use Survey (ATUS)

# Percentage of remote workers in 2021 was uneven across occupations



White-collar

| Occupation | 2019 | 2021 |
|---|---|---|
| Computer and Mathematical | 10.7% | 55.1% |
| Business and Financial Operations | 8.2% | 44.0% |
| Arts, Design, Entertainment, Sports, and Media | 7.1% | 39.1% |
| Legal | 4.7% | 35.7% |
| Management | 6.0% | 28.3% |
| Architecture and Engineering | 3.9% | 27.5% |
| Life, Physical, and Social Science | 3.9% | 25.2% |
| Office and Administrative Support | 4.0% | 21.6% |
| Sales | 6.4% | 19.8% |
| Community and Social Service | 3.7% | 18.9% |
| Educational Instruction, and Library | 2.4% | 13.7% |
| Healthcare Practitioners and Technical | 2.7% | 9.0% |
| Healthcare Support | 3.0% | 8.3% |
| Personal Care and Service | 4.0% | 8.3% |
| Protective Service | 1.7% | 7.2% |
| Production | 1.2% | 4.9% |
| Installation, Maintenance, and Repair | 1.6% | 4.8% |
| Transportation | 1.9% | 4.5% |
| Food Preparation and Serving | 1.1% | 4.1% |
| Material Moving | 1.0% | 4.0% |
| Construction and Extraction | 1.5% | 3.9% |
| Building and Grounds Cleaning and Maintenance | 1.7% | 3.8% |

● 2021
♦ 2019

# Research questions

- Do remote workers earn higher/lower wages?

- Do remote workers work longer/shorter hours?

- How did remote/on-site wage differentials change during the pandemic?

- How did hours worked of remote workers change compared to on-site workers?

- Do trends vary by gender, occupation, and other demographic characteristics?

- Did wages of remote workers grow slower or faster than wages of on-site workers?

# Theory: Wage penalty or premium for WFH?

- **Penalty**
  - Compensating differential story: Workers are willing to pay for WFH because WFH = job amenity (Mas & Pallais, 2017)
  - Less productive workers may select into WFH (Emanuel & Harrington, 2023; Pabilonia & Vernon, 2022)
  - Workers are less productive WFH with children present (Pabilonia & Vernon, 2023)

- **Premium**
  - WFH increased worker productivity via reduced commute and better work environment
  - WFH reduces costs for employers: office space, commute reimbursements
  - WFH increases costs for workers of maintaining workspace
  - WFH is socially isolating - job disamenity

- Oettinger (2011), White (2019)  American Community Survey (ACS) 1980 – 2014
  - "Home-based workers" paid a wage penalty, which shifted to a small wage premium by 2014
- Barrero et al. (2022): wage growth is lower in high-WFH jobs→ lower inflation

# American Community Survey (ACS) 2010-21

- Civilian non-institutionalized aged 25–64
- Full-time, wage and salary employees who worked at least 48 weeks over the prior 12 months in the nonfarm sector.
- Hourly wages = Total pre-tax wage and salary income for the past 12 months/ the product of weeks worked over the past 12 months and usual hours worked each week
- Hourly wages may be measured with error with respect to remote work because of the different reference period (last 12 months for income versus last week for WFH).
- Nominal wages are converted to real dollars using a two-year moving average of the CPI-U.
- Dropped top and bottom 1% of wages.

**Number of observations**

| Year | On-site | Remote | Total |
|------|---------|--------|-------|
| 2010 | 738,575 | 16,815 | 755,390 |
| 2011 | 721,485 | 16,863 | 738,348 |
| 2012 | 734,310 | 18,536 | 752,846 |
| 2013 | 752,475 | 20,411 | 772,886 |
| 2014 | 756,556 | 21,663 | 778,219 |
| 2015 | 769,757 | 23,667 | 793,424 |
| 2016 | 775,567 | 26,648 | 802,215 |
| 2017 | 794,700 | 29,178 | 823,878 |
| 2018 | 805,290 | 31,191 | 836,481 |
| 2019 | 810,534 | 35,757 | 846,291 |
| 2020 | 545,746 | 98,540 | 644,286 |
| 2021 | 632,995 | 162,034 | 795,029 |
| | | | |
| Total | 8,837,990 | 501,303 | 9,339,293 |

