Productivity and Welfare Implications of the Shift to WFH

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Executive Summary

We use data from our ***Survey of Working Arrangements and Attitudes (SWAA)*** covering October 2022 to June 2023 to quantify the relative efficiency of work from home (WFH), and its implications for the US economy and US workers.

- See www.wfhresearch.com and Barrero, Bloom, and Davis (2021) for more information about the survey and its methodology.

Key (Preliminary) Results:

1. On Average, Workers Say They Are **More Efficient** While WFH

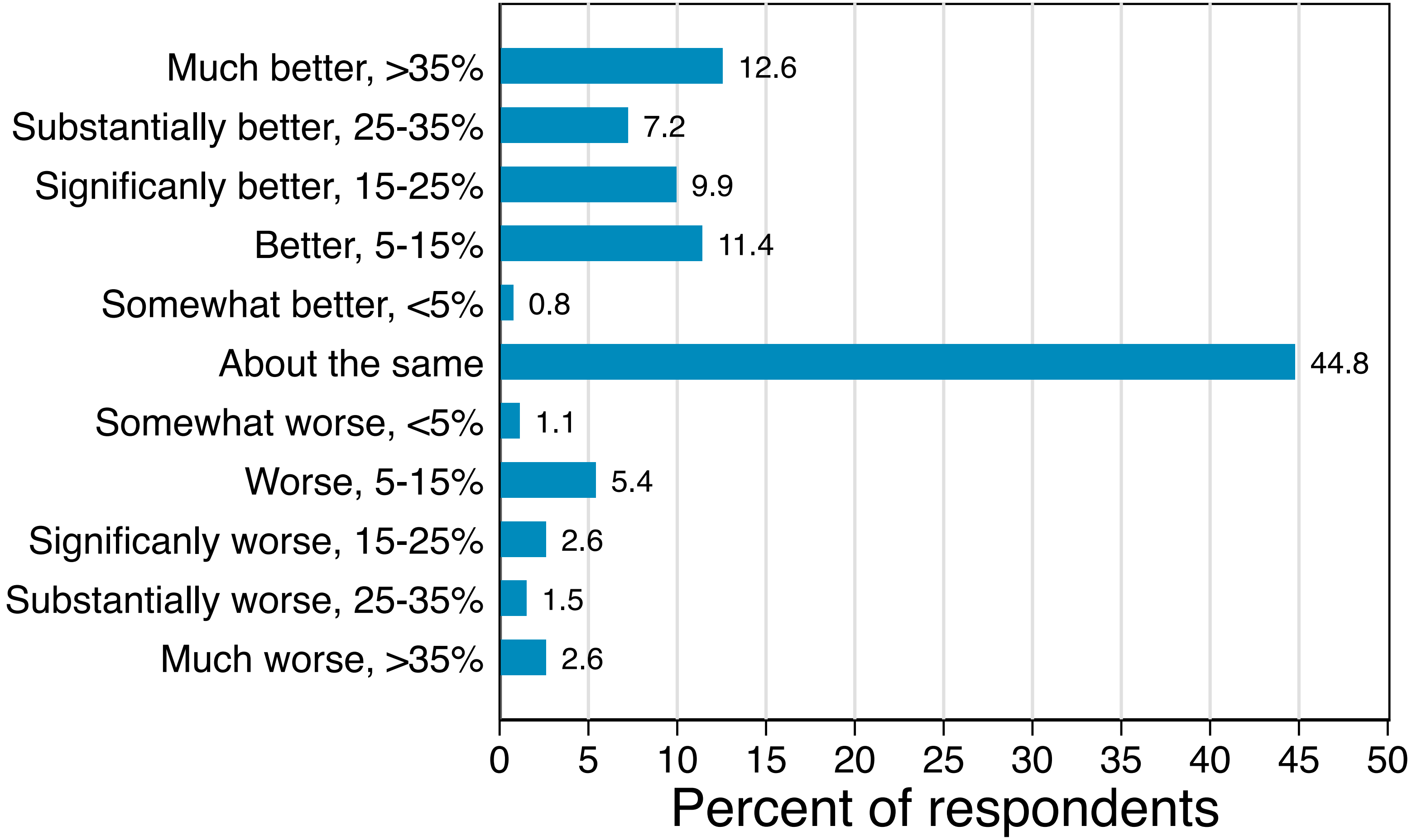
2. Persons Who WFH More Often Report **Higher Relative Efficiency**

3. Economic Models in Which Firms And Workers Choose WFH Levels, Calibrated to 2023 WFH Data Imply That a Forced Return to 2019 Levels of WFH Would Mean:
    - **0.9%** less GDP, **0.3 to 1.3%** lower productivity, **0.1%** lower welfare for workers

Part 1. Descriptive Evidence About the Productivity of WFH

Self-Assessed Relative Productivity of Working From Home is *Positive* on Average, for Those Who Are Able

How does your efficiency working from home compare to your efficiency working on business premises?



Overall Mean (SE) = 7.8 (0.1). N = 38696.

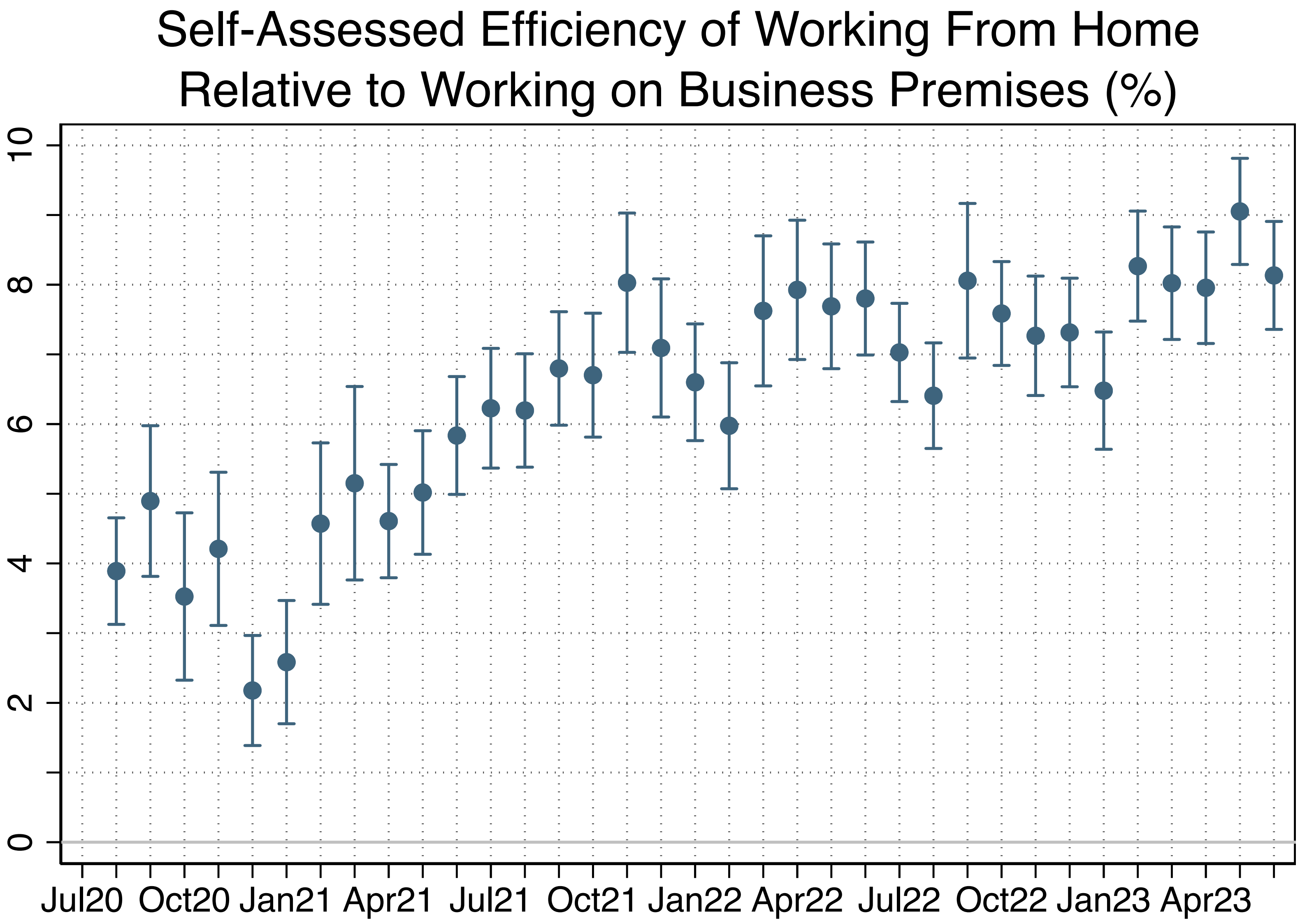
Responses to the questions:

- *How does your efficiency working from home compare to your efficiency working on business premises?*
    - *Better -- I am* ***more*** *efficient at home…*
    - *About the same…*
    - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*

Notes: We randomize the order of the response options for the first question, keeping "About the same" in the middle. The sample includes respondents who are able to work from home and meet our $10,000 prior earnings requirement in the October 2022 to June 2023 SWAA waves. We reweight the sample to match the CPS population on cells defined by age, sex, education, and earnings.

N = 38,696

Self-Assessed Relative Efficiency Rises During 2021, Then Stabilizes

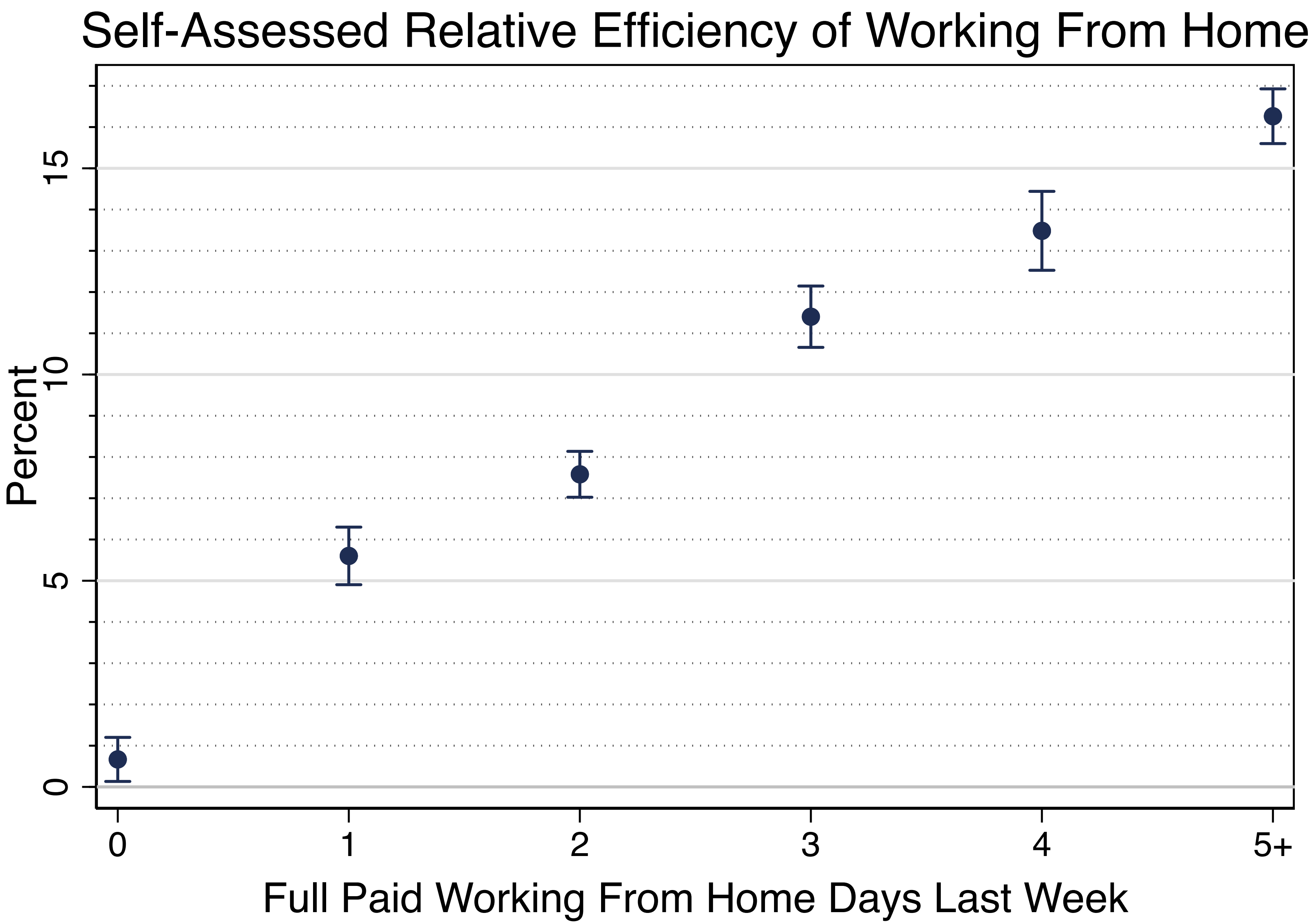


Responses to the questions:

