Macroeconomic Impact of the Work From Home Revolution

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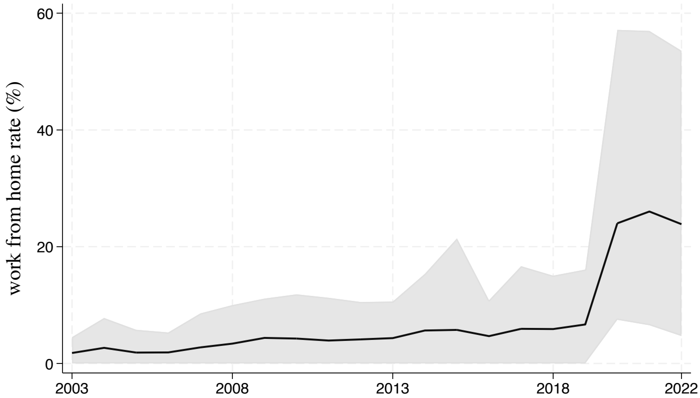
Motivation

COVID-19 pandemic spurred an unprecedented increase of work from home



Note: Work from home rate definition according to Barrero et al. (2023) using ATUS data.

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    - Setup: consider 3 sources of increased WFH rates

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    - Generalization: extend core theory along several dimensions, parameterize to U.S. economy
    - Quantitative analysis: importance of driving sources and overall macro impact of higher WFH
    - Validation: compare key model predictions to data

Related Literature

Work from home

- see e.g. Bloom et al. (2015); Natalia et al. (2019); Battiston et al. (2021); Barrero et al. (2022); Yang et al. (2022); Barrero et al. (2023); Decker, Haltiwanger (2023); Emanuel, Harrington (2023); Gibbs et al. (2023); Hansen et al. (2023); Monte et al. (2023); Bagga et al. (2024); Davis et al. (2024); Richard (2024)

Business dynamism

- see e.g. Hopenhayn, Rogerson (1993); Davis et al. (1994); Campbell (1998); Melitz (2003); Lee, Mukoyama (2012); Clementi, Palazzo (2016); Decker et al. (2016); Foster et al. (2016); Sedláček, Sterk (2017); Sterk et al. (2021)

Core Theoretical Framework

Core Theoretical Framework: “Pre-COVID” World

Theory of firms’ optimal choices, including the choice of letting employees WFH

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3. Preferences: workers may prefer WFH
   - willing to sacrifice wages in return for WFH flexibility
   - see e.g. Mas and Pallais, 2017; Barrero et al., 2021; He et al., 2021

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- Preferences: $h(\omega) \in [0, 1]$, $h'(\omega) < 0$: WFH lowers wage costs

Core Theoretical Framework: Firm Values, Entry and Exit

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Firm entry (free entry):

$$\kappa_e = \int v(z)h(z)dz,$$

- κ_e : entry cost, $h(z)$ productivity distribution

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Theoretical Results

Theoretical Results: Optimal Work From Home Rates

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Consider an increase in ω^* driven by an exogenous improvement in its productivity ($\uparrow f(\omega)$), reduction in its price ($\downarrow g(\omega)$) or an increase in its preference ($\downarrow h(\omega)$), then:

$$\frac{\partial \pi}{\partial \omega^*} > 0$$

Quantitative Model

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5. stochastic fixed costs ($\widetilde{\kappa}_o$) and endogenous firm exit ($v_j^x(k_{j,t})$)

More details?

Quantitative Model

Parametrization

Parameterization: Work From Home

Parameterization strategy (2003-2019 period)

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  - share of small firms (BED)
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Other parameters set in a "standard" fashion

Don't trust me?

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- willingness to sacrifice wages (4% vs 0 for hybrid setting)
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Quantitative Model

Results

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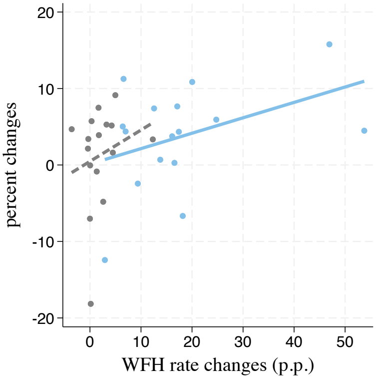

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Lower price of WFH shifts distribution of firms towards smaller businesses

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Higher productivity of WFH increased average firm-level productivity by about 1%

Results: Business Dynamism in Model and Data

	Entry rate	Size				Exit rate		
		Entrants	Young	Old	Exiters	All	Young	Old
Model	$+13\%$							

