No Commute, No Car?
Remote Work and Vehicle Demand

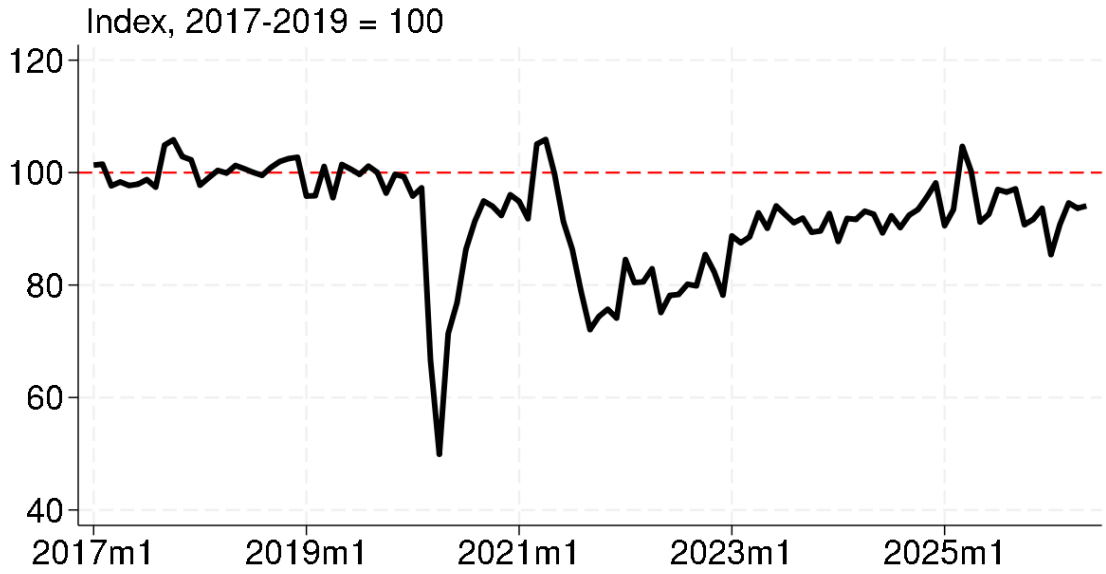
Sinem Hacioğlu-Hoke, Gisela Rua, & Maria D. Tito

Federal Reserve Board

Remote Work Conference
October 29, 2026

The views expressed are those of the authors and do not necessarily reflect those of the Board of Governors of the Federal Reserve System.

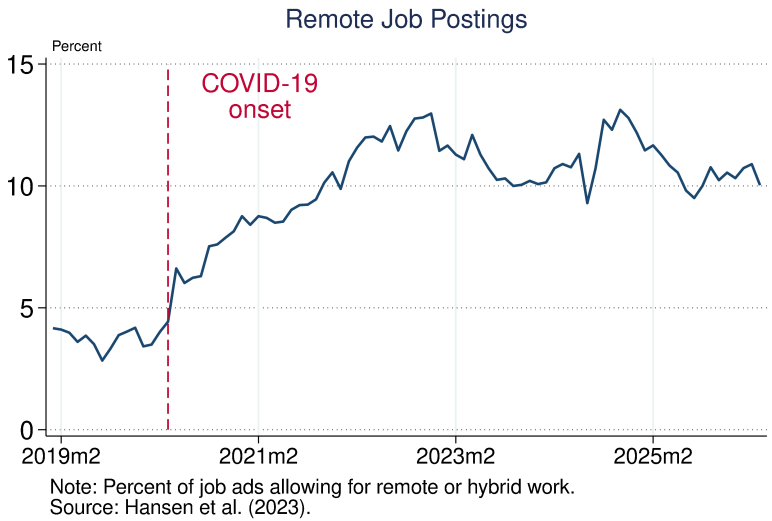
The Sluggish Post-Pandemic Trajectory of Light Vehicle Sales...