# Widening of the raw wage gap during the pandemic

Nominal wages
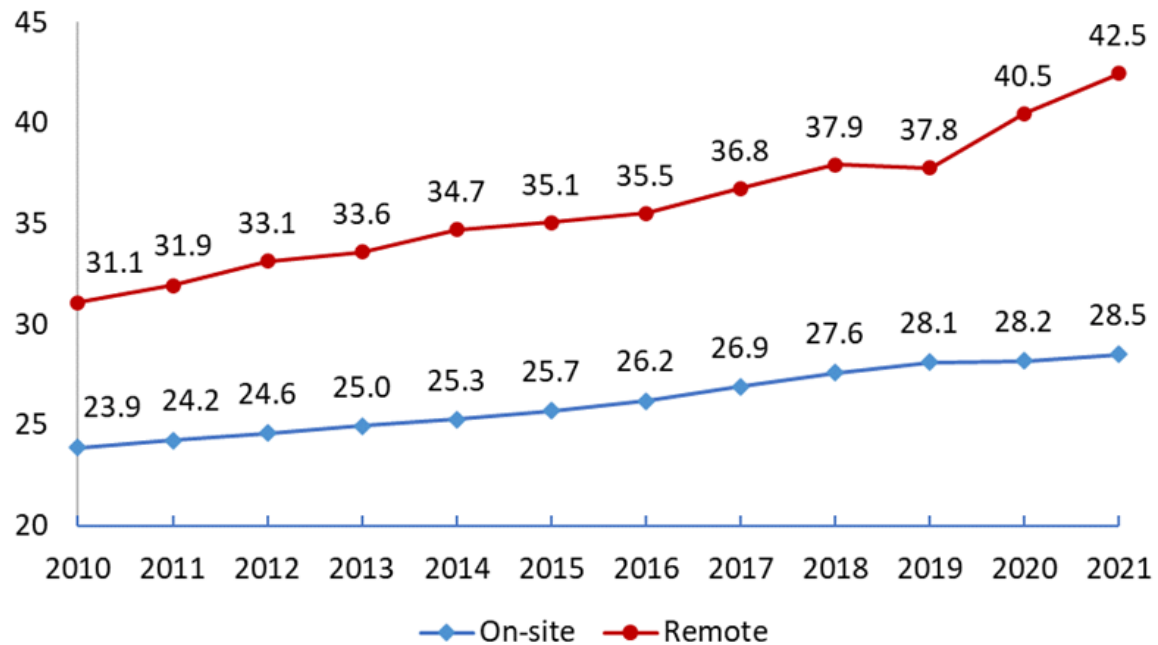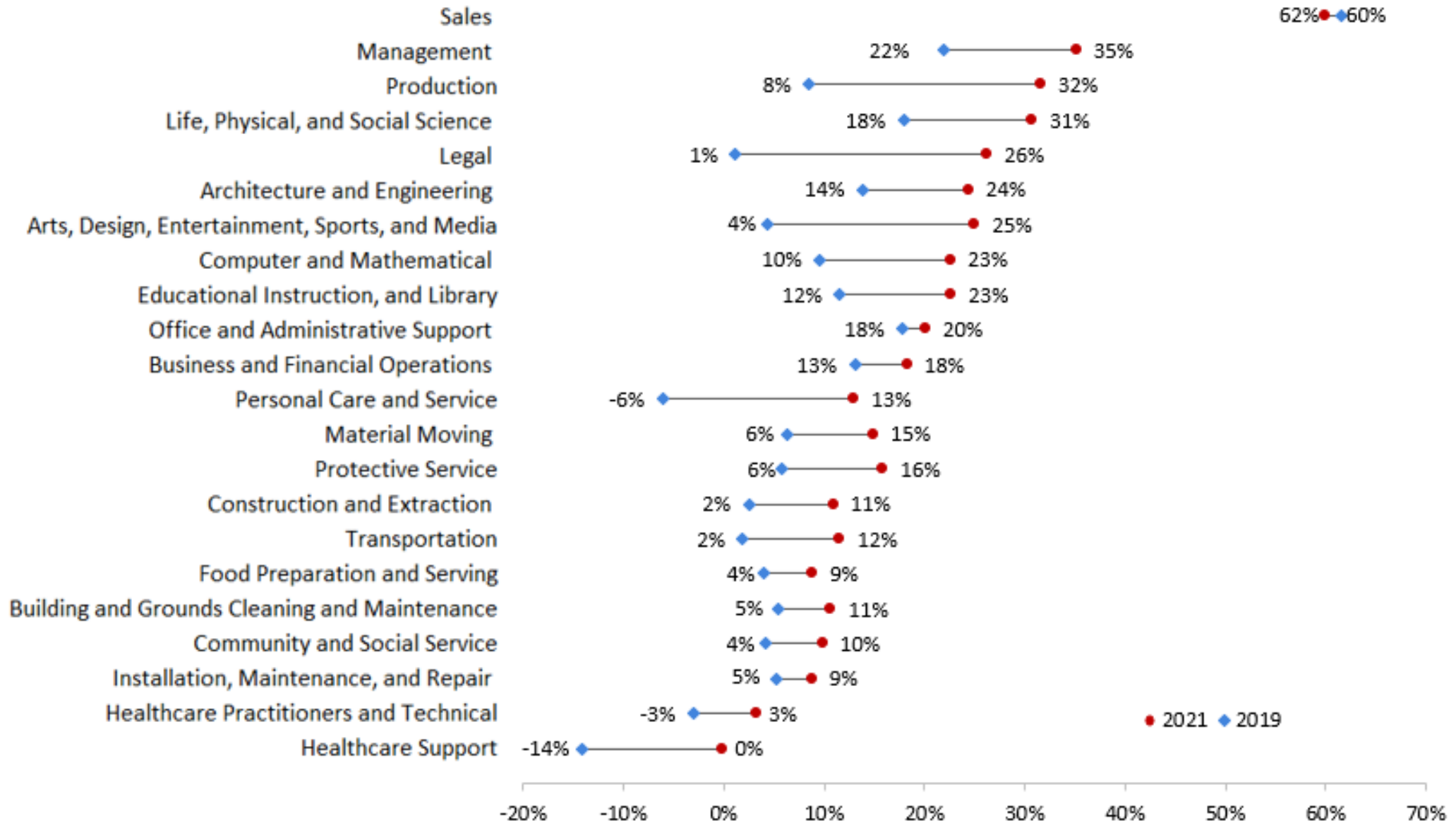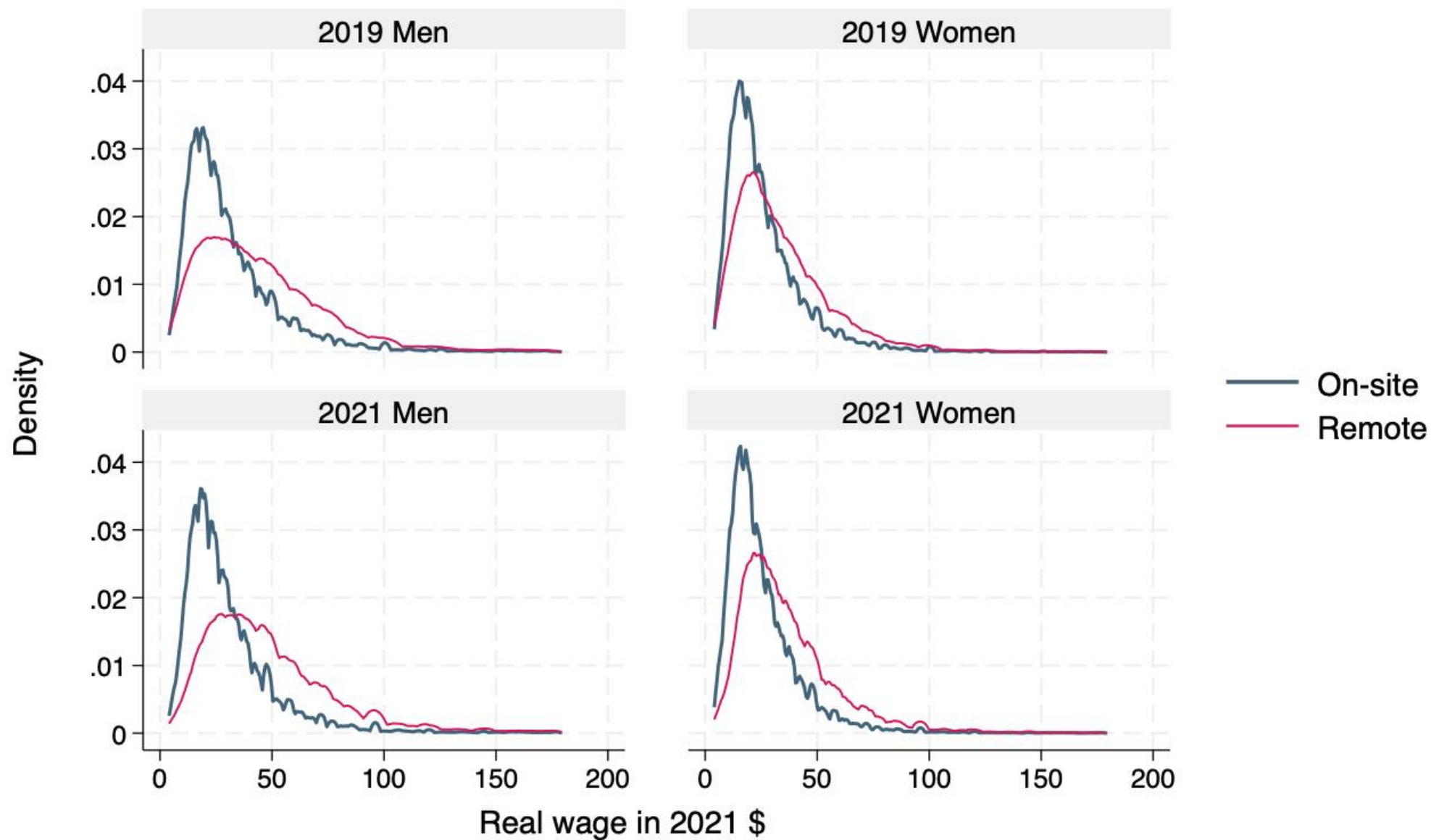
Real wages
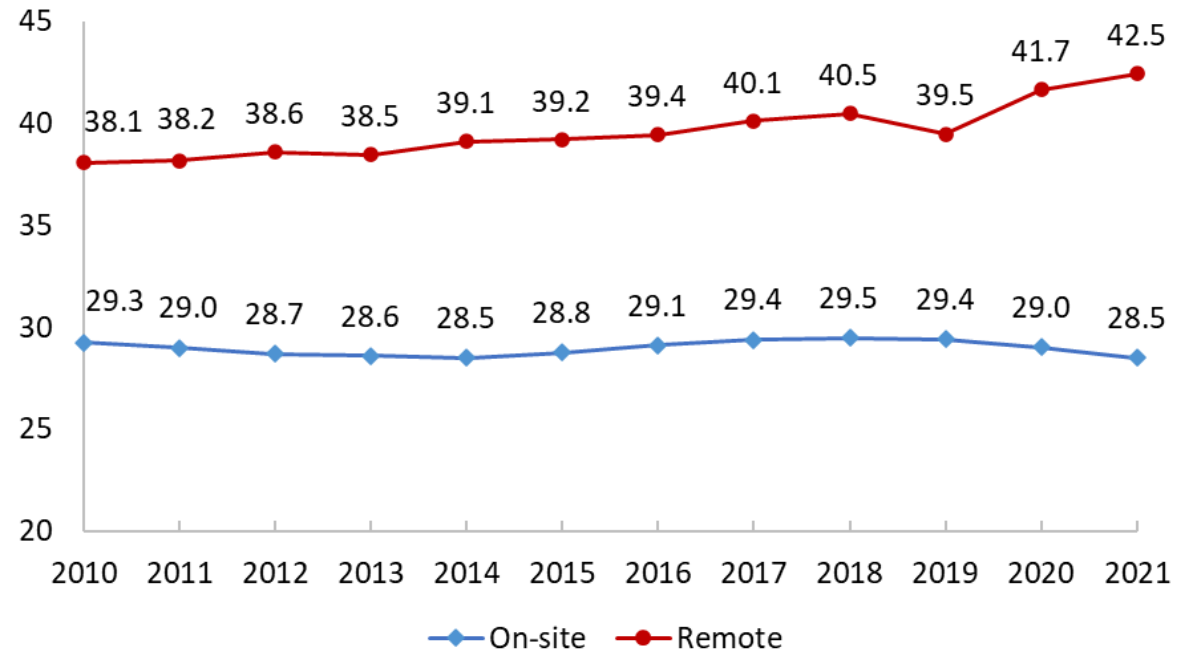


- On average, real wages rose for remote workers but fell slightly for on-site workers

# Raw wage premia for remote workers rose in 22 out of 23 occupations between 2019 and 2021



| Occupation | 2019 | 2021 |
|---|---|---|
| Sales | 60% | 62% |
| Management | 22% | 35% |
| Production | 8% | 32% |
| Life, Physical, and Social Science | 18% | 31% |
| Legal | 1% | 26% |
| Architecture and Engineering | 14% | 24% |
| Arts, Design, Entertainment, Sports, and Media | 4% | 25% |
| Computer and Mathematical | 10% | 23% |
| Educational Instruction, and Library | 12% | 23% |
| Office and Administrative Support | 18% | 20% |
| Business and Financial Operations | 13% | 18% |
| Personal Care and Service | -6% | 13% |
| Material Moving | 6% | 15% |
| Protective Service | 6% | 16% |
| Construction and Extraction | 2% | 11% |
| Transportation | 2% | 12% |
| Food Preparation and Serving | 4% | 9% |
| Building and Grounds Cleaning and Maintenance | 5% | 11% |
| Community and Social Service | 4% | 10% |
| Installation, Maintenance, and Repair | 5% | 9% |
| Healthcare Practitioners and Technical | -3% | 3% |
| Healthcare Support | -14% | 0% |