- *How does your efficiency working from home compare to your efficiency working on business premises?*
  - *Better -- I am* ***more*** *efficient at home…*
  - *About the same…*
  - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*

Notes: The figure shows the average relative efficiency among respondents able to work from home for each month shown, after controlling for age category, sex, education, and industry of the current or most recent job. We adjust the relative efficiency estimates prior to October 2022 for primacy bias. To do so, we estimate the ‘primacy bias effect’ using a regression covering October 2022 to March 2023 (6 months) and adjust the data prior to October 2022, when ‘Better’ always appeared first, downward by half the estimated effect. **N = 108,051**

Self-Assessed Relative Productivity Correlates with Actual WFH ⇒ the Choice to WFH Is Informative of Its Relative Productivity

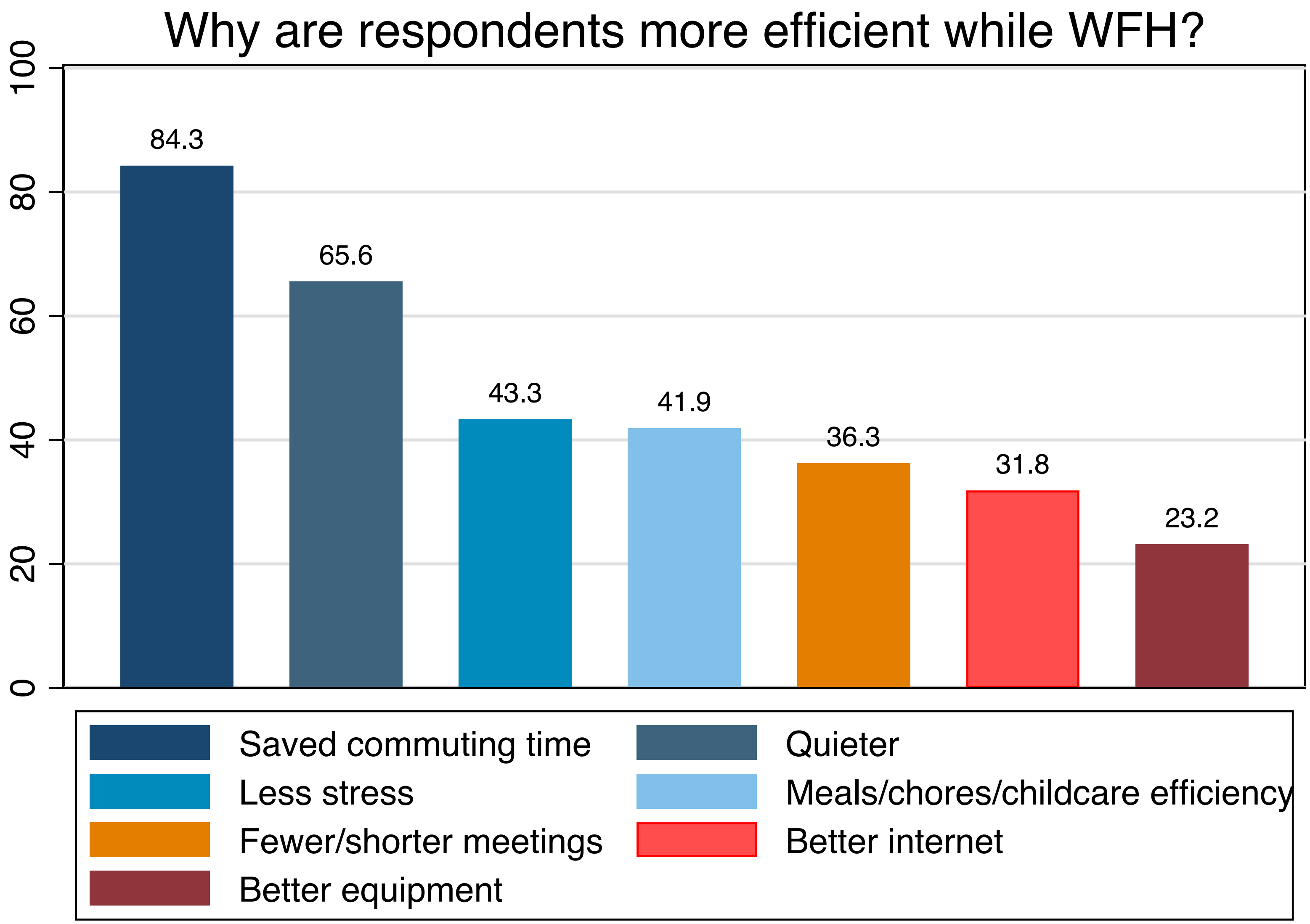


Responses to the questions:

- *How does your efficiency working from home compare to your efficiency working on business premises?*
  - *Better -- I am* ***more*** *efficient at home…*
  - *About the same…*
  - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*
- *For each day* **last week,** *did you* **work a full day (6 or more hours),** *and if so* **where?**

Notes: The figure shows the average relative efficiency by the amount of actual working from home and 95% confidence intervals. The sample covers respondents who participated in the October 2022 to June 2023 SWAA waves and are able to work from home.

84% of Workers Who Say They Are More Efficient at Home Cite Time Saved By Not Commuting As Part of the Reason



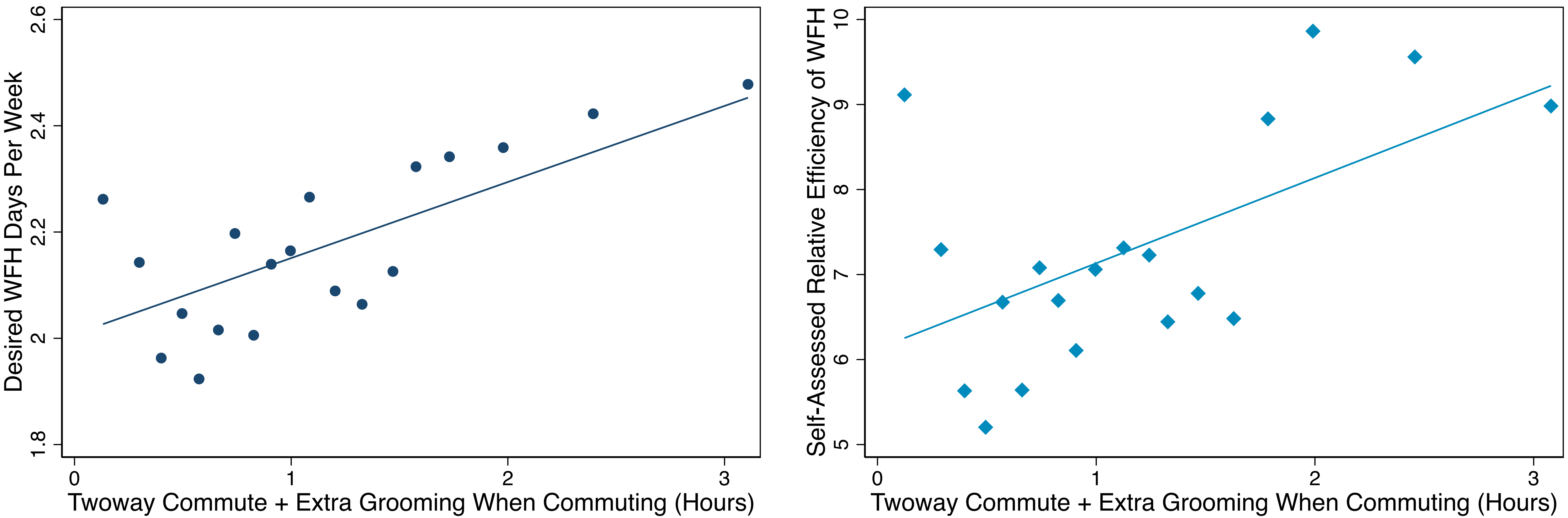
Responses to the questions:

- *Is* **time saved by not commuting** *part of your* **extra efficiency when working from home?**
- *Apart from saving time by not commuting,* **why are you <u>more efficient</u> when working from home?** *Please select all that apply.*

Notes: Data for the first question come from the February 2021 to June 2023 survey waves. Data for the second question come from the August 2021 to January 2022 survey waves. The sample includes respondents who are able to work from home, who say they are more efficient while working from home than at the office, and meet our $10,000 prior earnings requirement in the October 2022 to May 2023 SWAA waves. We reweight the sample to match the CPS population on cells defined by age, sex, education, and earnings.

N = 49,220 (first question – first bar)
N = 9,107 (second question – other bars)

Desired Work-From-Home Levels & Self-Assessments of Remote Efficiency Both Rise With Commuting Time & Extra Grooming Time When Commuting



Coef. (SE): 0.14 (0.02). N = 42439

Coef. (SE): 1.00 (0.22). N = 31643

Responses to the Questions: *"As the pandemic ends, how often would you **like to** have paid workdays at home?" "How does your efficiency working from home compare to your efficiency working on business premises?"* "*How much* **more efficient [less efficient]** *are you working from home than on business premises?" "How long do you usually spend* ***commuting <u>to and from</u> work (in minutes)?****" How much time do you spend on grooming and/or getting ready for work when: You commute to your employer's or client's worksite? Your work from home?"*

Notes: The figures show binned scatter plots of desired work-from-home days (left) and self-assessed relative work-from-home efficiency (right) against twoway commute times plus extra grooming on days when the respondent commutes. We focus on persons who participated in the October 2022 to June 2023 SWAA waves and worked during the week prior to the survey. We also exclude persons who report zero commuting time.

Setup: General Equilibrium Model of Labor Supply, Working Arrangements

Model Overview

- **Workers:** supply h_i hours and consume output good
  - **Two versions:** (1) Disutility from working, commuting, and grooming
    (2) Disutility from working and have an ideal WFH level

- **Intermediate firm:**
  - Hires worker i for h_i hours, with fraction $\delta_i \in [0,1]$ WFH days
  - Produces efficiency units of labor L_i from raw hours h_i
  - Chooses hours h_i and working arrangements δ_i to maximize its profits given a wage w_i. Determines a menu of employment contracts defined by $\{w_i, \delta_i, h_i\}$.

- **Final goods firm:** Produces consumption good from aggregate efficiency units $L = \int_i L_i \, \mathrm{d}F(i)$ using the following production function $Y = L^{2/3}$

- **Static equilibrium concept**

Final Goods Producer (simplest)

- A firm produces a final good Y with price p using aggregate efficiency units of labor L and the following quantity production function:

$$Y = L^{2/3}$$

- The final goods producer buys efficiency units of labor (at a price of 1, setting that as the numeraire), solving the following maximization problem:

$$\max_{L} pL^{2/3} - L$$

- The optimality condition means that $p = \frac{3}{2}L^{1/3}$ and therefore the value of final output sold is $pY = \frac{3}{2}L$ in equilibrium.

