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


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?

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.

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

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
**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 more efficient 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

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 to and from 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 two-way 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 $\delta_i$ 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 $L = \int_i L_i \, dF(i)$ 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
• \( \delta_i \) = WFH days as a fraction of all workdays
• \( \text{DAYS}_i \) = 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: \( p c_i = w_i h_i \).
Producing Efficiency Units of Labor

An intermediate firm transforms hours $h_i$ supplied by worker $i$ into efficiency units of labor $L_i$ using 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
- $\alpha$ is a parameter that governs substitution between work modes

The firm sells the aggregate efficiency units of labor $L = \int_i L_i di$ 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:

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

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 $\delta_i$ for each worker $i$ taking hourly wages $w_i$ as given, to maximize its profits:

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

The optimality conditions of this problem are:

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

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

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

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

$$w(h_i) = A_i \left( (1 - \delta(h_i)) + \delta(h_i) \frac{h_i}{h_i + f_i(t_i + g_i^c)\text{DAYS}_i} \right) = A_i \text{ if } f_i = 0$$
After substituting in for the budget constraint and the menu of contracts acceptable to
the intermediate firm, the worker’s problem is:

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

The worker optimally chooses $h_i$ to satisfy the following FOC:

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

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:
  - \( n_i = h_i + g_i \text{DAYS}_i + (t_i + g_i^e)\text{DAYS}_i (1 - \delta_i) \)
  - \( pc_i = w_i h_i \)
  - 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:
  \[
  A_i [(1 - \delta_i)h_i + B_i (h_i\delta_i + (t_i + g_i^e)\text{DAYS}_i\delta_if_i)\alpha] - w_i h_i
  \]

- 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)
  - \( L = \int_i A_i [(1 - \delta_i)h_i + B_i (h_i\delta_i + (t_i + g_i^e)\text{DAYS}_i\delta_if_i)\alpha] \) (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 $i$)

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

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 some WFH.

Note: If $\delta_i = 1$ the above expression provides the smallest $B_i$ 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)

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

given a value for $\alpha$, and data on measured hours $h_i$, the share of days working from home $\delta_i$, wages $w_i$, days worked per week $\text{DAYS}_i$, commuting and extra grooming when commuting $t_i$, and $g_i^c$ and the share of commuting time savings relocated to work $f_i$.

Calibration: we will choose $\alpha$ to minimize the average distance between inferred $B_i$s and self-assessments of the ability to WFH.

Sample: 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 $\chi_i$

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 $\chi_i$ from data on:

- measured hours $h_i$
- share of days working from home $\delta_i$
- commuting and grooming time $g_i, t_i, g^c_i$
- working days per week $\text{DAYS}_i$, and
- the share of commuting time savings reallocated to unpaid work $f_i$.

The household’s first-order condition implies that:

$$\chi_i = \frac{w'(h_i) + \frac{1}{h_i}}{w(h_i) + \frac{1}{h_i}}$$

$$\text{Sample: We focus on persons who worked 20+ hours per week and participated in the October 2022 to June 2023 waves of the SWAA.}$$

**Calibration:** We set $\eta = 2$, consistent with a Frisch elasticity of hours devoted to work equal to $\frac{1}{2}$. 
Questions and Counterfactual Exercises (1/2)

1. How do the $B_i$s (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 in equilibrium 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 equilibrium 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:
\[ u(c_i, h_i + (t_i+g_i) \text{DAYS}_i (1 - \delta_i')) = u(c_i (1 + x_i), (t_i+g_i) \text{DAYS}_i (1 - \delta_i)) \]

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

Then $x_i$ satisfies:
\[ u(c_i', h_i' + (t_i+g_i) \text{DAYS}_i (1 - \delta_i')) = u(c_i (1 + x_i), h_i + (t_i+g_i) \text{DAYS}_i (1 - \delta_i)) \]

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 $\delta_i'$ as given.
Distributions of Implied $A_i$s and $B_i$s

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.
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 $B_i$s vs. Self-Assessed Relative Efficiency of WFH, for $\alpha$ 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.
<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Output $\Delta \log(pY)$</th>
<th>Measured Productivity $\Delta \log(pY/H)$</th>
<th>Productivity Accounting for Commuting + Grooming Time $\Delta \log\left(\frac{pY}{H + T + G}\right)$</th>
<th>Profits $\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-0.9</td>
<td>-0.3</td>
<td>-1.3</td>
<td>-4.5</td>
</tr>
<tr>
<td>2020</td>
<td>-10.9</td>
<td>-11.4</td>
<td>-9.9</td>
<td>-5.8</td>
</tr>
</tbody>
</table>