● 2021  ◆ 2019

-20%   -10%   0%   10%   20%   30%   40%   50%   60%   70%

# Kernel density estimates, 2019 and 2021

Usual hours worked by remote and on-site workers converged
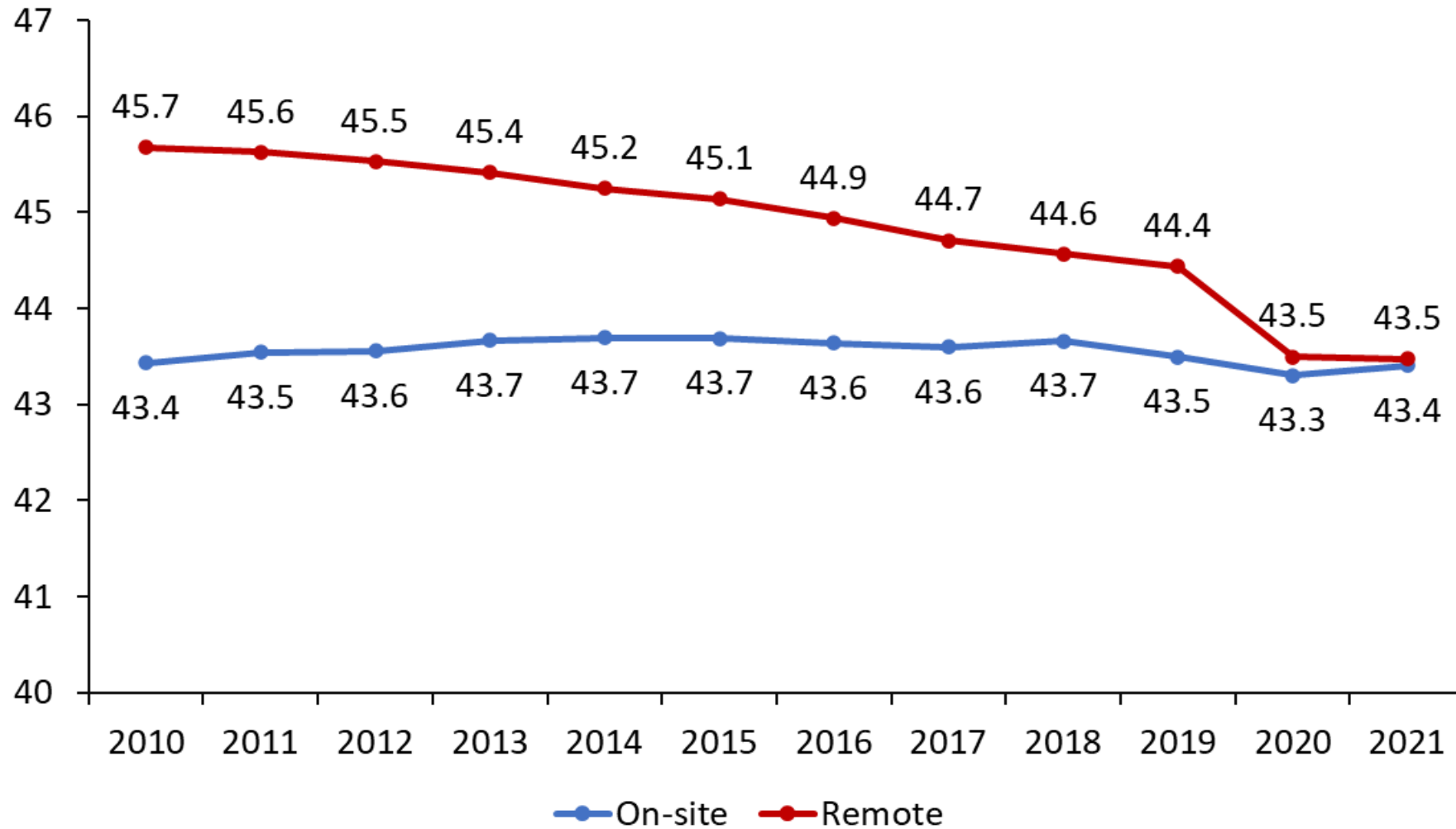
# Log wage and log hours regressions

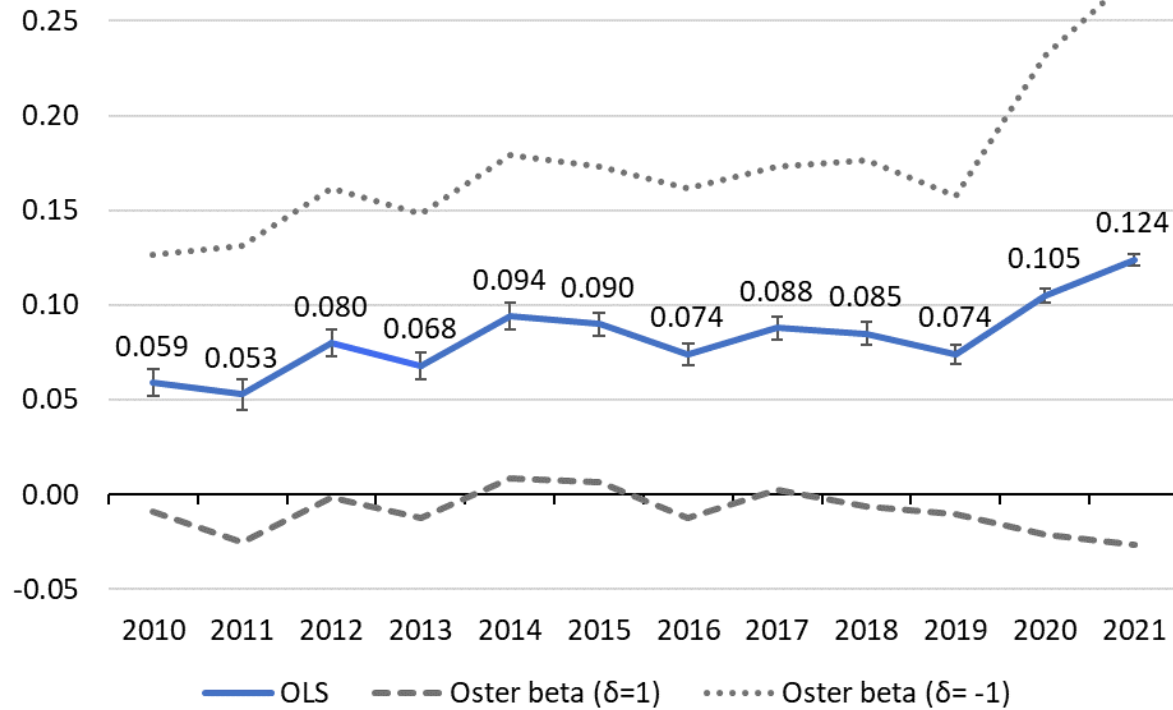$$\ln(Y_{it}) = \alpha + \beta Remote_{it} + \gamma X_{it} + \varepsilon_{it}$$