Workers (preferences over time spent working, commuting, grooming)

- Individual utility from consumption and time devoted to work:

$$u(c_i, n_i) = \log(c_i) - \frac{\chi_i}{1+\eta} n_i^{1+\eta}$$

- Hours devoted to work, inclusive of commuting, are measured work hours plus commuting and grooming hours,

$$n_i = h_i + g_i \text{DAYS}_i + (t_i + g_i^c)[\text{DAYS}_i\ (1 - \delta_i)]$$

where:

- h_i = measured work hours, i.e., response to “How many hours per week are you working for pay?”
- t_i = daily two-way commute time in hours
- g_i = baseline grooming time per day
- g_i^c = extra grooming time per day when commuting
- δ_i = WFH days as a fraction of all workdays
- DAYS_i = workdays per week

We will allow actual work hours to exceed paid work hours when working from home. Our data allow us to make this adjustment and suggest it is a common occurrence.

$$n_i = h_i + g_i \text{DAYS}_i + (t_i + g_i^c)[\text{DAYS}_i\ (1 - \delta_i)] + (t_i + g_i^c)\text{DAYS}_i \delta_i f_i$$

In this case $f_i \in [0,1]$ is the fraction of commute time savings reallocated to work.

- (Static) Budget constraint: $pc_i = w_i h_i$.

Producing Efficiency Units of Labor

An intermediate firm transforms hours h_i supplied by worker i into efficiency units of labor L_i using to the following technology:

$$L_i = A_i[(1-\delta_i)h_i + B_i(h_i\delta_i)^{\alpha}], \alpha \in (0,1],$$

Here

- A_i is worker's i's productivity relative to other workers
- B_i governs i's relative productivity in WFH mode
- α is a parameter that governs substitution between work modes

The firm sells the aggregate efficiency units of labor $L = \int_i L_i \mathrm{d}i$ to the final goods producer at a market price of 1(i.e., making efficiency units of labor be the numeraire).

Again, our data say that some workers devote more time to the job when they WFH. Treating that extra work time as unpaid, the technology that produces efficiency units of labor becomes:

$$L_i = A_i[(1-\delta_i)h_i + B_i(h_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i\delta_i f_i)^{\alpha}], \alpha \in (0,1]$$

where f_i equals the fraction of time savings that gets allocated to extra work.

The Intermediate's Firm Problem

The intermediate firm chooses hours h_i and working arrangements δ_i for each worker i taking hourly wages w_i as given, to maximize its profits:

$$\max_{h_i,\delta_i} A_i[(1-\delta_i)h_i + B_i(h_i\delta_i + (t_i+g_i^c)\mathrm{DAYS}_i\delta_i f_i)^\alpha] - w_i h_i$$

The optimality conditions of this problem are:

$$A_i[(1-\delta_i) + B_i\alpha\delta_i^\alpha(h_i + (t_i + g_i^c)\mathrm{DAYS}_i f_i)^{\alpha-1}] = w_i$$

$$B_i\alpha\delta_i^{\alpha-1}(h_i + (t_i + g_i^c)\mathrm{DAYS}_i f_i)^\alpha = h_i$$

Simplifying we get that the menu of contracts acceptable to the firm in equilibrium can be indexed by h_i:

$$\delta(h_i) = \min\left\{\left[\alpha B_i \frac{(h_i + f_i(g_i^c + t_i)\mathrm{DAYS}_i)^\alpha}{h_i}\right]^{\frac{1}{1-\alpha}}, 1\right\} = \min\left\{\frac{[\alpha B_i]^{\frac{1}{1-\alpha}}}{h_i}, 1\right\} \text{ if } f_i = 0$$

$$w(h_i) = A_i\left((1-\delta(h_i)) + \delta(h_i)\frac{h_i}{h_i + f_i\left(t_i + g_i^c\right)\mathrm{DAYS}_i}\right) = A_i \text{ if } f_i = 0$$

Optimal Hours Choice

After substituting in for the budget constraint and the menu of contracts acceptable to the intermediate firm, the worker's problem is:

$$\max_{h_i} \log\left(\frac{w_i(h_i)h_i}{p}\right) - \chi_i \frac{[h_i + g_i\text{DAYS}_i + (t_i + g_i^c)\text{DAYS}_i(1-\delta(h_i)) + f_i(t_i + g_i^c)\text{DAYS}_i(1-\delta(h_i))]^{1+\eta}}{1+\eta}$$

The worker optimally chooses h_i to satisfy the following FOC:

$$\frac{w'(h_i)}{w(h_i)} + \frac{1}{h_i} = \chi_i\left[h_i + g_i\text{DAYS}_i + (t_i + g_i^c)\text{DAYS}_i\left(1-\delta(h_i)(1-f_i)\right)\right]^{\eta}[1-(t_i + g_i^c)\text{DAYS}_i\,(1-f_i)\delta'(h_i)]$$

We can obtain closed form solutions for $w(h_i)$, $w'(h_i)$ and $\delta'(h_i)$ from the formulas that wage contract.

Equilibrium Definition

An equilibrium is a set of prices $\{p, \{w_i\}\}$ and allocations $\{Y, L, \{h_i, \delta_i\}\}$ such that:

- Workers choose hours, working arrangements and consumption to maximize their utility $\log(c_i) - \chi_i \frac{n_i^{1+\eta}}{1+\eta}$ subject to:
  - $n_i = h_i + g_i \text{DAYS}_i + (t_i + g_i^c)[\text{DAYS}_i\ (1 - \delta_i)]$
  - $pc_i = w_i h_i$
  - the menu of wage employment contracts $\{w(h_i), \delta(h_i)\}$ acceptable to the intermediate firm
- The intermediate firm chooses hours and working arrangements taking wages as given, to maximize its profits:
$$A_i[(1-\delta_i)h_i + B_i(h_i\delta_i + (t_i + g_i^c)\text{DAYS}_i\delta_i f_i)^\alpha] - w_i h_i$$
- The final goods firm chooses how many efficiency units of labor to buy to maximize its profits $pL^{2/3} - L$, taking prices as given.
- The following markets clear:
  - $Y = L^{2/3}$ (final output)
  - $L = \int_i A_i[(1-\delta_i)h_i + B_i(h_i\delta_i + (t_i + g_i^c)\text{DAYS}_i\delta_i f_i)^\alpha]$ (efficiency units of labor)
  - $\{h_i\}$ individual hours

Using the Model to Infer Unobservable Quantities: A_i and B_i

The optimality conditions of the intermediate firm that produces efficiency units of labor allow us to infer:

1. B_i (governs the WFH productivity of worker i)

$$B_i = \frac{1}{\alpha}\left[\frac{h_i \delta_i^{1-\alpha}}{\left(h_i + \left(t_i + g_i^c\right)\mathrm{DAYS}_i f_i\right)^{\alpha}}\right]$$

Note: This implies $B_i = 0$ for anyone not WFH. We will relax that for some of the counterfactuals where we move workers from not WFH in 2022-2023 to doing <u>some</u> WFH.

Note: If $\delta_i = 1$ the above expression provides the <u>smallest</u> B_i consistent with observed choices. Assuming all outcomes stem from interior solutions is therefore a conservative choice.

2. A_i (shifts the productivity of worker i relative to other workers)

$$A_i = \frac{w_i}{(1-\delta_i) + \frac{h_i \delta_i}{h_i + f_i\left(t_i + g_i^c\right)\mathrm{DAYS}_i}}$$

given a value for α, and data on measured hours h_i, the share of days working from home δ_i, wages w_i, days worked per week DAYS_i, commuting and extra grooming when commuting t_i, and g_i^c and the share of commuting time savings relocated to work f_i.

<u>Calibration</u>: we will choose α to minimize the average distance between inferred B_is and self-assessments of the ability to WFH.

<u>Sample</u>: We focus on persons who worked 20+ hours per week and participated in the October 2022 to June 2023 waves of the SWAA.

Using the Model to Infer Unobservable Quantities: Disutility of Work χ_i

Assuming workers are on their labor supply curves, the household's optimality condition for hours choice allows us to infer the individual disutility of hours devoted to work χ_i from data on:

- measured hours h_i
- share of days working from home δ_i
- commuting and grooming time g_i, t_i, g_i^c
- working days per week DAYS_i, and
- the share of commuting time savings reallocated to unpaid work f_i.

The household's first-order condition implies that:

$$\chi_i = \frac{\frac{w'(h_i)}{w(h_i)} + \frac{1}{h_i}}{\left[h_i + g_i\text{DAYS}_i + \left(t_i + g_i^c\right)\text{DAYS}_i\left(1 - \delta(h_i)(1 - f_i)\right)\right]^{\eta}\left[1 - \left(t_i + g_i^c\right)\text{DAYS}_i\,(1 - f_i)\delta'(h_i)\right]}$$

<u>Sample</u>: We focus on persons who worked 20+ hours per week and participated in the October 2022 to June 2023 waves of the SWAA.

<u>Calibration</u>: We set $\eta = 2$, consistent with a Frisch elasticity of hours devoted to work equal to ½.

Questions and Counterfactual Exercises (1/2)

1. How do the B_is (i.e. inferred relative productivities) line up with worker self-assessments of the relative productivity of WFH?

2. How do aggregate output pY and productivity pY/H (where H is a measure of aggregate hours devoted to work) differ <u>in equilibrium</u> from their implied 2022-2023 levels under different working arrangements that workers and firms take as given?
   We consider the following counterfactuals:
   - **"2019:"** Set $\delta_i = 0$ for all those unable to WFH and not doing so in 2022-2023, and $\delta_i = 0.1$ for those who are able and doing so in 2022-2023.
   - **"2020:"** Set $\delta_i = 1$ for anyone able to WFH, but impute $B_i = 0.5$ instead of $B_i = 0$ for workers able to WFH but who are not doing so in 2022-2023. Set $\delta_i = 0$ if unable to WFH.

3. How does the shift in working arrangements to the counterfactual level matter for worker welfare:
   - Holding prices constant, to isolate the **value of time saved from WFH in 2022-2023**
   - In <u>equilibrium</u> to account for price changes?

Questions and Counterfactual Exercises (2/2)

To conduct the welfare calculations we ask: By what percent x_i do we need to increase worker i's consumption in 2022-2023 to make them equally happy as in the counterfactual scenario.