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

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 $H = \int h_i di$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i)\text{DAYS}_i\delta_i + (t_i + g_i)\text{DAYS}_i(1 - \delta_i) + g_i\text{DAYS}_i] di$. $\Pi$ 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

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Holding Hours, Prices, and Wages Constant</th>
<th>Letting Hours, Prices, and Wages Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-1.6</td>
<td>-0.1</td>
</tr>
<tr>
<td>2020</td>
<td>3.3</td>
<td>-7.0</td>
</tr>
</tbody>
</table>

**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.
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 \( \gamma_i \) such that \( \delta_i^* \) 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 \( \delta_i^* \) is the worker’s preferred arrangement with “no consequences,” so that \( \delta_i^* \) maximizes utility holding consumption and hours constant:

\[ \delta_i^* \equiv \arg\max_{\delta_i} \log(c_i) - \chi_i \frac{h_i^{1+\eta}}{1+\eta} - \frac{1}{2} (\delta_i - \gamma_i)^2 \]

- 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)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Δlog(pY))</th>
<th>Δlog(pY/H)</th>
<th>Δlog(\frac{pY}{H + T + G})</th>
<th>(\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-0.7</td>
<td>-0.2</td>
<td>-1.1</td>
<td>-4.2</td>
</tr>
<tr>
<td>2020</td>
<td>-12.3</td>
<td>-11.4</td>
<td>-11.0</td>
<td>-7.2</td>
</tr>
<tr>
<td>Worker desired amount of WFH</td>
<td>-5.1</td>
<td>-4.4</td>
<td>-4.6</td>
<td>-3.9</td>
</tr>
</tbody>
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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 \(H = \int h_i d_i\). Hours worked inclusive of commuting and grooming time are \(H + T + G = \int [h_i + f_i(t_i + g_i)\text{DAYS}_i\delta_i + (t_i + g_i)\text{DAYS}_i(1 - \delta_i) + g_i\text{DAYS}_i]d_i\). \(\Pi\) 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 (\(\delta_i = y_i\)). 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

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</tbody>
</table>

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](http://www.wfhresearch.com)

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


  [www.wfhresearch.com](http://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 $\geq 10K$ in 2019 ($\geq 20K$ in early survey waves). From January to March 2022, we transitioned to earned $\geq 10K$ 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.
**Primacy Bias: Slightly Less Positive when ‘Better’ is Shown Last**

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

<table>
<thead>
<tr>
<th>Comparison</th>
<th>'Better' shown last</th>
<th>'Better' shown first</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much better, &gt;35%</td>
<td>12.3</td>
<td>12.9</td>
</tr>
<tr>
<td>Substantially better, 25-35%</td>
<td>6.7</td>
<td>7.7</td>
</tr>
<tr>
<td>Significantly better, 15-25%</td>
<td>8.3</td>
<td>8.1</td>
</tr>
<tr>
<td>Better, 5-15%</td>
<td>11.5</td>
<td>14.6</td>
</tr>
<tr>
<td>Somewhat better, &lt;5%</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>About the same</td>
<td>41.7</td>
<td>47.9</td>
</tr>
<tr>
<td>Somewhat worse, &lt;5%</td>
<td>0.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Worse, 5-15%</td>
<td>7.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Significantly worse, 15-25%</td>
<td>2.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Substantially worse, 25-35%</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Much worse, &gt;35%</td>
<td>2.6</td>
<td>2.7</td>
</tr>
</tbody>
</table>

**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)

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

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

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 distribution 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)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>$\Delta \log(pY)$</th>
<th>$\Delta \log(pY/H)$</th>
<th>$\Delta \log \left( \frac{pY}{H + T + G} \right)$</th>
<th>$\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>0.5</td>
<td>0.1</td>
<td>-0.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>2020</td>
<td>-8.4</td>
<td>-11.1</td>
<td>-7.6</td>
<td>-7.2</td>
</tr>
</tbody>
</table>