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Model	$+13\%$	-16%	-18%	-15%	-21%	$+13\%$	$+5\%$	$+19\%$

Results: Business Dynamism in Model and Data

	Entry rate	Size				Exit rate		
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Model	+13%	−16%	−18%	−15%	−21%	+13%	+5%	+19%
Data	+28%	−24%	−18%	−15%	−22%	+15%	+1%	+22%

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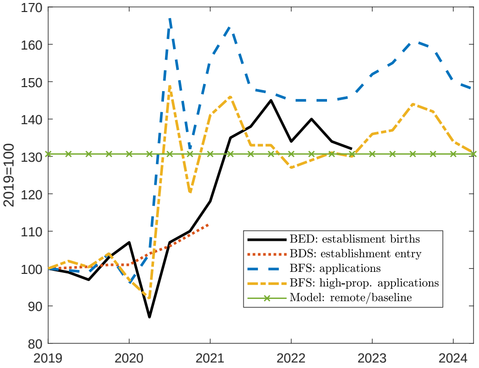

"...surprising surge in applications for new businesses..." (Decker and Haltiwanger, 2024)

Results: Aggregate Output and Welfare

Panel A: Full adjustment

	Output (Y)		Welfare ($\mathcal{W}$)	
Overall	2.9		0.2	
Components	Z	$(N^{\alpha}K^{1-\alpha})^{\theta}$	C	N
	1.1	1.7	0.3	−0.1

More details

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Panel B: No change in the mass of firms

	Output (Y)		Welfare ($\mathcal{W}$)	
Overall	−1.5		0.0	
Components	Z	$(N^\alpha K^{1-\alpha})^\theta$	C	N
	−0.6	−1.0	−0.0	0.0

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Novel identification strategy using "rental commitments" in Compustat

$$\ln y_{j,t} = \alpha + \beta_E \mathbb{1}(E)_j + \beta_T \mathbb{1}(T)_{j,t} + \beta_{E,T} \mathbb{1}(T)_{j,t} \mathbb{1}(E)_j + \mathbf{X}'\theta + \epsilon_{j,t}$$

- y : object of interest (costs, productivity)
- $\mathbb{1}(E)$: indicator fce =1 when firm is "exposed", $\mathbb{1}(T)$: indicator fce=1 for 2020-2023
- "exposure": firm has no rental commitments as of 2020 (can "downsize")

Model Mechanism in Data: Results

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	rental costs		fixed costs		variable costs		productivity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure, $\beta_{E,T}$	-0.46^{***}	-0.55^{***}	-0.19^{**}	-0.10^{**}	-0.10	-0.09^{**}	-0.07^{*}	-0.06^{**}
	(0.05)	(0.07)	(0.08)	(0.04)	(0.08)	(0.04)	(0.04)	(0.03)
Fixed effects		✓		✓		✓		✓
R-squared	0.02	0.43	0.06	0.55	0.0002	0.50	0.01	0.41
Observations	23,006	23,006	23,018	23,018	25,666	25,666	25,139	25,139

Conclusion

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Remote work surged since 2020

- show theoretically why/how remote work changes affect business dynamism
- build rich model to quantitatively evaluate *macroeconomic* impact

Key results

- remote work rise predominantly driven by preferences
- more favorable/desired remote work conditions encourage firm entry
- but small (less productive) firms benefit more (conditional on conducting WFH)
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- implications for “new business types”?

Thanks!

Appendix

Incumbent Firms: Values and Decisions

Firms which have not yet paid remote work setup cost:

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$$v_j(z_{j,t}, k_{j,t}) = \max_{n_{j,t}, x_{j,t}} \left\{ \pi_{j,t} + \beta(1-\delta) u_j(z_{j,t}, k_{j,t}) \right\}$$

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Go back

Firm Entry: Endogenous Long-Run Differences

Build on setting in Sedláček, Sterk (2017)

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Assuming free entry gives

$$\kappa_e = \frac{m_i}{s_i} \int \max \left[v(z, 0; \bar{z}_i, \kappa_i^\omega), v^\omega(z, 0; \bar{z}_i, \kappa_i^\omega) - \kappa_i^\omega \right] dH_z(z)$$