These are the two versions of the welfare calculations (where y' denotes a counterfactual outcome for y):

a) Holding hours and prices constant to isolate the effect of time savings on welfare:

Then x_i satisfies:

$$u\big(c_i, h_i + (t_i + g_i)\mathrm{DAYS}_i\,(1-\delta_i')\big) = u(c_i(1+x_i), (t_i+g_i)\mathrm{DAYS}_i(1-\delta_i))$$

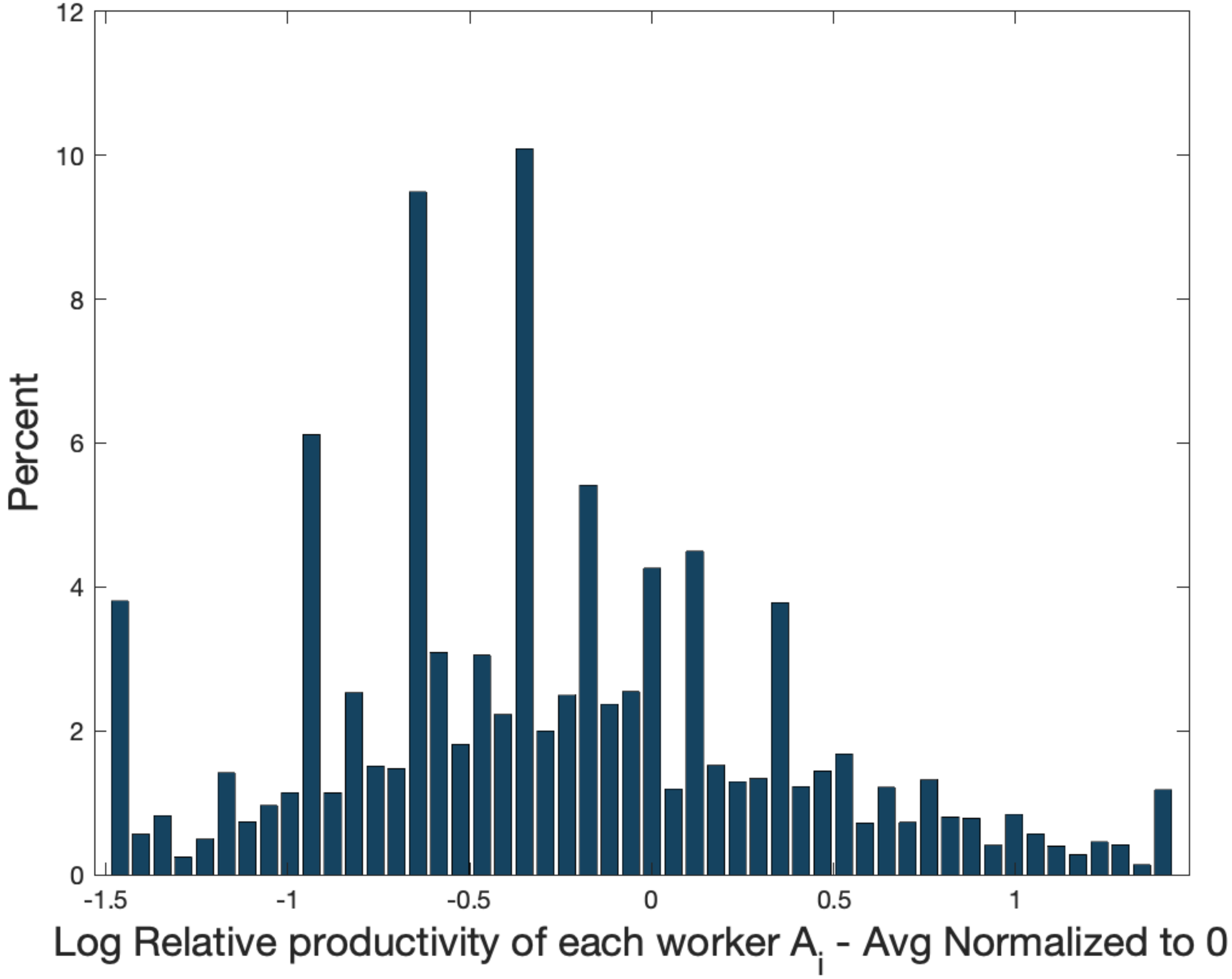
b) Letting hours and equilibrium prices adjust, obtaining the full welfare difference between the 2022-2023 situation and the counterfactual.

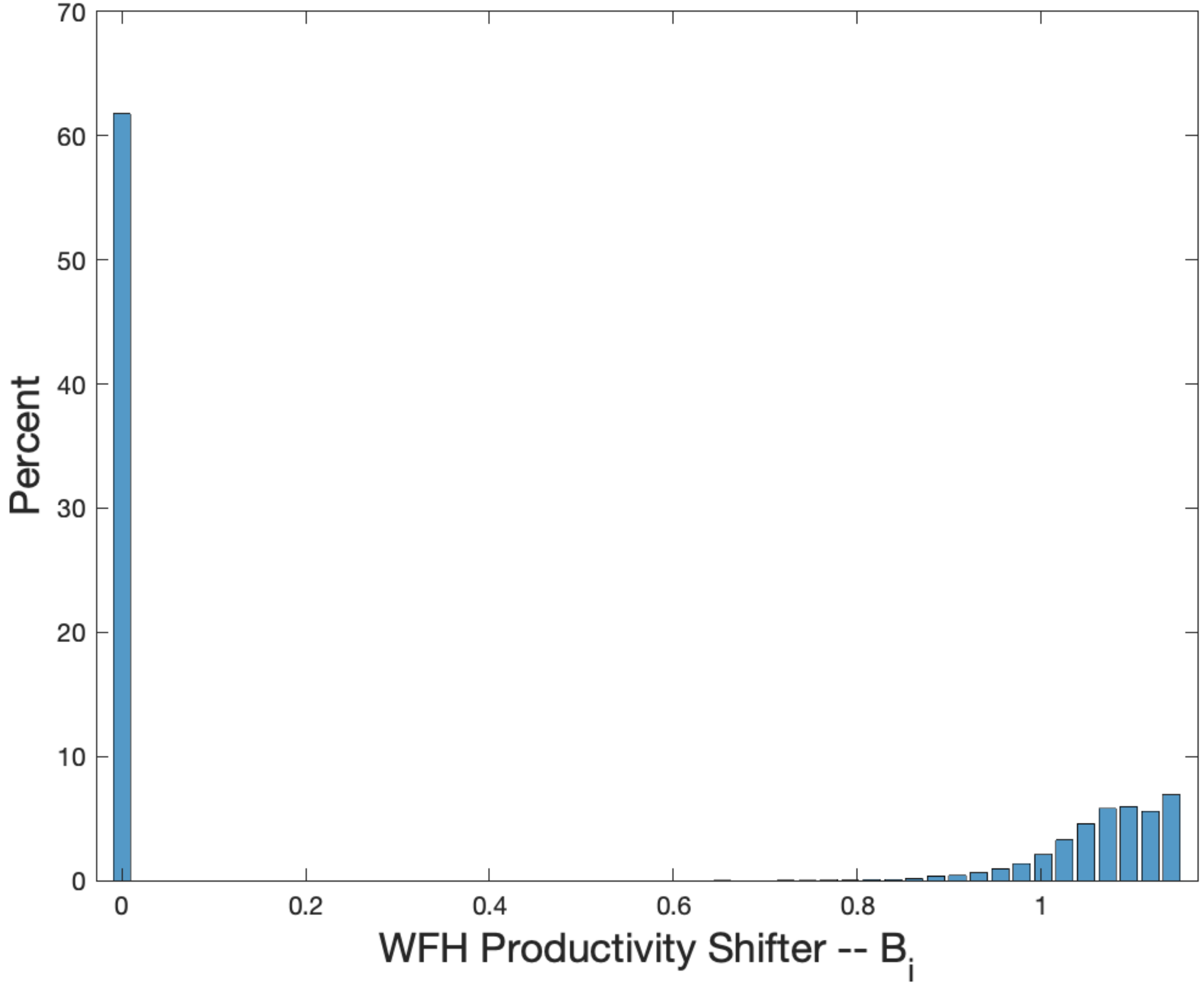
Then x_i satisfies:

$$u\big(c_i', h_i' + (t_i + g_i)\mathrm{DAYS}_i\,(1-\delta_i')\big) = u(c_i(1+x_i), h_i + (t_i+g_i)\mathrm{DAYS}_i\,(1-\delta_i))$$

Where $pc_i = w_i h_i$ and $p'c_i' = w_i' h_i'$ and h_i' satisfies the first order condition for the household's choice of hours taking δ_i' as given.