- $Y$ is either hourly wage or usual hours worked
- Remote is a binary indicator for working from home from commute question.
- $X$ includes a quadratic in age, number of own children under age 5, number of own children aged 5 to 17, number of adult family members, and binary indicators for educational attainment (less than high school, some college, bachelor's degree, and master's degree or higher), non-Hispanic Black, Hispanic, married, cohabiting, disability, living with a partner/parent with a disability, government employee, 21 occupation groups, 18 industry groups, lives in a MSA, and 8 Census divisions.
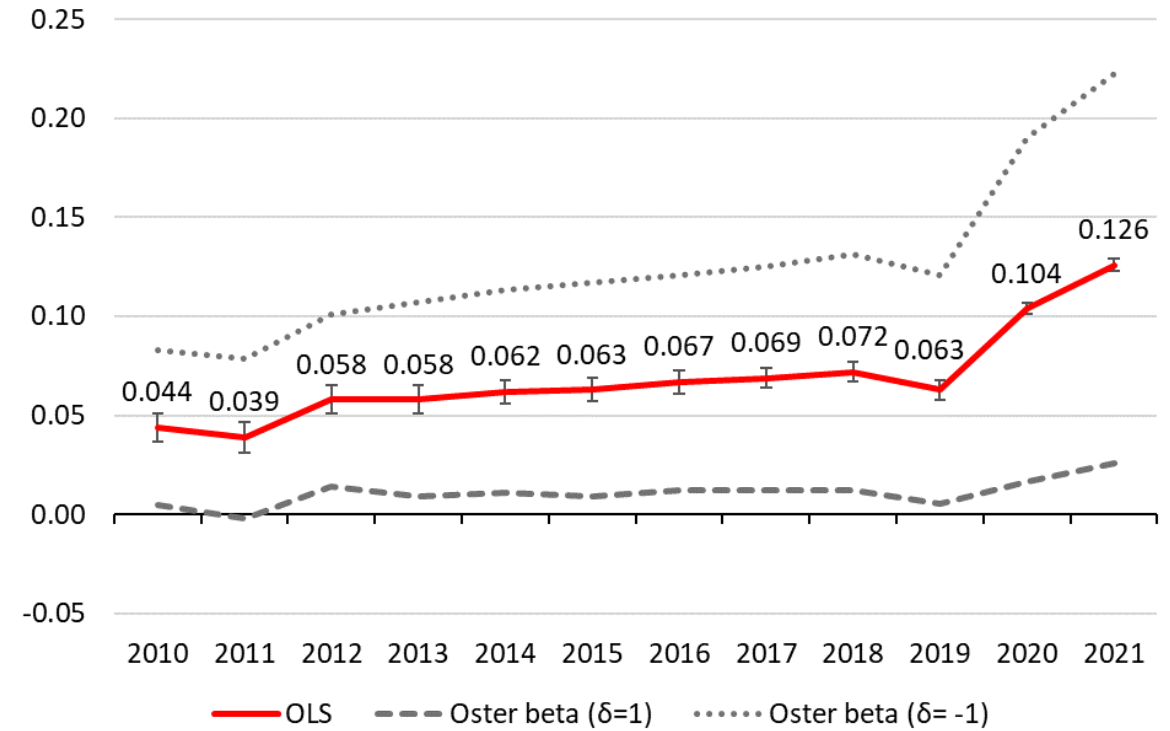
# Correcting for selection

- Our specification does not control for worker motivation or productivity, tenure, firm size, risk aversion, etc., which may be correlated with remote work and wages/hours.

- Use Oster's method relating selection on observables to selection on unobservables to assess the importance of omitted variables for our estimates.

  - Calculate Oster betas.

    - Places bounds on the coefficient estimates.

    - Our estimates are robust to omitted variable bias if the bounds do not include zero.

- For 2021, we estimate a linear model with an endogenous binary treatment using full maximum likelihood.

  - Instrument for remote using the percentage of remote workers in the same 3-digit occupation.
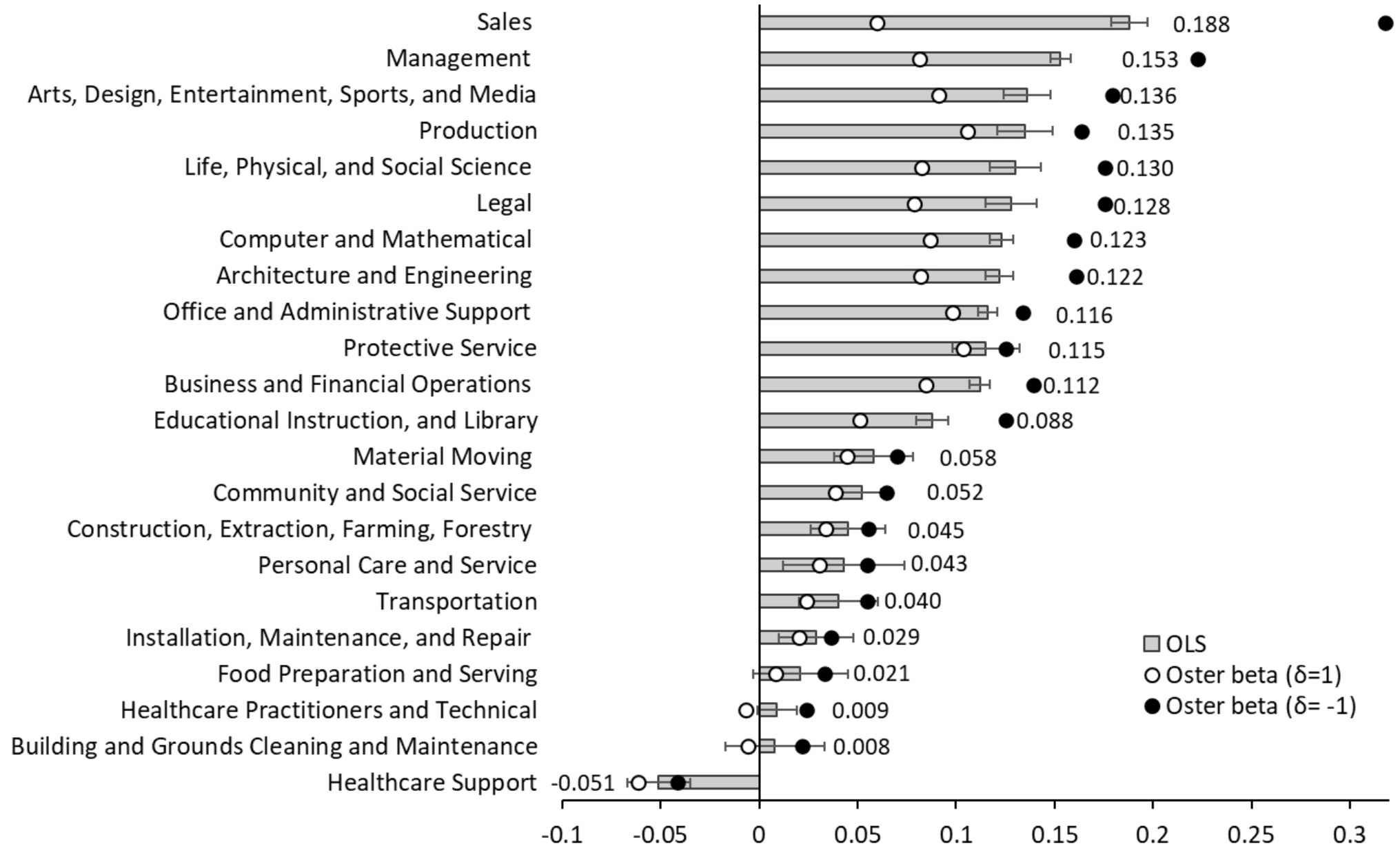
# Wage premia and Oster betas

Men

Women

# 2021 Wage differentials and Oster betas by major occupation groups



| | |
|---|---|
| Sales | 0.188 |
| Management | 0.153 |
| Arts, Design, Entertainment, Sports, and Media | 0.136 |
| Production | 0.135 |
| Life, Physical, and Social Science | 0.130 |
| Legal | 0.128 |
| Computer and Mathematical | 0.123 |
| Architecture and Engineering | 0.122 |
| Office and Administrative Support | 0.116 |
| Protective Service | 0.115 |
| Business and Financial Operations | 0.112 |
| Educational Instruction, and Library | 0.088 |
| Material Moving | 0.058 |
| Community and Social Service | 0.052 |
| Construction, Extraction, Farming, Forestry | 0.045 |
| Personal Care and Service | 0.043 |
| Transportation | 0.040 |
| Installation, Maintenance, and Repair | 0.029 |
| Food Preparation and Serving | 0.021 |
| Healthcare Practitioners and Technical | 0.009 |
| Building and Grounds Cleaning and Maintenance | 0.008 |
| Healthcare Support | -0.051 |

□ OLS
O Oster beta (δ=1)
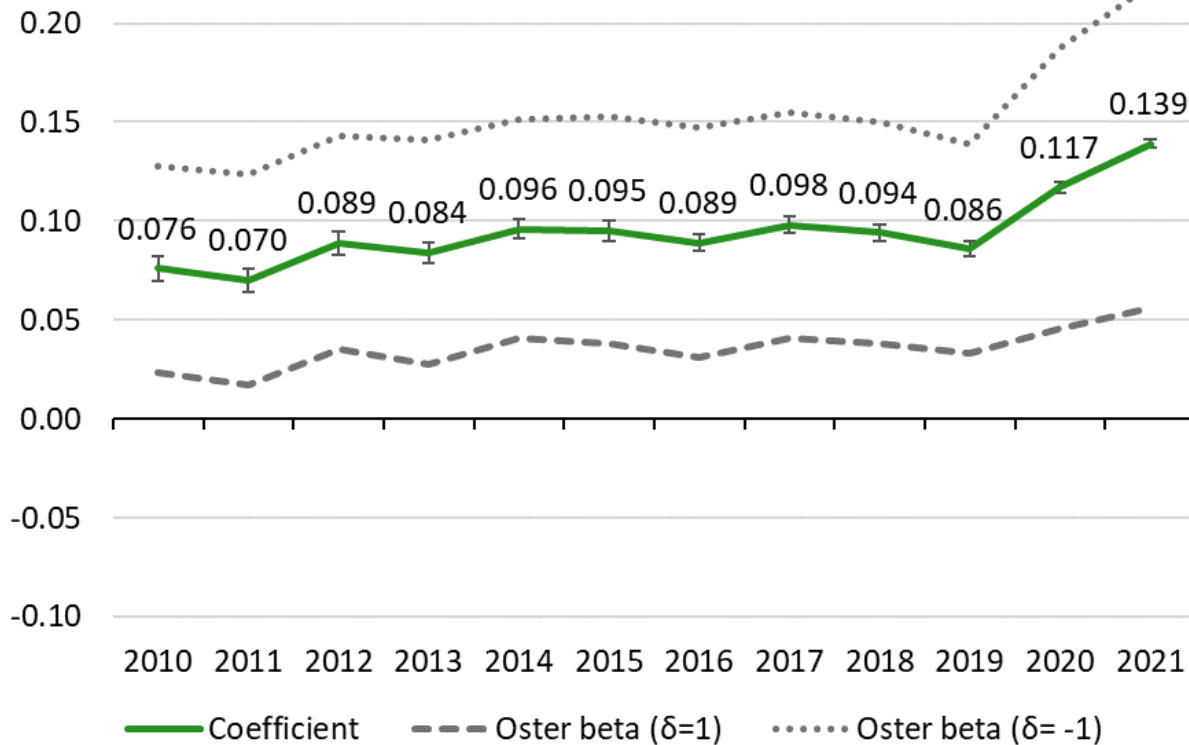● Oster beta (δ= -1)