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 $H = \int h_i \text{di}$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c) \text{DAYS}_i] \delta_i + (t_i + g_i^c) \text{DAYS}_i(1 - \delta_i) + g_i \text{DAYS}_i] \text{di}$. $\Pi$ 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 Without Allocating Commute Time Savings to Work (Time Saving Model)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Holding Hours, Prices, and Wages Constant</th>
<th>Letting Hours, Prices, and Wages Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>“2019”</td>
<td>-2.3</td>
<td>-2.4</td>
</tr>
<tr>
<td>“2020”</td>
<td>5.1</td>
<td>-5.1</td>
</tr>
</tbody>
</table>

**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.)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>$\Delta \log(pY)$</th>
<th>$\Delta \log(pY/H)$</th>
<th>$\Delta \log \left( \frac{pY}{H + T + G} \right)$</th>
<th>Profits $\frac{\Pi' - \Pi}{0.5(\Pi' + \Pi)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-0.3</td>
<td>-0.1</td>
<td>-1.1</td>
<td>-1.1</td>
</tr>
<tr>
<td>2020</td>
<td>-12.0</td>
<td>-11.7</td>
<td>-10.2</td>
<td>-10.9</td>
</tr>
<tr>
<td>Worker desired amount of WFH</td>
<td>-4.7</td>
<td>-4.5</td>
<td>-4.1</td>
<td>-4.5</td>
</tr>
</tbody>
</table>

**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 $H = \int h_i \, di$. Hours worked inclusive of commuting and grooming time are $H + T + G = \int [h_i + f_i(t_i + g_i^c) \text{DAYS}_i \delta_i + (t_i + g_i^c) \text{DAYS}_i (1 - \delta_i) + g_i \text{DAYS}_i] \, di$. $\Pi$ 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 ($\delta_i = y_i$). 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)  

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Holding Hours, Prices, and Wages Constant</th>
<th>Letting Hours, Prices, and Wages Adjust</th>
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</thead>
<tbody>
<tr>
<td>2019</td>
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<td>-4.2</td>
</tr>
<tr>
<td>2020</td>
<td>-2.2</td>
<td>-9.4</td>
</tr>
<tr>
<td>Worker desired amount of WFH</td>
<td>6.6</td>
<td>2.2</td>
</tr>
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</table>

**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.
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<thead>
<tr>
<th>Counterfactual</th>
<th>( \Delta \log(pY) )</th>
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<th>( \Delta \log \left( \frac{pY}{H + T + G} \right) )</th>
<th>Profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-1.9</td>
<td>-0.8</td>
<td>-2.1</td>
<td>-5.0</td>
</tr>
<tr>
<td>2020</td>
<td>-11.0</td>
<td>-11.9</td>
<td>-10.3</td>
<td>-9.2</td>
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</tbody>
</table>

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 \( H = \int h_i \, di \). Hours worked inclusive of commuting and grooming time are \( H + T + G = \int [h_i + f_i(t_i + g_c \text{DAYS}_i)\delta_i + (t_i + g_c \text{DAYS}_i)(1 - \delta_i) + g_i \text{DAYS}_i] \, di \). \( \Pi \) 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)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Holding Hours, Prices, and Wages Constant</th>
<th>Letting Hours, Prices, and Wages Adjust</th>
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<tbody>
<tr>
<td>2019</td>
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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)

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Δlog(pY)</th>
<th>Δlog(pY/H)</th>
<th>Δlog ( \frac{pY}{H + T + G} )</th>
<th>Profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-0.5</td>
<td>-0.5</td>
<td>-1.1</td>
<td>-4.3</td>
</tr>
<tr>
<td>2020</td>
<td>-11.6</td>
<td>-11.6</td>
<td>-10.5</td>
<td>-9.7</td>
</tr>
<tr>
<td>Worker desired amount</td>
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<td>-8.7</td>
<td>-8.4</td>
<td>-9.7</td>
</tr>
</tbody>
</table>

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 \( H = \int h_i \, dt \). Hours worked inclusive of commuting and grooming time are \( H + T + G = \int [h_i + f_i(t_i + g_i^c)DAYS_i\delta_i + (t_i + g_i^c)DAYS_i(1 - \delta_i) + g_iDAYS_i] \, dt \). \( \Pi \) 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 (\( \delta_i = y_i \)). 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

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Holding Hours, Prices, and Wages Constant</th>
<th>Letting Hours, Prices, and Wages Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-4.6</td>
<td>-3.4</td>
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<tr>
<td>2020</td>
<td>-2.2</td>
<td>-9.9</td>
</tr>
<tr>
<td>Worker desired amount of WFH</td>
<td>6.6</td>
<td>-1.6</td>
</tr>
</tbody>
</table>

**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.