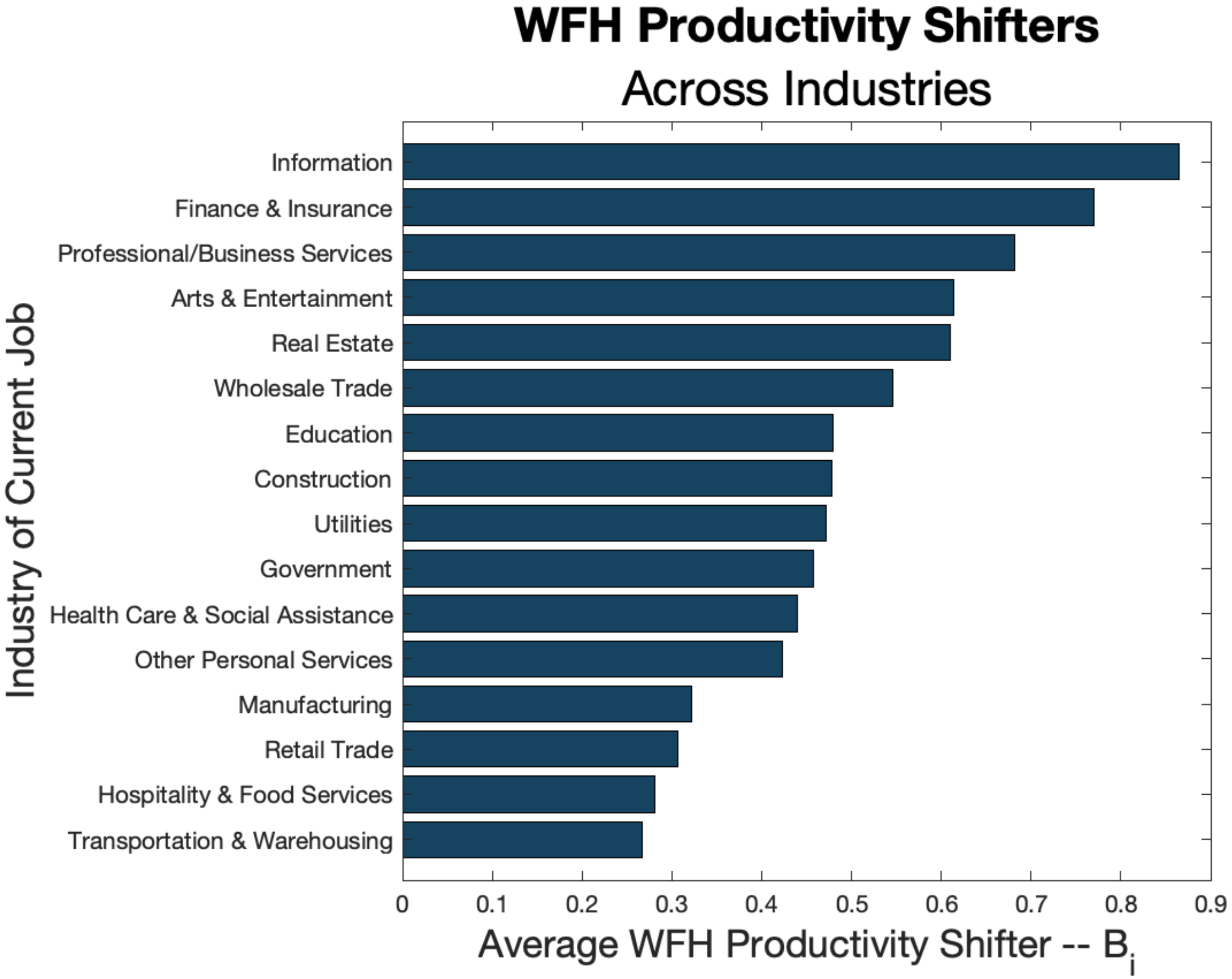
Distributions of Implied A_is and B_is

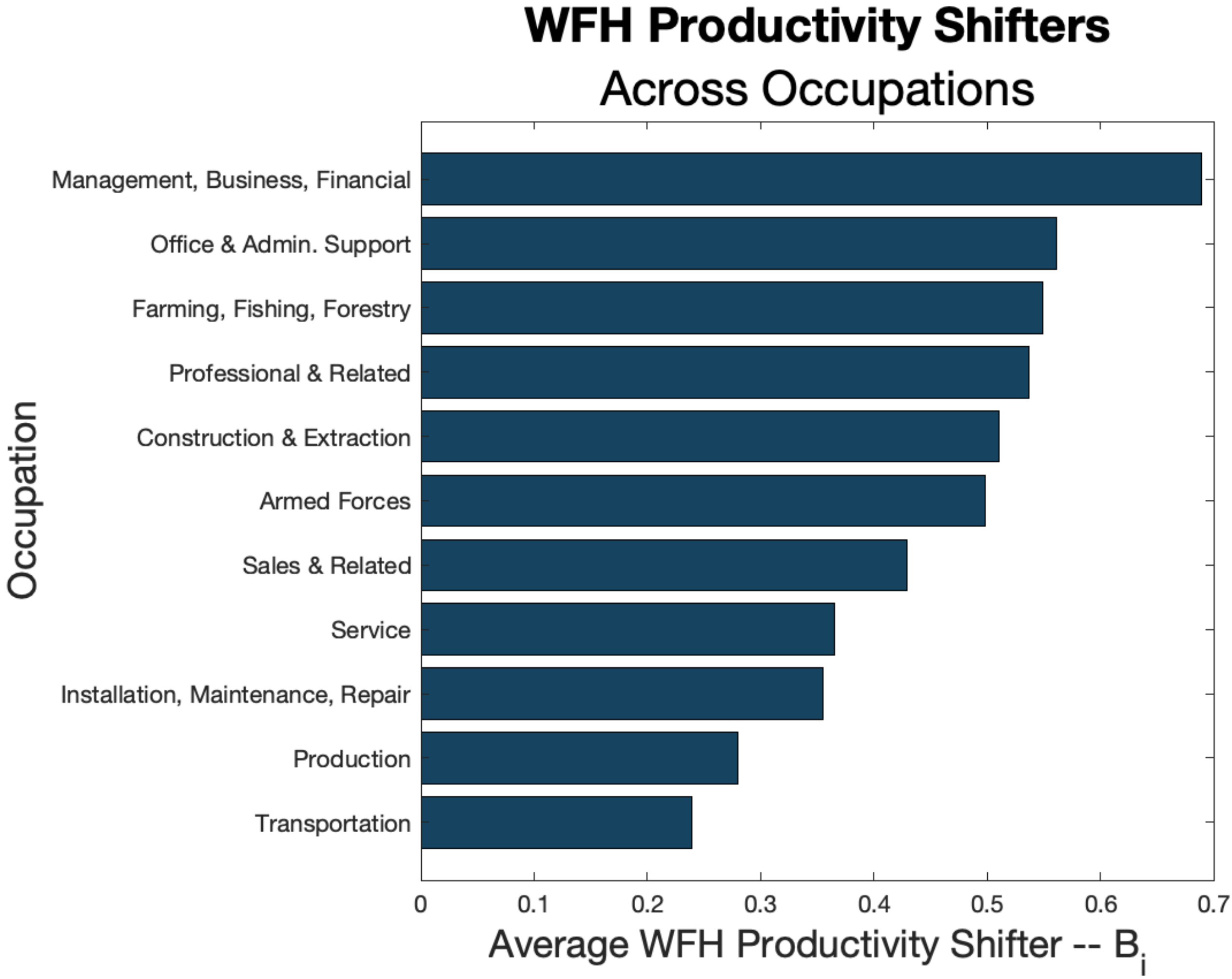




Notes: The figure on the left shows the distribution of relative worker productivity $\log A_i$ after normalizing the average A_i to equal 1. The figure on the right shows the distribution of B_i, the worker-specific shifter that governs the relative productivity of worker i in WFH mode. Both charts are winsorized at the 1st and 99th percentile and use SWAA data from October 2022 to June 2023, focusing on workers who reported at least 20 hours of work in the week prior to the survey. In this version, we assume workers allocate a fraction f_i of commuting and grooming time saving to unpaid work based on their relevant survey responses.

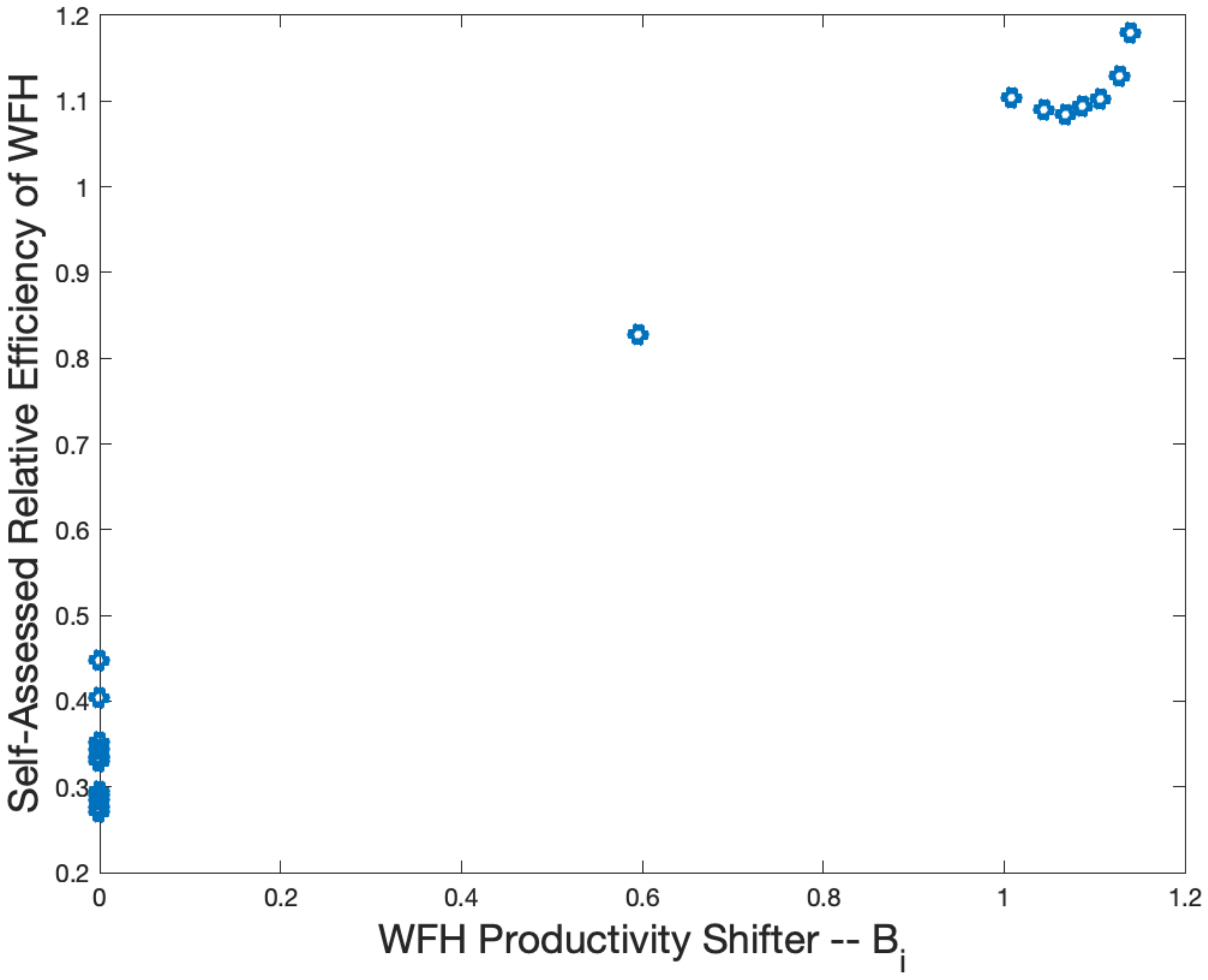
Remote Productivity Shifters by Industry & Occupation

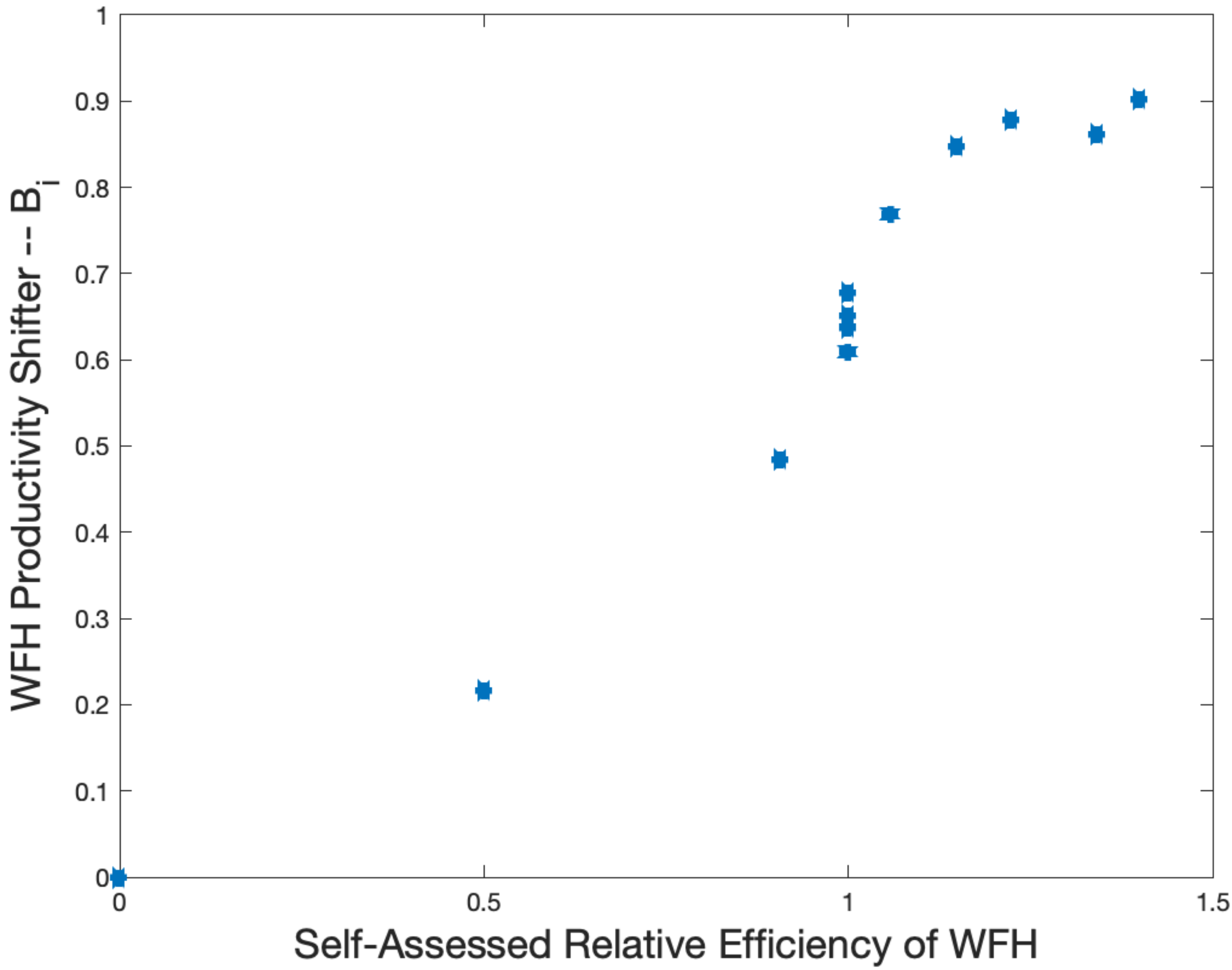




Notes: The figures show the average productivity shifter B_i for each industry and occupation group. We exclude agriculture and mining, as well as "other" occupations due to small samples and lack of suitability for remote work.