-0.1  -0.05  0  0.05  0.1  0.15  0.2  0.25  0.3

# Decompositions of changes over time in the remote employment share and the mean log wage gap between remote and on-site workers, by time period

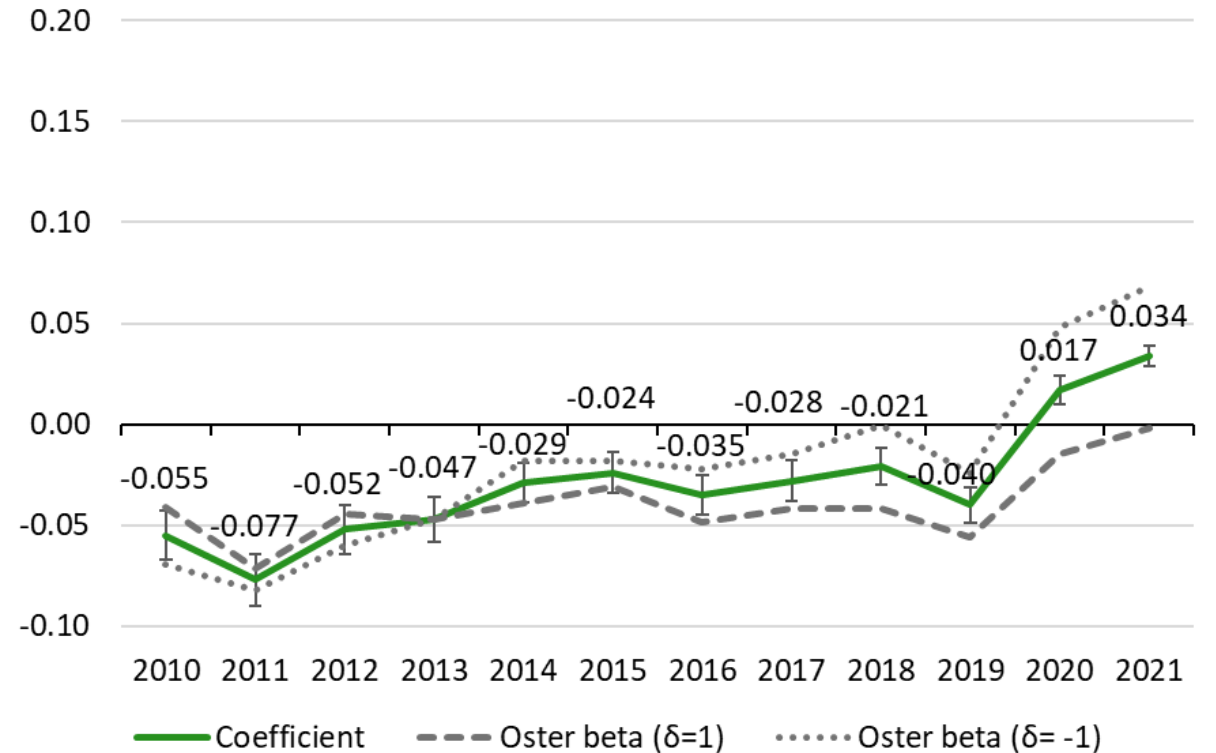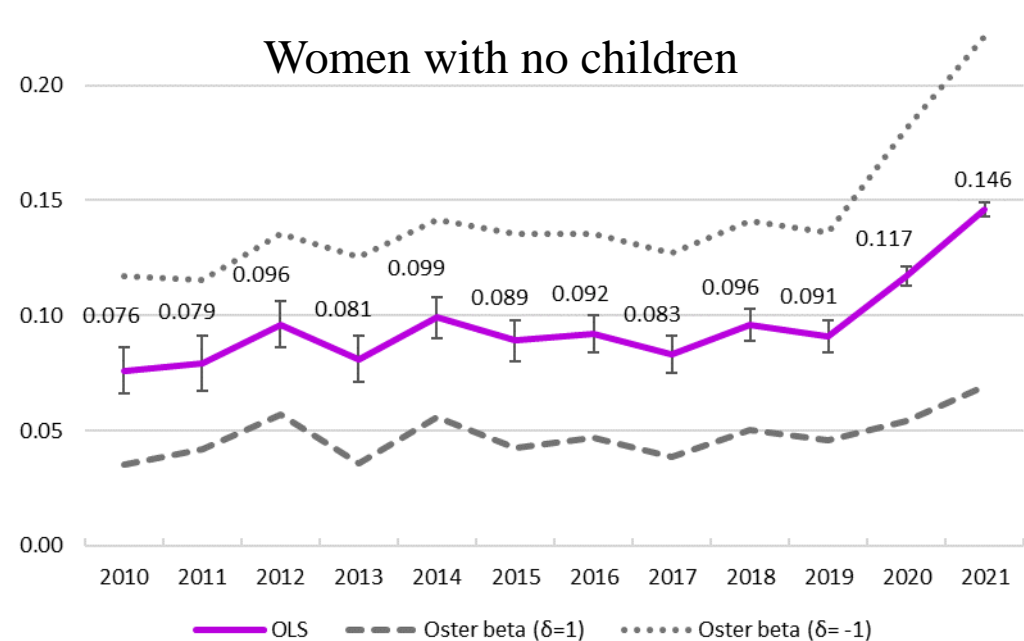|  | 2010-19 | 2019-21 |
|---|---|---|
| **Total change in remote employment share** | **0.0185** | **0.1569** |
| Part due to changes in the composition of wage and salary employment across occupations | 0.0004 | 0.0058 |
| Part due to changes in remote employment shares within occupations | 0.0189 | 0.1511 |
| **Total change in mean log wage gap between remote and onsite workers** | **0.0567** | **0.1185** |
| Part due to changes in the mean observed skill gap between remote workers and onsite workers | 0.0294 | 0.0793 |
| Part due to changes in the returns to observed skills, given the mean gap in observed skills | 0.0107 | -0.0213 |
| Part due to changes in the composition of remote employment across occupations | -0.0028 | 0.0032 |
| Part due to changes in remote wage premia within occupations | 0.0195 | 0.0573 |