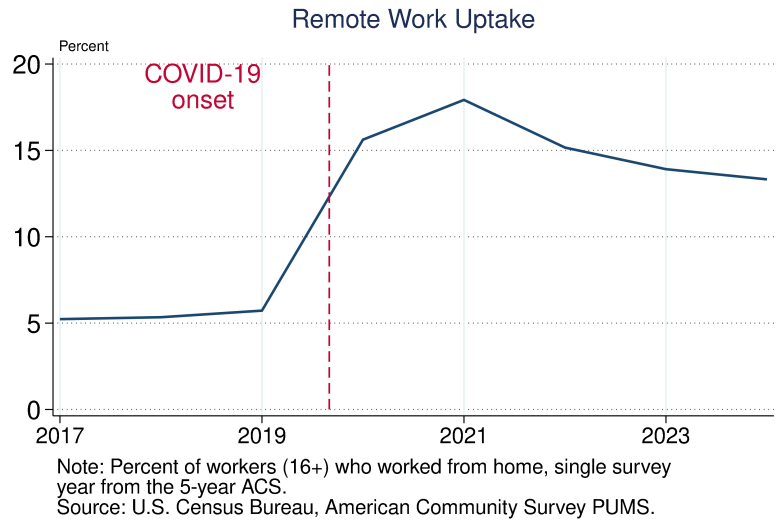
Source: Informa, Wards Data Intelligence Query.

- After post-pandemic volatility, new light vehicle sales remain ~ 7 percent below their 2017-2019 average.
- Shortfall even more pronounced if comparing with a trend projection based on population growth (▸ LV Trend).

...And The Shift to Remote Work



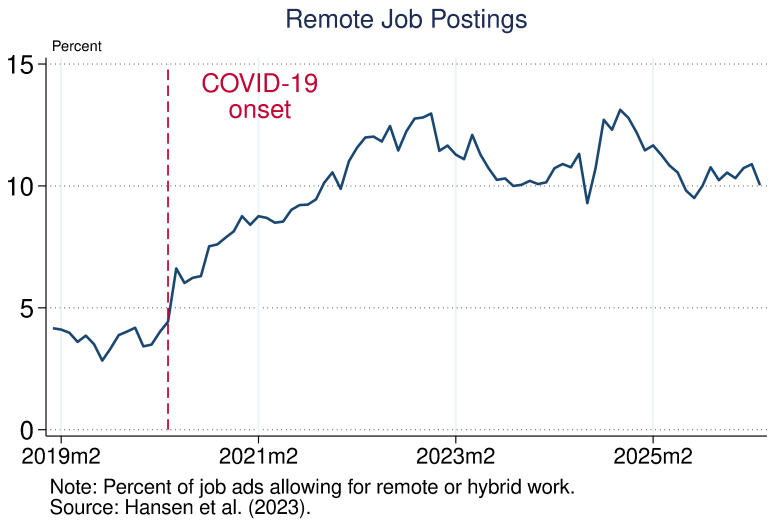
Note: Percent of job ads allowing for remote or hybrid work.
Source: Hansen et al. (2023).



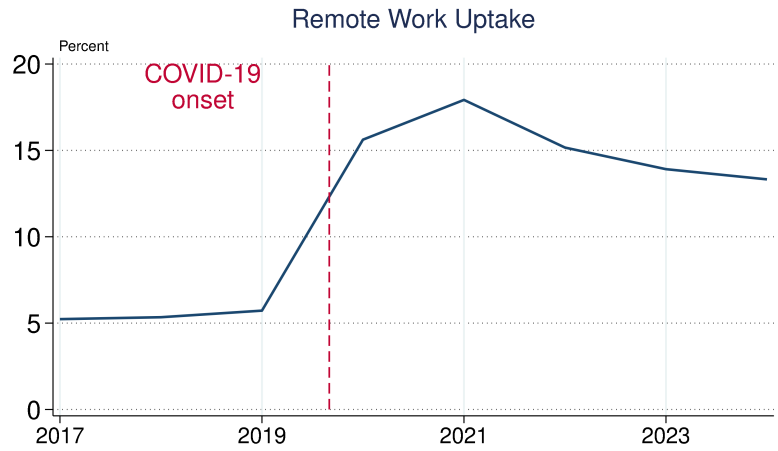
Note: Percent of workers (16+) who worked from home, single survey year from the 5-year ACS.
Source: U.S. Census Bureau, American Community Survey PUMS.

- Remote work surged following the COVID-19 pandemic and has stabilized at higher levels.[Barrero, Bloom & Davis (2021, 2023), Aksoy et al. (2025), Buckman et al. (2025)]

...And The Shift to Remote Work



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Is remote work driving lower vehicle sales?

What We Find

- Declines in new vehicle registrations relative to pre-pandemic period in counties with higher exposure to remote work.

- Significant heterogeneity across registration types; 1 SD larger exposure to remote work lowers
  - household registrations by **8–10** percent of SD
  - firm registrations by **20–25** percent of SD
  - government fleet by **30–40** percent of SD

- Lower sales translate into lower (federal) vehicle stock
  - Declines in vehicle acquisitions...
  - ...only partly offset by declines in vehicle utilization.