Implied B_is vs. Self-Assessed Relative Efficiency of WFH, for α That Minimizes The Distance Between The Two Variables





Note: The figures show binned scatter plots showing the joint distribution of self-assessed relative productivity of WFH as elicited in the SWAA conditional on our inferred B_i shifters for each worker's productivity in WFH mode (left) and vice versa (right). Both charts use SWAA data from October 2022 to June 2023, focusing on workers who reported at least 20 hours of work in the week prior to the survey. In this version, we assume workers allocate a fraction f_i of commuting and grooming time saving to unpaid work based on their relevant survey responses.

Output and Productivity Differences (%): Going From 2022-2023 to Counterfactual

	$100 \times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	-0.9	-0.3	-1.3	-4.5
2020	-10.9	-11.4	-9.9	-5.8

Notes: We report the change in key outcomes from going from the 2022-2023 equilibrium to the counterfactual equilibrium. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1-\delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't ($\delta_i = 0$), but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$ for those who can work from home only under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours.

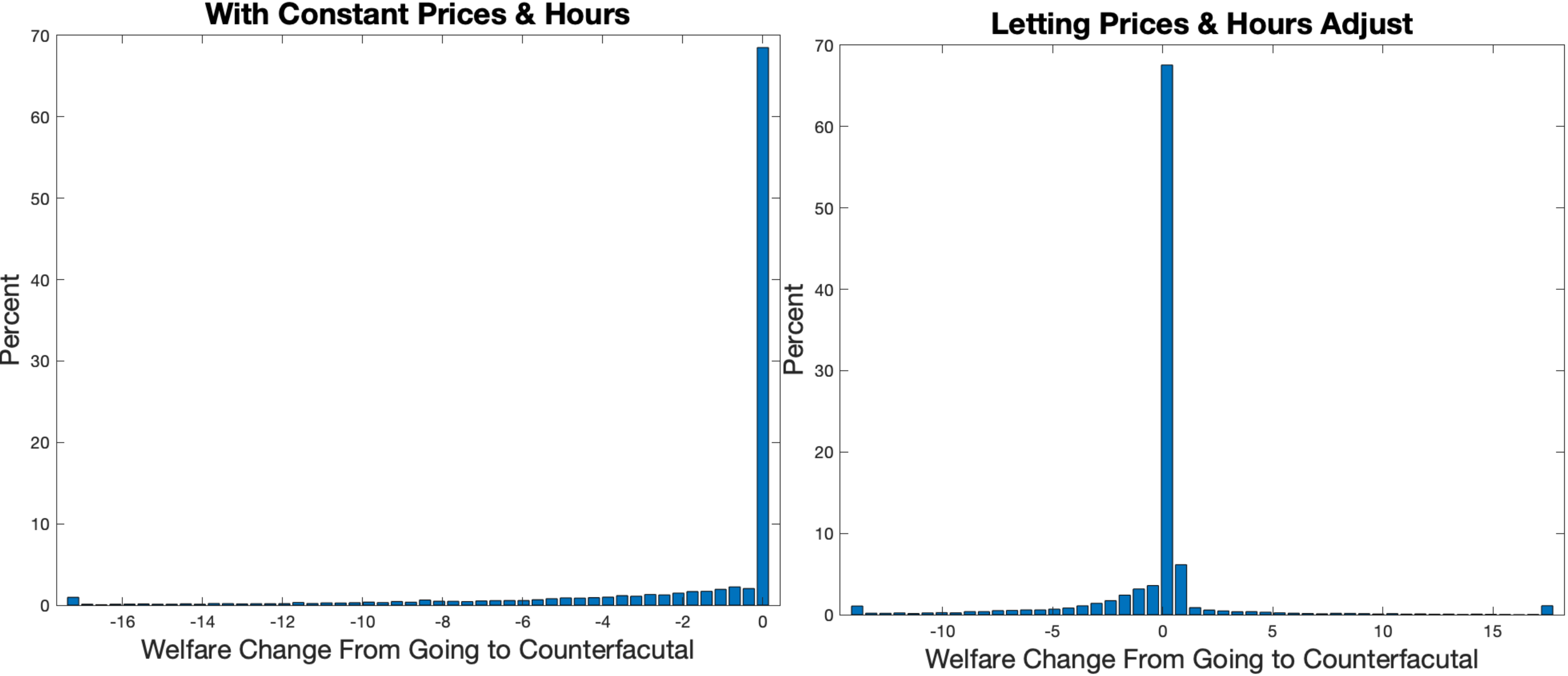
Output and Productivity Differences Between 2022-2023 Amount of WFH and Counterfactuals

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
2019	-1.6	-0.1
2020	3.3	-7.0

Notes: The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't ($\delta_i = 0$) but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours devoted to work.

Distribution of Consumer Welfare Changes: From 2022-2023 to "2019"



Notes: Each figure shows the distribution of percentage cuts to 2022-2023 consumption that would be required to make the worker indifferent with their utility under "2019" working arrangements. The left chart holds work hours and prices constant, thereby focusing on time savings from not commuting. The chart on the right allows hours and prices to adjust, comparing across equilibrium outcomes in the baseline and counterfactual worlds. Both charts are winsorized at the 1st and 99th percentiles.

Alternative Model Specification Focusing on Heterogeneous Preferences for WFH

Alternative Specification: Worker Preferences Over The Amount of WFH

Individual utility from consumption, disutility from measured work hours and working arrangements (compared to an ideal level for each worker):

$$u(c_i, h_i, \delta_i) = \log(c_i) - \chi_i \frac{h_i^{1+\eta}}{1+\eta} - \frac{1}{2}(\delta_i - \gamma_i)^2$$

Define γ_i such that δ_i^* matches the worker's response to the question, *"As the pandemic ends, how often would you like to have paid workdays at home?"* That means δ_i^* is the worker's preferred arrangement with "no consequences," so that δ_i^* maximizes utility holding consumption and hours constant:

$$\delta_i^* \equiv \underset{\delta_i}{\operatorname{argmax}} \log(c_i) - \chi_i \frac{h_i^{1+\eta}}{1+\eta} - \frac{1}{2}(\delta_i - \gamma_i)^2$$

- The worker's full problem (considering all constraints) then becomes:

$$\max_{h_i} \log\left(\frac{w(h_i)h_i}{p}\right) - \chi_i \frac{h_i^{1+\eta}}{1+\eta} - \frac{1}{2}(\delta(h_i) - \gamma_i)^2$$

And the first-order condition is:

$$\frac{w'(h_i)}{w(h_i)} + \frac{1}{h_i} = \chi_i h_i^{\eta} + (\delta(h_i) - \gamma_i)\delta'(h_i)$$

Output and Productivity Changes (%): Going From 2022-2023 To Counterfactual (WFH Preferences Specification)

	$100 \times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	-0.7	-0.2	-1.1	-4.2
2020	-12.3	-11.4	-11.0	-7.2
Worker desired amount of WFH	-5.1	-4.4	-4.6	-3.9

Notes: We report the change in key outcomes from going from the 2022-2023 equilibrium to the counterfactual equilibrium. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1-\delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't ($\delta_i = 0$). The final counterfactual gives each worker their preferred working arrangement ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which matters for the third column.

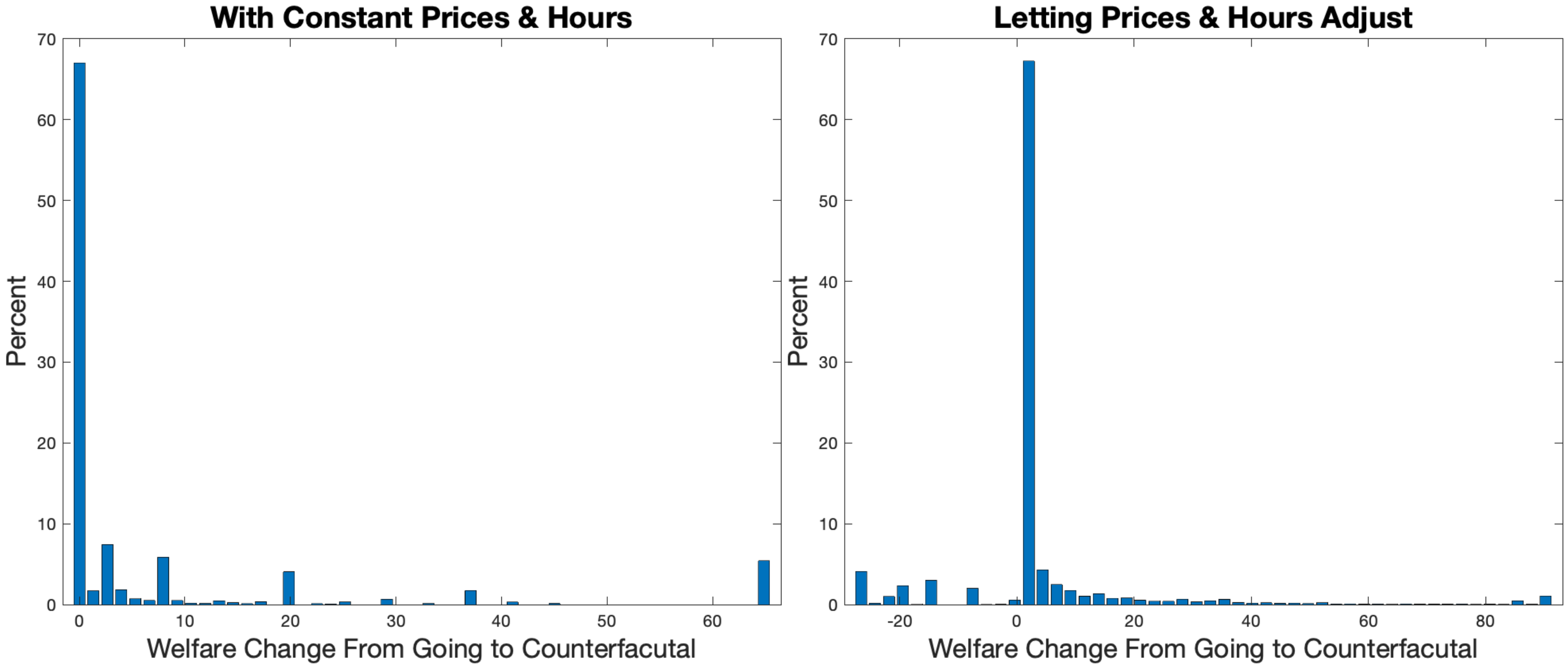
Average Welfare Change (as % 2022-2023 Consumption) Going to Counterfactual (WFH Preferences Specification)

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
2019	-4.6	-2.0
2020	-2.2	-9.4
Worker desired amount of WFH	6.6	3.4