# White-collar and blue-collar wage differentials and Oster betas
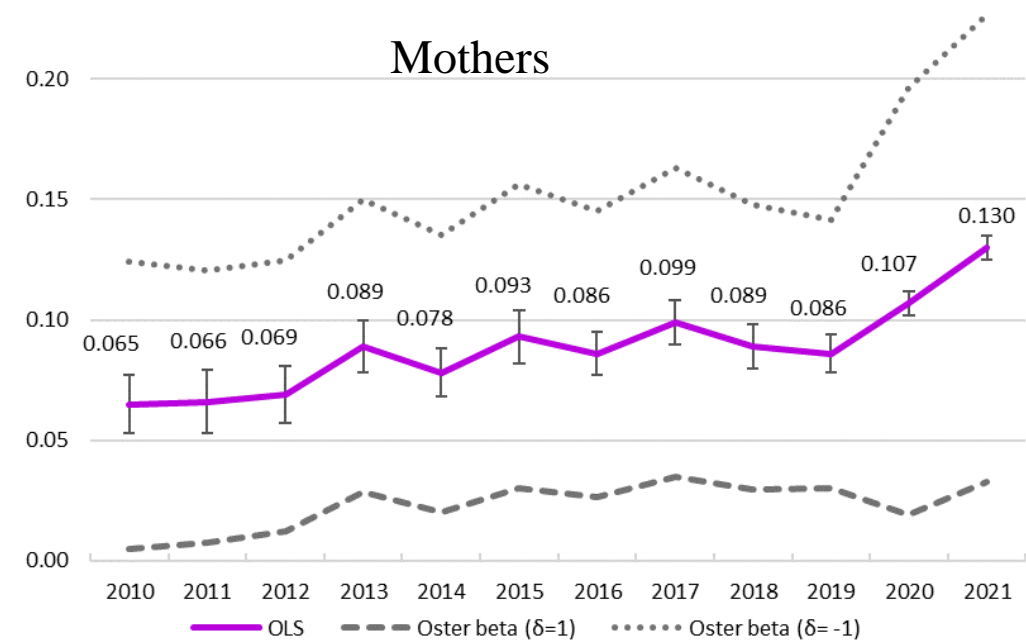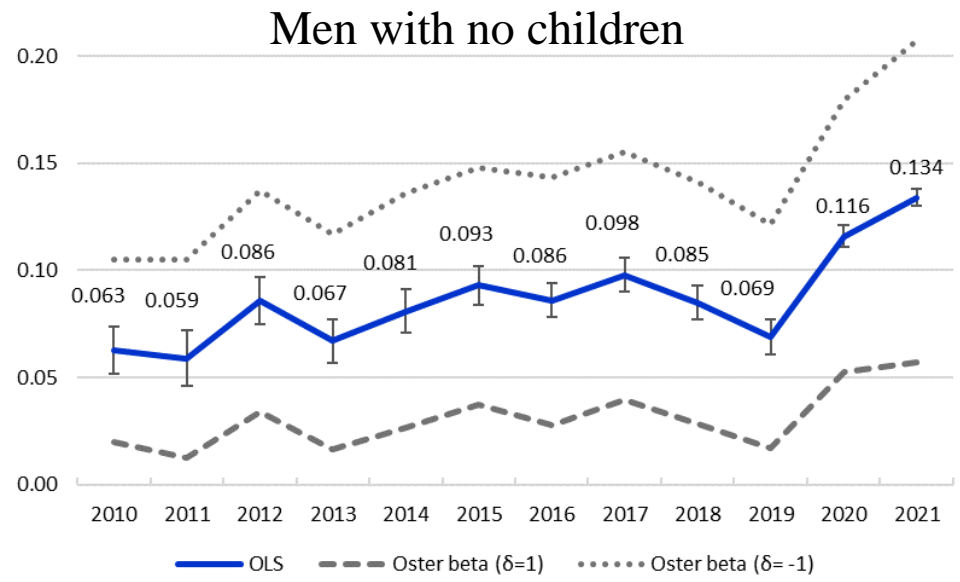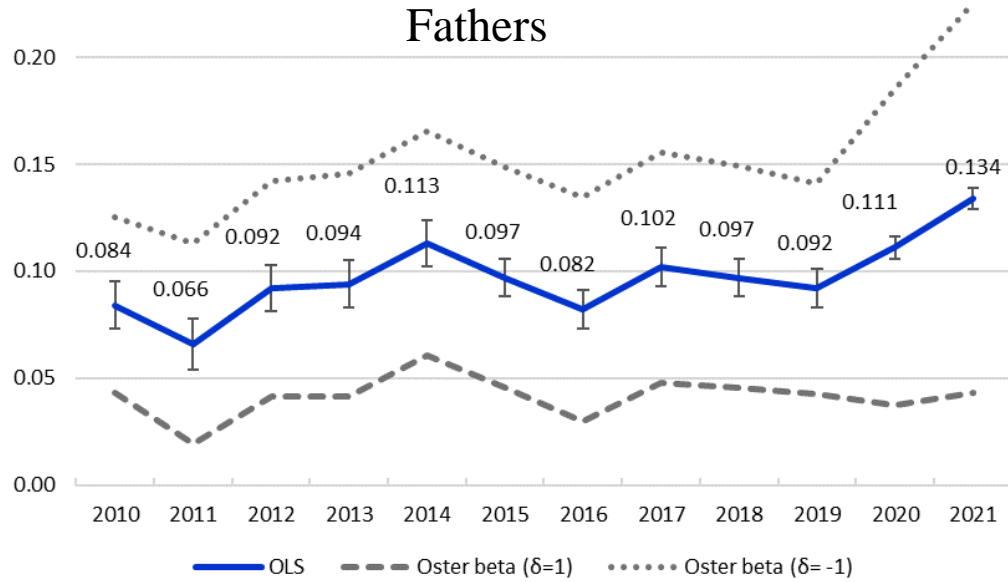


White-collar Occupations

Blue-collar Occupations

# White-collar workers by parental status: Wage premia and Oster betas



**Fathers**

OLS values: 0.084, 0.066, 0.092, 0.094, 0.113, 0.097, 0.082, 0.102, 0.097, 0.092, 0.111, 0.134

Legend: OLS — Oster beta (δ=1) ⋯ Oster beta (δ= -1)

**Men with no children**

OLS values: 0.063, 0.059, 0.086, 0.067, 0.081, 0.093, 0.086, 0.098, 0.085, 0.069, 0.116, 0.134

Legend: OLS — Oster beta (δ=1) ⋯ Oster beta (δ= -1)

**Mothers**

OLS values: 0.065, 0.066, 0.069, 0.089, 0.078, 0.093, 0.086, 0.099, 0.089, 0.086, 0.107, 0.130

Legend: OLS — Oster beta (δ=1) ⋯ Oster beta (δ= -1)

**Women with no children**

OLS values: 0.076, 0.079, 0.096, 0.081, 0.099, 0.089, 0.092, 0.083, 0.096, 0.091, 0.117, 0.146
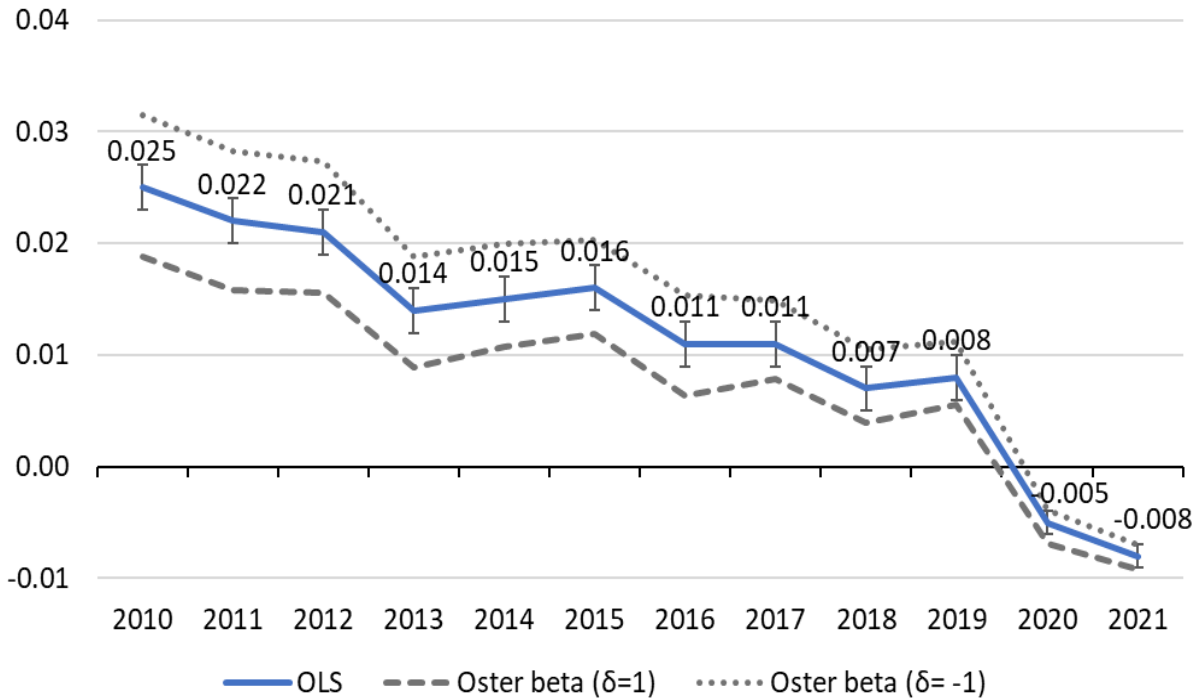
Legend: OLS — Oster beta (δ=1) ⋯ Oster beta (δ= -1)