Related Literature

- Rise and implications of remote work [Bloom et al. (2015), Mas & Pallais (2017), Dingel & Neiman (2020), Barrero, Bloom & Davis (2021, 2023), Aksoy et al. (2025)]
  - Impact on urban structure [Ramani & Bloom (2021), Delventhal, Kwon & Parkhomenko (2023), Gupta, Mittal & Van Nieuwerburgh (2026)
  - Impact on environment [Krebs, et al. (2026)]
  - Impact on consumption patterns [Baker et al. (2025), De Fraja et al. (2026), Gambuli et al. (2026)]
- Determinants of vehicle demand and the dynamics of vehicle stock [Greenspan & Cohen (1999), Attanasio, Goldberg & Kyriazidou (2008), Busse, Knittel & Zettelmeyer (2013), Jacobsen (2013)]

Data

Source	Used for
Main County-Level Analysis	
– Polk new vehicle registrations by county and owner type, 2015–2025	Outcome
– Lightcast share of remote job postings, 2019–2025 [Hansen et al. (2023)]	Remote work
– ACS Remote Work, 2017–2024	
– 2016 ACS county occupations and O*NET remote ability [Dingel & Neiman (2020), Montenovo et al. (2022)]	Instrument
– Census population, BEA income, NWS weather, BLS QCEW (establishments, employment, pay)	Controls
Evidence on Channels	
GSA Federal Fleet Report and OPM telework rates	Federal fleets
Automotive Fleet Top 300 matched to Lightcast postings	Commercial fleets

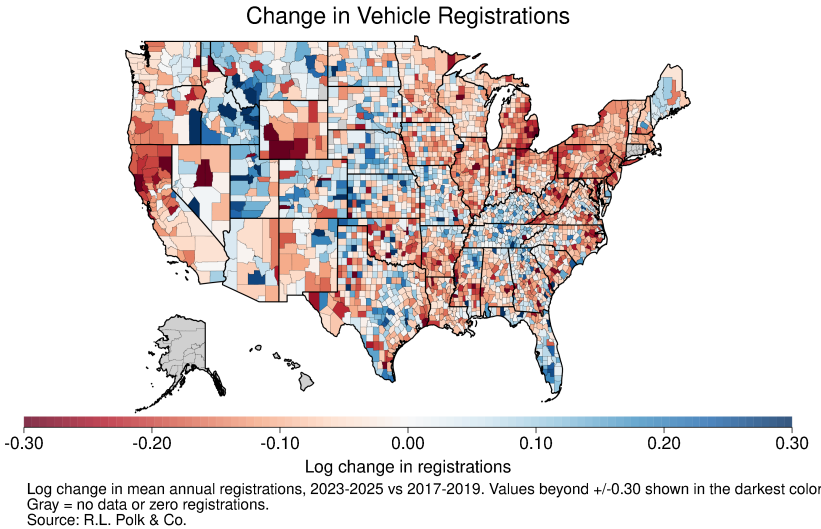
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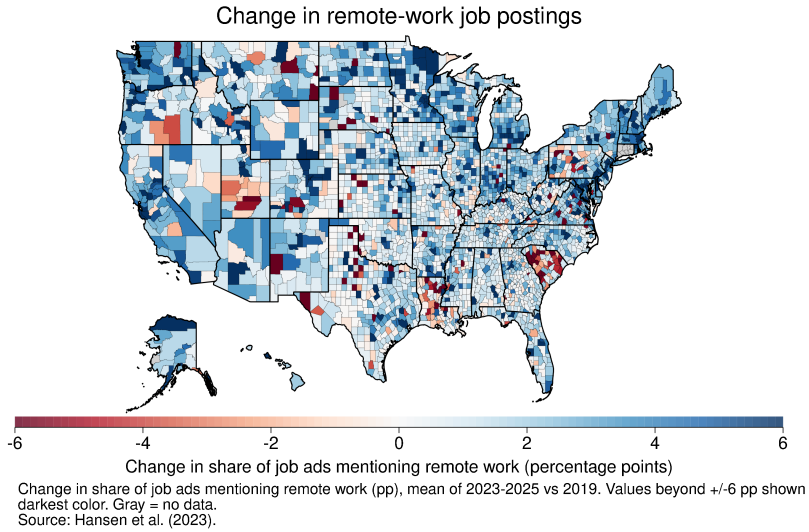
Main sample: 3,016 counties in 47 states, representing about 97 percent of the 2010 U.S. population

New Registrations and Remote Work

County Long-Difference Variation



Log change in mean annual registrations, 2023-2025 vs 2017-2019. Values beyond +/-0.30 shown in the darkest color
Gray = no data or zero registrations.
Source: R.L. Polk & Co.