Go back

Parameterization table

	Parameter	Value	Target/Source	Data	Model
β	Discount factor	0.96	Interest rate of approx. 4%		
α	Labor elasticity of output	0.65	Labor share in income of approx. 65%		
θ	Returns to scale	0.90	Basu, Fernald (1997) estimate		
δ_k	Capital depreciation	0.08	Cooper, Haltiwanger (2006)		
υ	Disutility of labor	0.0173	Normalization, $W = 1$		
κ_e	Entry cost	0.67	Normalization, $s_H + s_L = 1$		
ϕ	Elasticity of entry function	0.156	Sedláček and Sterk (2017)		
κ_L^ω	"Low" remote work setup costs	0.00	Normalization, minimum remote work setup cost of 0		
$\widetilde{f}$	Speed of remote work productivity losses	-0.151	Productivity loss of fully remote work, Battiston et al. (2021)	14%	14%
$\widetilde{g}$	Speed of remote work cost savings	0.325	Average work from home rate, ATUS	4.1%	3.9%
$\widetilde{h}$	Degree of household preferences for remote work	0.325	Wages unresponsive to remote work	0	0
κ_n	Non-wage labor costs	0.255	Avg wfh rate of 100+ over 100− firms, ATUS & ASEC	1.12	1.12
κ_H^ω	"High" remote work setup costs	5.3	Share of large firms conducting remote work, BRS	30%	29%
Ψ_ω	Share of "low" remote work setup costs	0.195	Share of firms conducting remote work, BRS	23%	23%
Ψ_L	Mass of "low" business opportunities	$1.1e-4$	Share of small (<50) businesses, BED	95%	94%
Ψ_H	Mass of "high" business opportunities	$9.2e-6$	Startup success rate, BED	21%	24%
z_H	Mean "high" productivity	0.131	Average establishment size, BED	15.4	14.9
z_L	Mean "low" productivity	0.104	Average establishment size of small (<50) businesses, BED	6.8	7.6
ρ	Productivity persistence	0.723	Establishment size life-cycle profile, BED	see Figure 3	
σ_z	Productivity shock dispersion	0.208	Establishment size life-cycle profile, BED	see Figure 3	
ζ_0	Capital adjustment costs, fixed	0.001	Establishment size life-cycle profile, BED	see Figure 3	
ζ_1	Capital adjustment costs, variable	0.61	Establishment size life-cycle profile, BED	see Figure 3	
μ_κ	Overhead costs, mean	0.795	Establishment exit life-cycle profile, BED	see Figure 3	
σ_κ	Overhead costs, dispersion	2.49	Establishment exit life-cycle profile, BED	see Figure 3	

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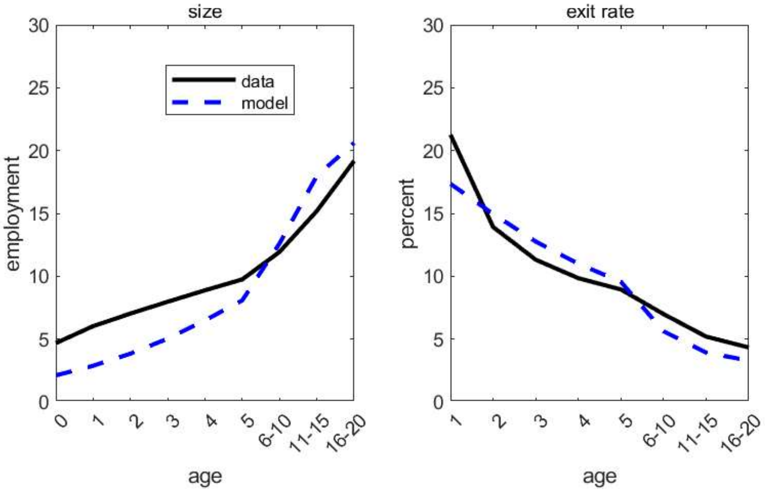
Model Fit



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Model Fit

- match TFP persistence and dispersion (Foster et al., 2008)
- match level and dispersion of investment rates (Cooper, Haltiwanger, 2006)
- match share of gazelles (Haltiwanger et al., 2016)
- match size distribution of share of firms conducting remote work

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Aggregate Effects: Details

$$Z = \frac{Y}{(N^{\alpha}K^{1-\alpha})^{\theta}} = \sum_{i}\sum_{l}\int\int zf(\omega)\left(\left(\frac{n}{\overline{\overline{n}}}\right)^{\alpha}\left(\frac{k}{\overline{\overline{k}}}\right)^{1-\alpha}\right)^{\theta}\Omega^{1-\theta}\widetilde{\mu}_{i,l}(z,k)dzdk, \tag{1}$$

Back