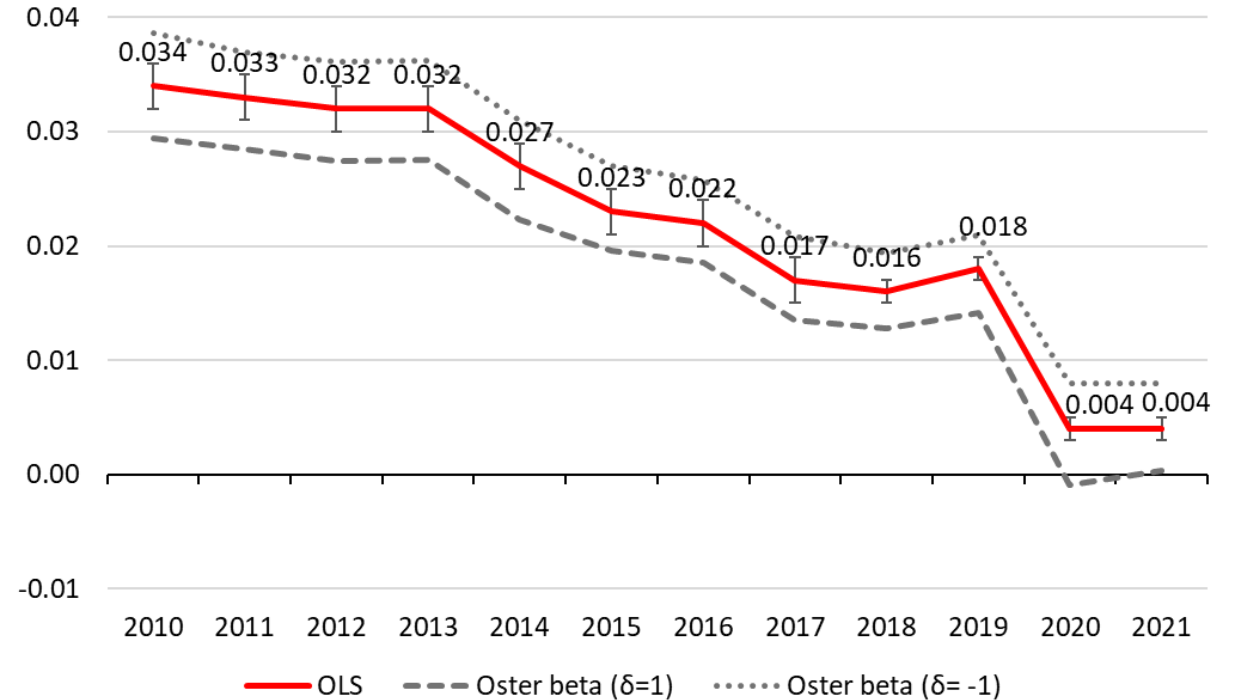# Wages: 2021 coefficient on remote worker and Oster betas, subsamples of white-collar workers
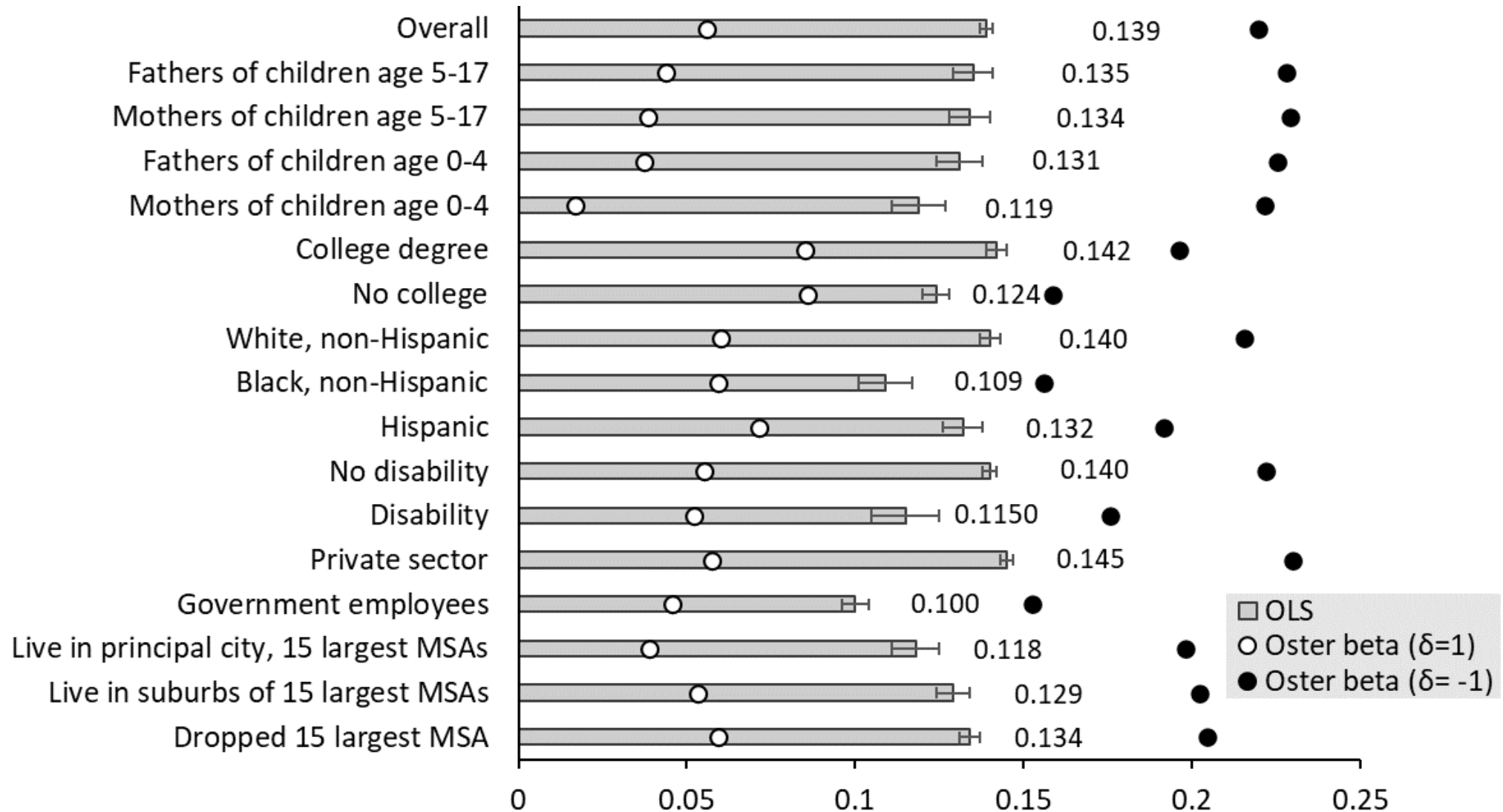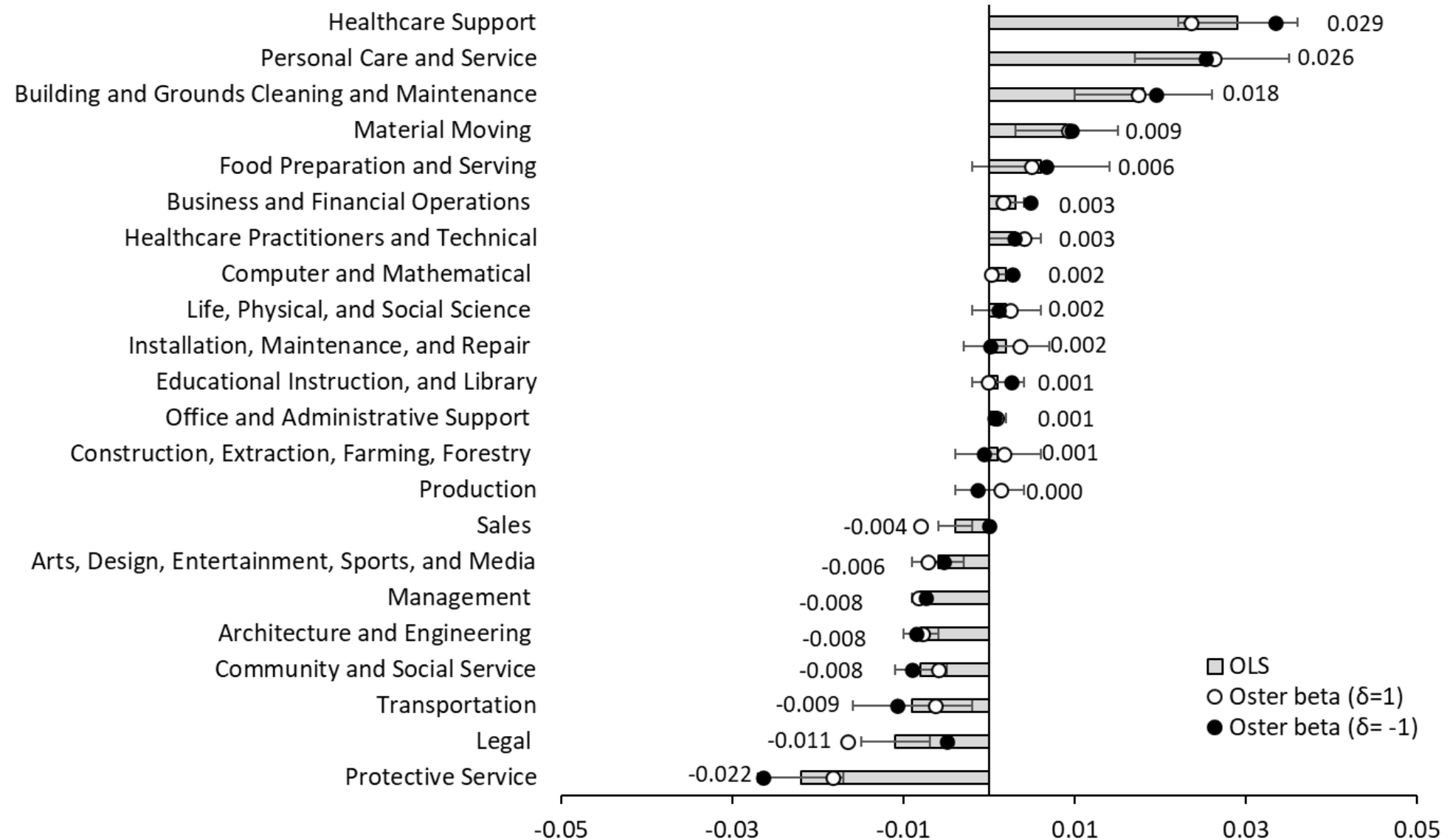
**Hours differentials and Oster betas**