Change in share of job ads mentioning remote work (pp), mean of 2023-2025 vs 2019. Values beyond +/-6 pp shown i
darkest color. Gray = no data.
Source: Hansen et al. (2023).

- **Long difference strategy:** Compare 2017–2019 with 2023–2025 to identify structural shifts in response to remote work.
  - Smoothing through sales volatility, particularly due to transitory shocks (stay-at-home orders, stimulus checks, semiconductor shortages)
  - 2017–2019 counterfactual aligns with pre-pandemic population trend projections.

Empirical Design

$$\Delta \ln \text{Regs}_c = \beta_0 + \beta_1 \, \Delta \text{RemoteWork}_c + \beta_2 \, \Delta X_c + \gamma_s + \varepsilon_c$$

Outcome: Light vehicle registrations

- Measured at owner location

Main Regressor: Remote work exposure

- Share of remote job postings or workers reporting WFH.
- Captures labor demand or worker behavior in the county of residence.

Controls and specification:

- Controls: population growth, income, weather, local business activity
- State fixed effects absorb state-level policies and trends
- First difference regression implicitly absorbs time-invariant county unobservables
- 2010 population weights for national representativeness

Instrumental variable strategy:

$$Z_c = \sum_o s_{oc}^{2016} \times A_o$$

Intuition:

- Predetermined county occupation structure (s_{oc}^{2016}), fixed before pandemic and remote work surge
- Some occupations inherently more teleworkable (A_o) based on physical task requirements and communication technology [Dingel & Neiman (2020); Montenovo et al. (2022)]
- Robust first-stage F-stats (above 200)

Identification: Occupational Composition and Remote Work Ability

Instrumental variable strategy:

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Challenge: Remote work exposure for individuals may reflect occupational structure of other counties, not just where they reside.

- Instrumenting remote work uptake using own county and neighboring counties' occupational structure and remotability.

▸ First Stage

Declines in Registrations Linked to Remote Work Exposure

Effects on Total Registrations

	OLS	IV, Rem. Comm.	IV, Telew.
Postings	-0.29^{***}	-0.52^{***}	-0.49^{***}
ACS WFH	-0.31^{***}	-0.41^{***}	-0.35^{***}

Coefficients are percent changes in registrations per 1 pp of remote work. State fixed effects, 2010 population weights, standard errors clustered by state. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- Fairly consistent estimates across different measures and empirical strategies.
- 1 standard deviation increase in remote work exposure $\rightarrow$ 10-15 percent of SD lower registrations.

Registration Types

- **Retail:** vehicles titled to an individual
  - Around $^3/_4$ of all registrations.

- **Fleet:** vehicles titled to a business
  - **Firm:** vehicles titled to a business that registers no more than five vehicles a month
  - **Commercial:** entities with large fleet transactions
  - **Government:** federal, state, and local agencies
  - **Rental:** rent-a-car companies

Declines Reflecting Responses of Households and Businesses

	OLS	IV, Rem. Comm.	IV, Telew.
Retail	-0.22^{***}	-0.28^{**}	-0.28^{**}
Fleet	-1.37^{***}	-2.20^{***}	-2.11^{***}
Fleet ex. rental	-0.56^{*}	-1.10^{**}	-1.11^{***}

Coefficients are percent changes in registrations per 1 pp of remote work. Full controls. State fixed effects, 2010 population weights, standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.10.

- Exploiting variation only within registration type.
- Responsiveness much stronger for fleet per SD change in remote work exposure
  - 8-10 percent of SD decline in retail registrations
  - 10-20 percent of SD decline in fleet (ex. rental) registrations
  - Rental registrations affected by a number of special factors, likely unrelated to remote work.

Looking within Fleets

	OLS	IV, Rem. Comm.	IV, Telew.
Government	−3.07***	−4.69***	−4.64***
Firm	−1.07***	−1.37***	−1.40***
Commercial	−0.42	−1.14*	−1.14*

Coefficients are percent changes in registrations per 1 pp of remote work. Full controls. State fixed effects, 2010 population weights, standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.10.