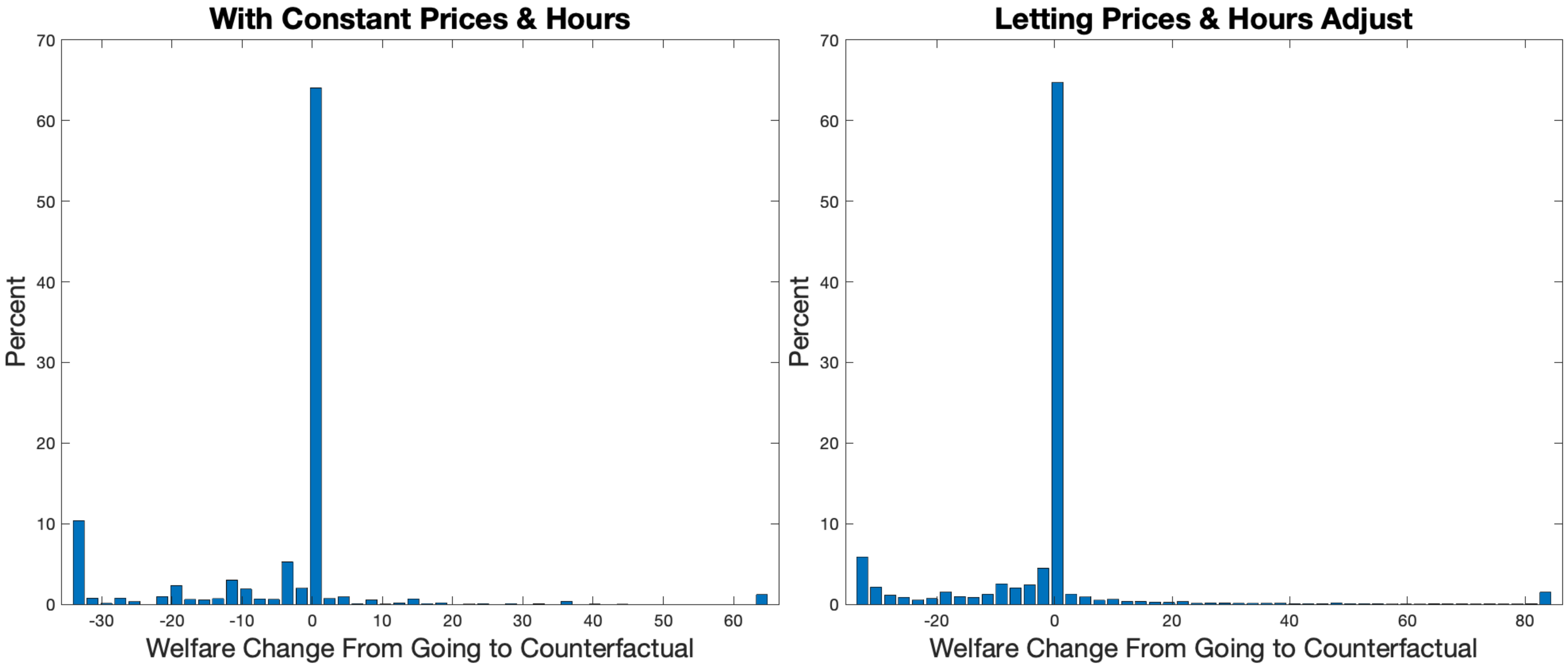
Notes: The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't ($\delta_i = 0$). The final counterfactual gives workers their preferred working arrangements ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours inclusive of commuting and grooming time.

Distribution of Welfare Changes: Going From 2022-2023 to Giving Workers Their Preferred Amount of WFH



Notes: Each figure shows the distribution of percentage changes to 2022-2023 consumption that would be required to make the worker indifferent with their utility under their preferred working arrangements. The left chart holds work hours and prices constant, thereby focusing on the pure loss of working from home more or less than their desired amount. The chart on the right allows hours and prices to adjust, comparing across equilibrium outcomes in the baseline and counterfactual worlds. Both charts are winsorized at the 1st and 99th percentiles.

Distribution of Welfare Changes: Going from 2022-2023 to "2019" (Preferences Over WFH Version)



Notes: Each figure shows the distribution of percentage changes to 2022-2023 consumption that would be required to make the worker indifferent with their utility under "2019" working arrangements. The left chart holds work hours and prices constant, thereby focusing on the pure loss of working from home more or less close to their desired amount. The chart on the right allows hours and prices to adjust, comparing across equilibrium outcomes in the baseline and counterfactual worlds. Both charts are winsorized at the 1st and 99th percentiles.

Appendix

Source of Data and Citation

- **Source of all data (unless noted):** Survey of Working Arrangements and Attitudes (SWAA), see www.wfhresearch.com

- **When referring to these results please cite:**

Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis, 2021. "Why working from home will stick," National Bureau of Economic Research Working Paper 28731.

www.wfhresearch.com

The Survey of Working Arrangements and Attitudes

- Monthly online survey since May 2020, >200,000 observations to date.
- We design the survey instrument.
- Target population: U.S. residents, 20-64, who earned ≥ $10K in 2019 (≥$20K in early survey waves). From January to March 2022, we transitioned to earned ≥ $10K in the prior year. As of July 2023, we also now developed a dataset for 2022 and later that does not impose an earnings requirement.
- The SWAA is fielded by market research firms that rely on wholesale aggregators (e.g., Lucid) for lists of potential survey participants.
- After dropping "speeders" (~16% of sample), we re-weight to match 2010-2019 CPS worker shares in age-sex-education-earnings cells. Dropping those who fail attention checks (roughly another 12%) sharpens some results.
- Median response time: 7 to 12 minutes, after dropping speeders
- Results, micro data, survey instruments, and more are freely available at www.WFHresearch.com.

SWAA Representativeness

- By design, we focus on persons who exhibit some attachment to the workforce, as evidenced by prior earnings. When noted, some results using 2022 and later data do not impose an earnings requirement.

- No respondents are recruited based on an interest in our topics.

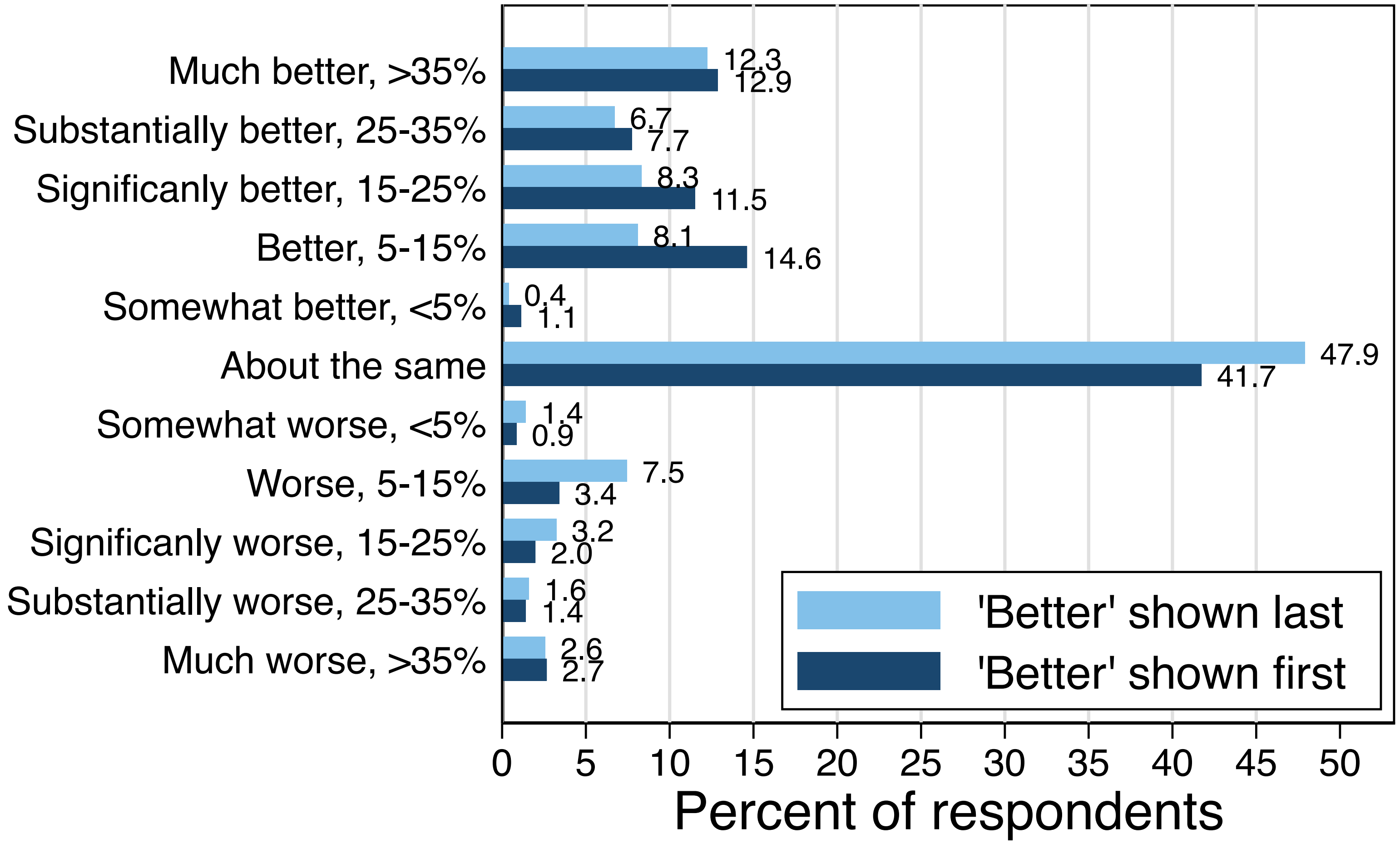
- Since respondents take the survey using a computer, smartphone, iPad or like device, we miss people who never use such devices.

- Before re-weighting, the SWAA under samples the less educated, particularly those who did not finish high school.

- Even after re-weighting, we may over sample those who are more tech and internet savvy, especially among the least educated.

<u>Primacy Bias</u>: Slightly Less Positive when 'Better' is Shown Last

How does your efficiency working from home compare to your efficiency working on business premises?



Mean with better first: 9.0 (.2). Mean with better last: 6.5 (.2)

Responses to the questions:

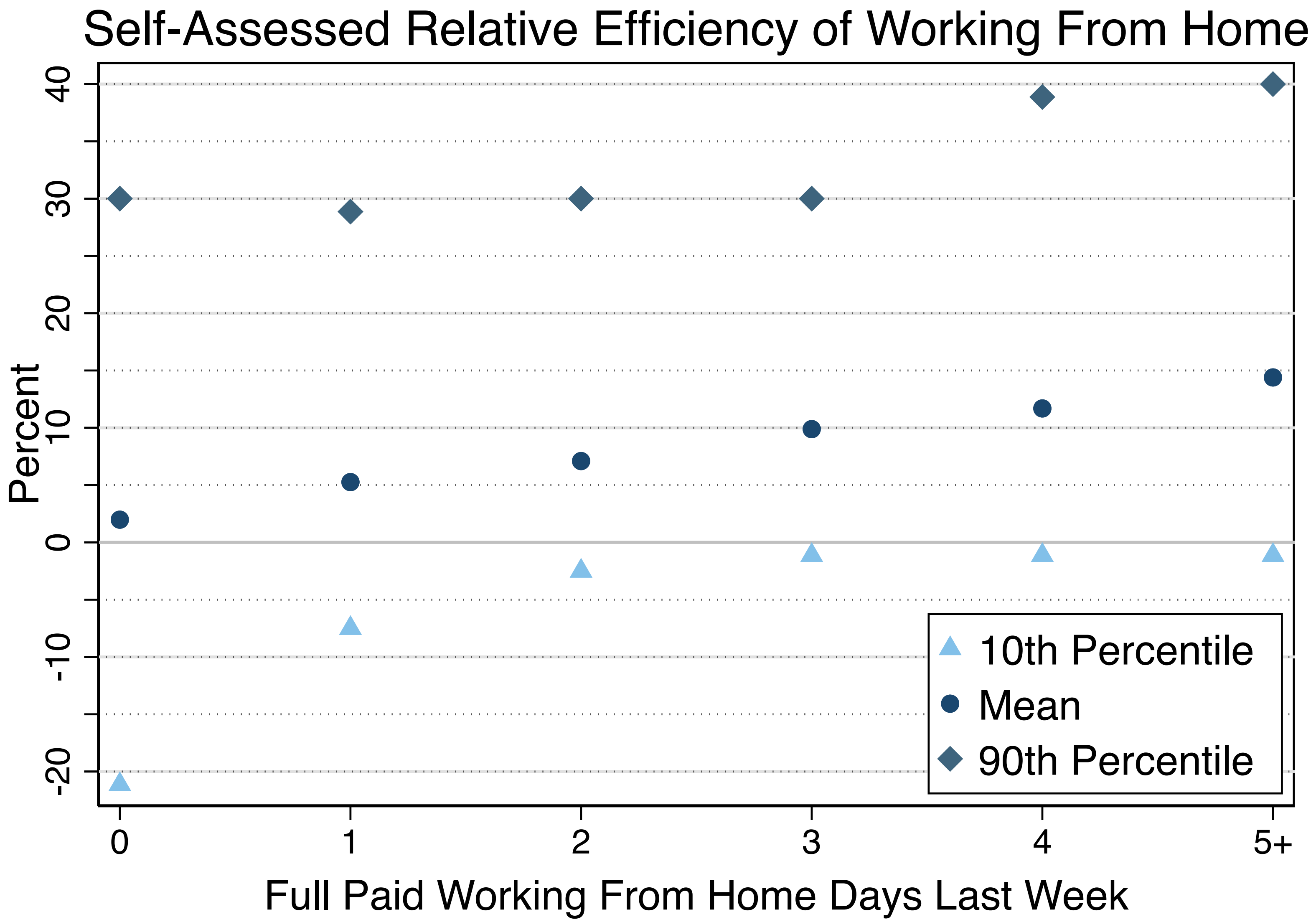
- *How does your efficiency working from home compare to your efficiency working on business premises?*
    - *Better -- I am* ***more*** *efficient at home…*
    - *About the same…*
    - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*

Notes: We randomize the order of the response options for the first question, keeping "About the same" in the middle. The sample includes respondents who are able to work from home and meet our $10,000 prior June requirement in the October 2022 to May 2023 SWAA waves. We reweight the sample to match the CPS population on cells defined by age, sex, education, and earnings.