Men
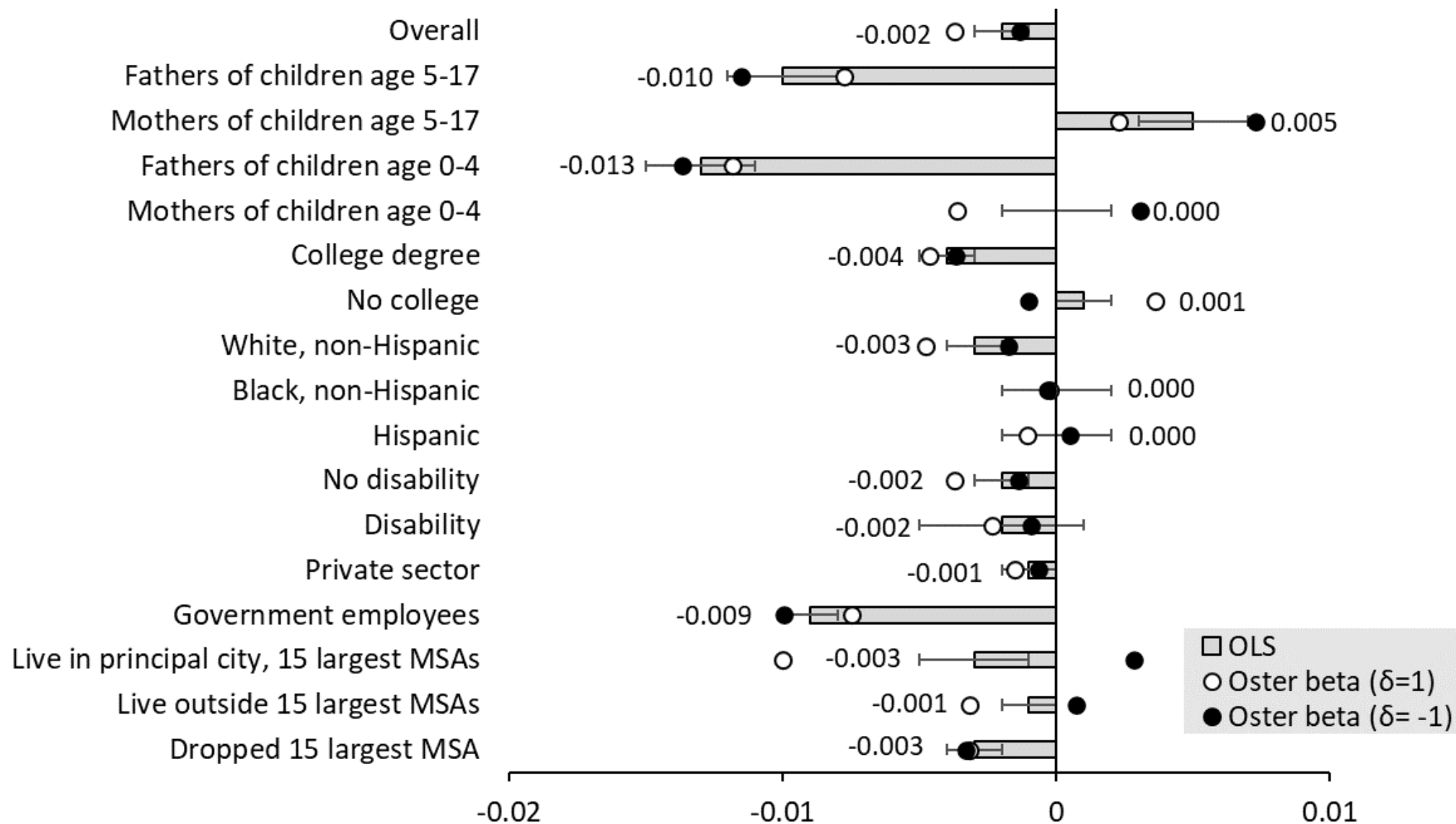
Women

# 2021 Hours differentials and Oster betas by major occupation group

# Hours worked: 2021 remote worker coefficient and Oster betas, subsamples of white-collar workers

## Instrumental variable estimates (2021)

|  | Log wages | | Log hours worked | |
|---|---|---|---|---|
|  | **Men** | **Women** | **Men** | **Women** |
| IV | 0.377*** | 0.330*** | -0.031*** | 0.004 |
|  | (0.034) | (0.032) | (0.010) | (0.014) |
| ρ | -0.307*** | -0.267*** | 0.088*** | 0.001 |
|  | (0.039) | (0.044) | (0.034) | (0.059) |
| P value for Wald test that ρ=0 | 0.001 | 0.001 | 0.009 | 0.980 |
| *First stage instrument* | | | | |
| Share of remote workers by detailed occupation | 2.403*** | 2.646*** | 2.193*** | 2.565*** |
|  | (0.101) | (0.109) | (0.079) | (0.130) |
| OLS | 0.124*** | 0.126*** | -0.008*** | 0.004*** |
|  | (0.003) | (0.003) | (0.001) | (0.001) |
| Unconditional mean difference | 0.465*** | 0.366*** | -0.005*** | 0.015*** |
|  | (0.003) | (0.003) | (0.001) | (0.001) |

Note: Standard errors are clustered at the occupation level. Wald tests of exclusion restriction are significant, p<0.001.

# Detailed Occupation-level Wage Growth Analysis

- Did wages grow faster or slower during the pandemic for remote workers relative to on-site workers **within** occupations?
  - Between 2019 and 2021, average real wages grew 3.4% faster for remote workers than on-site workers within detailed occupation groups.
- Is wage growth **across** occupations related to the rise in remote work?

## Occupation-level wage growth between 2019 and 2021 for remote versus on-site workers

|  | Log Mean Wage | Log Mean Wage |
|---|---|---|
| Remote | 0.124*** | 0.013 |
|  | (0.019) | (0.012) |
| Year 2021 | -0.011*** | 0.001 |
|  | (0.004) | (0.003) |
| Remote × Year 2021 | 0.037** | 0.020* |
|  | (0.014) | (0.011) |
| Controls | No | Yes |
| R-squared | 0.991 | 0.997 |
| *Joint hypothesis test:* |  |  |
| Remote + Remote × Year 2021 | 0.160*** | 0.033*** |
|  | (0.013) | (0.008) |

Note: N = 1,176 (294 occupations). Regressions also include occupation indicators. Observations are weighted using the sum of the person weights for each cell. Standard errors clustered at the occupation level.

# Wage growth across occupations by the change in remote workers, 2019–2021



- The average percent of remote workers across occupations increased by 15.4 pp during the pandemic.

- Thus, the rise in remote work is associated with an 0.4 pp increase in occupation-level wage growth.

- Mean wage growth = 1.7%

# Key Takeaways

- There was a substantial **jump** in the wage premium for remote workers during the pandemic.
  - In 2021, on average, primarily remote workers earned 13.4% more than office-based workers, with even larger premia for remote workers in management, computer science and math, legal, and sales occupations.
  - Among white-collar occupations with over 10% of workers working remotely in 2021, fathers of young children working remotely earned 14.7% while mothers of young children working remotely earned 13.0%.

- Between 2019 and 2021, average real wages grew 3.4 percent faster for remote workers than on-site workers **within** detailed occupation groups.

- The increase in the percentage of remote workers during the pandemic is **positively** correlated with the growth in occupation-level wages.

# Key Takeaways

- Usual hours worked by remote workers and the hours differential decreased steadily from 2010 to 2021.
  - In 2019, men working remotely worked 15 minutes longer than men working on-site. By 2021, men working remotely worked 13 fewer minutes.
  - In 2019, women working remotely worked 46 minutes longer than women working on-site. In 2021, women working remotely worked 10 minutes more.
- The data supports productivity effects and not a compensating differentials story.