- Strong elasticities for government and firm fleets. 1 SD increase in remote work lowers
  - government registrations by 30-40 percent of SD
  - firm registrations by 20-25 percent of SD
- Commercial registrations, large fleets tied to field operations, show no robust response, ▸ firm-level response

Robustness

- Exposure-robust shift-share inference, ▸ inference
- Controlling for pre-pandemic characteristics, such as income, ▸ income
- Single post-pandemic years, ▸ post years
- ACS measure, ▸ ACS
- Alternative reference periods, ▸ Base period

The Impact of Remote Work on Government Fleet

A Collection of Anecdotes for State and Local Government

VIRTUAL INSPECTIONS REDUCE VEHICLE NEEDS *NBC San Diego, 2021*

"Performing an inspection without actually visiting the site. Wherever I am, I can just go on my iPad and do an inspection." — *Dan Scherer, Program Manager, San Diego Building Inspection*

Impact: Inspectors give contractors exact meeting times instead of 3-4 hour windows, saving time and money for both parties. Reduces inspector driving and fuel costs.

State of Ohio

170 vehicles eliminated
(5% of 3,400-unit fleet)

"With all agencies having to change the way they do business, it has been a lot easier to reduce our size."

— *Darryl Syler, CPFP*
State Fleet Administrator

✔ Virtual meetings more productive
✔ Shared fleet vehicles (instead of assigned) more common

Iowa State University

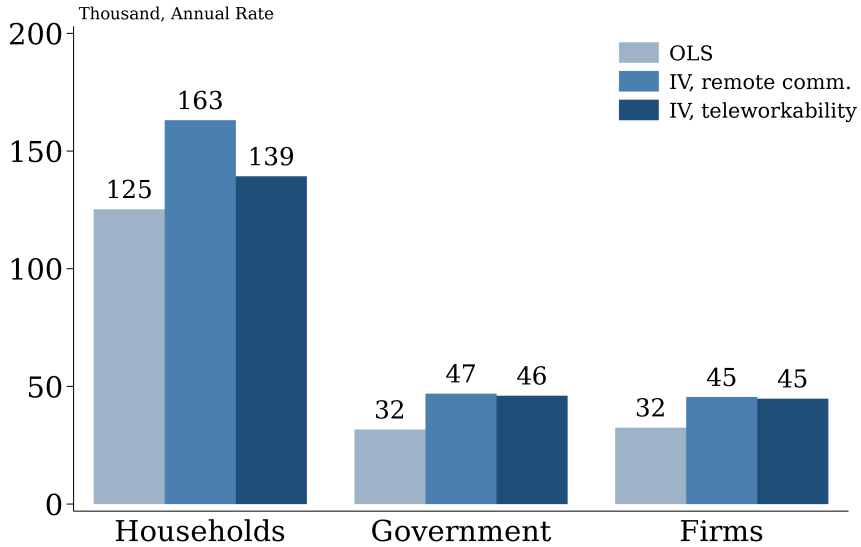
46 vans → 35 vans
(24% reduction)

"It's like playing Tetris to me, you can really move the reservations around to maximize vehicle reservations per vehicle, so then you don't need as many."

— *Kathy Wellik, CAFM*
Fleet Director

Automated kiosks for weekend rentals
Better utilization through data analysis

A Quantification Exercise



Registrations lost a year for the average 4.4 pp rise in remote work, applying the OLS and IV estimates to 2017–2019 national registrations.

- Rise in remote work accounts for 150,000–250,000 lower annual registrations.
- Declines driven by retail registrations, as they account for larger share despite lower responsiveness to remote work.

Implications for Vehicle Stock

$$V_t = V_{t-1} + \text{Registrations}_t - \text{Scrap}_t$$

- Change in vehicle stock, V_t, reflects new registrations net of scrappage[Greenspan & Cohen (1999)]

- Scrappage rates driven by utilization.

Implications for Vehicle Stock

$$V_t = V_{t-1} + \text{Registrations}_t - \text{Scrap}_t$$

- Change in vehicle stock, V_t, reflects new registrations net of scrappage[Greenspan & Cohen (1999)]
- Scrappage rates driven by utilization.
- Has remote work affected vehicle utilization?
  - GSA federal fleet data

The Federal Fleet

Civilian agencies	2017–19	2023–24	% change
Stock	246,312	245,987	−0.1
Acquisitions	28,665	26,522	−7.5
Disposals	27,737	24,170	−12.9
Miles per passenger vehicle	9,257	7,765	−16.1

GSA Federal Fleet Report. Averages of fiscal years 2017–19 and 2023–24. Age base is 2019 only.