N = 38,696

Self-Assessed Relative Productivity Correlates with Actual WFH ⇒ the Choice to WFH Is Informative of Its Relative Productivity (To Appendix)

Density Plot for 0, 3, 5+ days

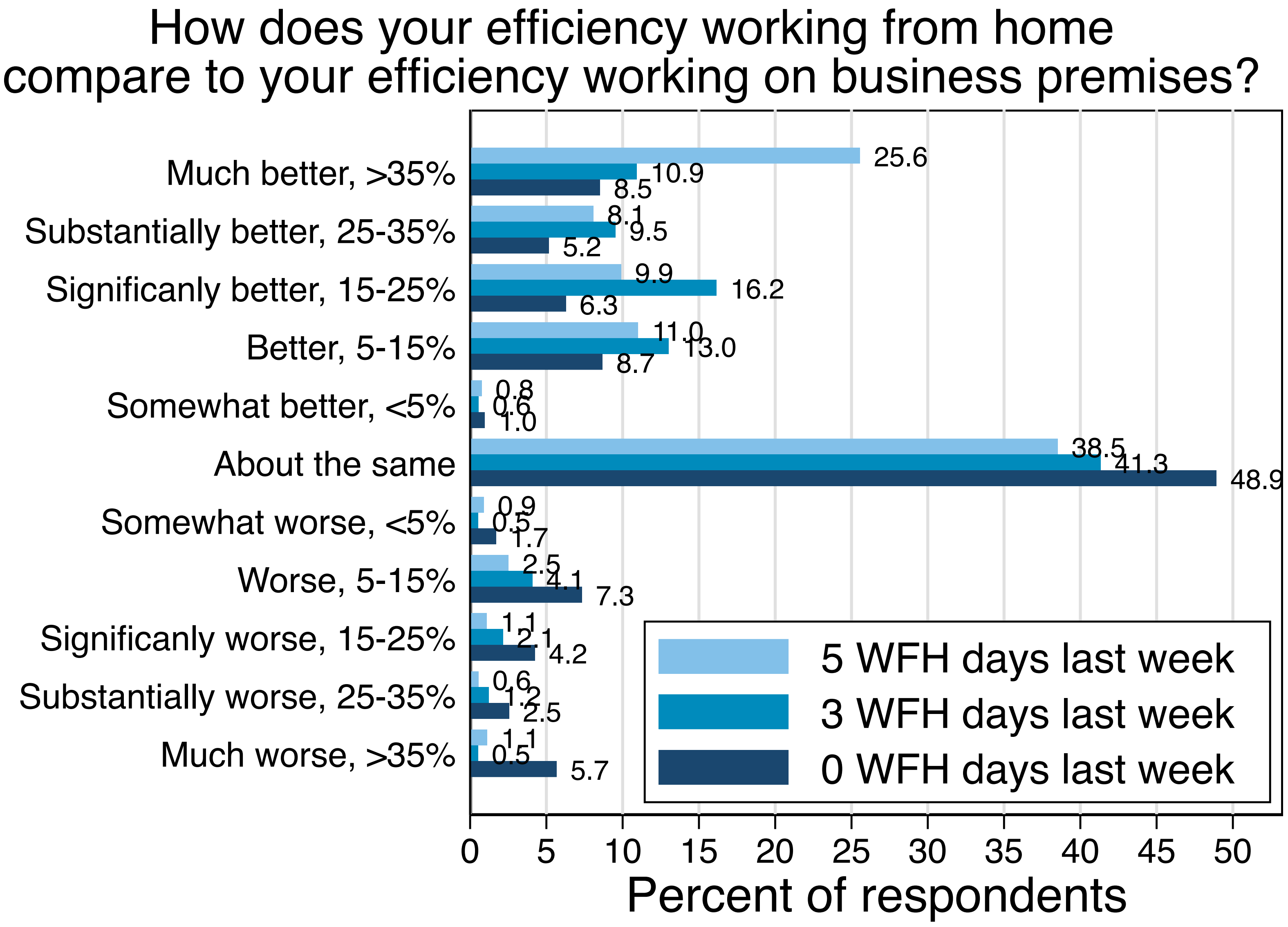


Responses to the questions:

- *How does your efficiency working from home compare to your efficiency working on business premises?*
  - *Better -- I am* ***more*** *efficient at home…*
  - *About the same…*
  - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*
- *For each day* **last week,** *did you* **work a full day (6 or more hours),** *and if so* **where?**

Notes: The figure shows the average relative efficiency by the amount of actual working from home. The sample covers respondents who participated in the October 2022 to June 2023 SWAA waves and are able to work from home.

Distribution of Self Assessments by Actual WFH Amount



Responses to the questions:

- *How does your efficiency working from home compare to your efficiency working on business premises?*
  - *Better -- I am* ***more*** *efficient at home…*
  - *About the same…*
  - *Worse – I am less efficient at home…*
- *How much* **more efficient [less efficient]** *are you working from home than on business premises?*

Notes: We compare the response deistribution by the amount of work from home respondents did in the prior week, focusing on 0, 3, or 5 days worked from home. The sample includes respondents who are able to work from home and meet our $10,000 prior June requirement in the October 2022 to May 2023 SWAA waves. We reweight the sample to match the CPS population on cells defined by age, sex, education, and earnings.

N = 23,379

Robustness: Output and Productivity Differences Between 2022-2023 Amount of WFH and Counterfactuals Without Allocating Commute Time Savings to Work (Time-Saving Model)

	$100\times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	0.5	0.1	-0.5	-0.3
2020	-8.4	-11.1	-7.6	-7.2

Notes: We report the difference between the 2022-2023 equilibrium and equilibrium under the counterfactual. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1-\delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't, but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$ for those who can work from home only under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours.

<u>Robustness</u>: Output and Productivity Differences Between 2022-2023 Amount of WFH and Counterfactuals Without Allocating Commute Time Savings to Work (Time Saving Model)

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
"2019"	-2.3	-2.4
"2020"	5.1	-5.1

Notes: The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours.

Output and Productivity Changes (%): Going From 2022-2023 To Counterfactual (WFH Preferences Spec. + Fully Competitive Eqbm.)

	$100 \times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	-0.3	-0.1	-1.1	-1.1
2020	-12.0	-11.7	-10.2	-10.9
Worker desired amount of WFH	-4.7	-4.5	-4.1	-4.5

Notes: We report the change in key outcomes from going from the 2022-2023 equilibrium to the counterfactual equilibrium. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i.$ Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1 - \delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't ($\delta_i = 0$). The final counterfactual gives each worker their preferred working arrangement ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which matters for the third column.

Average Welfare Change (as % 2022-2023 Consumption) Going to Counterfactual Without Allocating Commute Time Savings to Work (WFH Preferences Specification)

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
2019	-4.6	-4.2
2020	-2.2	-9.4
Worker desired amount of WFH	6.6	2.2

Notes: The “2019” counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The “2020” counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can’t don’t ($\delta_i = 0$). The final counterfactual gives workers their preferred working arrangements ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours inclusive of commuting and grooming time.

Robustness: Output and Productivity Differences Between 2022-2023 Amount of WFH and Counterfactuals When Firms Choose WFH & Workers Take WFH As Given (Time-Saving Model)

	$100 \times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	-1.9	-0.8	-2.1	-5.0
2020	-11.0	-11.9	-10.3	-9.2

Notes: We report the difference between the 2022-2023 equilibrium and equilibrium under the counterfactual. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1 - \delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't, but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$ for those who can work from home only under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours.

Robustness: Output and Productivity Differences Between 2022-2023 Amount of WFH and Counterfactuals When Firms Choose WFH & Workers Take WFH As Given (Time Saving Model)

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
2019	-1.8	0.0
2020	3.4	-5.8

Notes: The "2019" counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The "2020" counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can't don't but imputes $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i = 1$. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours.

Output and Productivity Changes (%): Going From 2022-2023 To Counterfactual When Firms Choose WFH & Workers Take WFH As Given (WFH Preferences Specification)

	$100 \times$			
	Output	Measured Productivity	Productivity Accounting for Commuting + Grooming Time	Profits
Counterfactual	$\Delta\log(pY)$	$\Delta\log(pY/H)$	$\Delta\log\left(\frac{pY}{H+T+G}\right)$	$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$
2019	-0.5	-0.5	-1.1	-4.3
2020	-11.6	-11.6	-10.5	-9.7
Worker desired amount of WFH	-8.7	-8.7	-8.4	-9.7

Notes: We report the change in key outcomes from going from the 2022-2023 equilibrium to the counterfactual equilibrium. The value of aggregate output is pY, which in equilibrium equals $\frac{3}{2}L$ and L are efficiency units of labor. Total measured hours are $H = \int h_i \mathrm{d}i$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c)\mathrm{DAYS}_i\delta_i + (t_i + g_i^c)\mathrm{DAYS}_i(1-\delta_i) + g_i\mathrm{DAYS}_i]\mathrm{d}i$. Π are total profits including those of the final good producer and the intermediate firm that transforms hours worked into efficiency units of labor. The “2019” counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The “2020” counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can’t don’t ($\delta_i = 0$). The final counterfactual gives each worker their preferred working arrangement ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which matters for the third column.

Average Welfare Change (as % 2022-2023 Consumption) Going to Counterfactual When Firms Choose WFH & Workers Take WFH As Given (WFH Preferences Specification)

% Cut to 2022-2023 Consumption Required to Match Counterfactual Utility

Counterfactual	Holding Hours, Prices, and Wages Constant	Letting Hours, Prices, and Wages Adjust
2019	-4.6	-3.4
2020	-2.2	-9.9
Worker desired amount of WFH	6.6	-1.6

Notes: The “2019” counterfactual assumes no working from home (i.e., sets $\delta_i = 0$) except for those who are currently working from home in 2023-2023, who are allowed to do so on 10% of working days ($\delta_i = 0.1$). The “2020” counterfactual assumes anyone who can work from home does so full time ($\delta_i = 1$) and those who can’t don’t ($\delta_i = 0$). The final counterfactual gives workers their preferred working arrangements ($\delta_i = \gamma_i$). The 2020 and worker desired counterfactuals impute $B_i = 0.5$ instead of $B_i = 0$ when $\delta_i > 0$ so those persons can work from home under duress. This specification of the model assumes workers allocate a fraction f_i of commuting time savings to unpaid work, which adds to total hours inclusive of commuting and grooming time.