- Large declines in acquisition, consistent with evidence from registrations.
- Disposals also fell substantially, likely reflecting lower utilization (miles per vehicle)
- Change in the stock more muted.

Vehicle Stock Lower at Agencies With Higher WFH Rate

	FEVS survey	OPM administrative
Log inventory	−6.74***	−5.43***
Log miles per vehicle	−0.42***	−0.14
Agencies	25	37

Coefficients are percent changes per 1 pp of agency telework. Period fixed effects, respondent weights for FEVS and employment weights for OPM. Miles regressions have 49 and 72 observations, inventory regressions 50 and 73. *** $p<0.01$.

- Exploiting cross-section variation in telework rates and fleet characteristics.
- Utilization is lower at agencies with higher telework rates, but the impact on stock is net negative, suggesting a dominant impact of the "registration" channel.

Conclusions

- Persistent decline in new registration driven by remote work.
- Decline in registrations reflects not only responsiveness of households but also of government and firm.
- Detailed micro-data suggests the impact of remote work on registrations has further implications for vehicle stock.

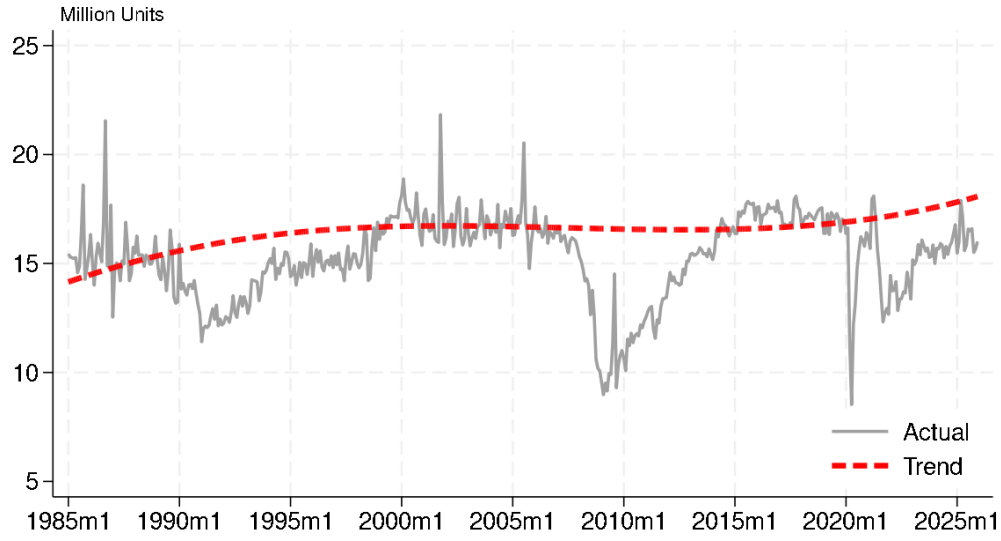
Thank You!


C.TOM
WORK-FROM-HOME COMMUTE


THE WALL STREET JOURNAL.
"Consider yourself fortunate.
Some employees don't have
a company vehicle at all."

Appendix

Light Vehicle Sales and Population-Based Trend

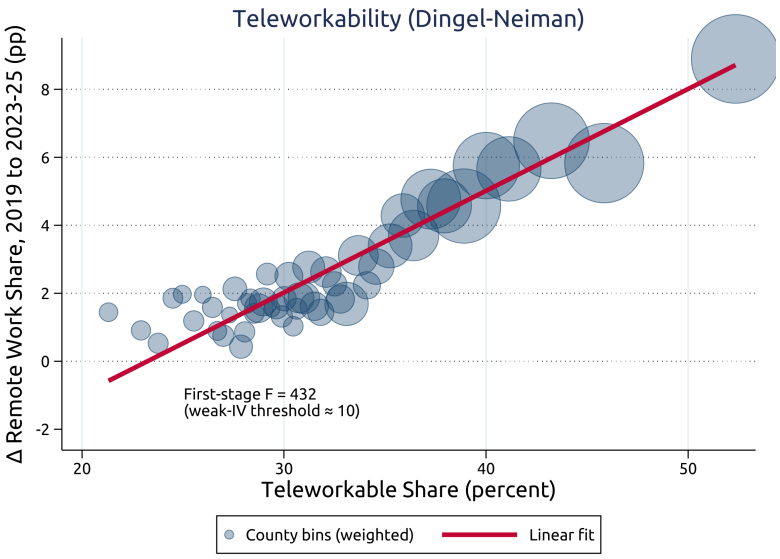


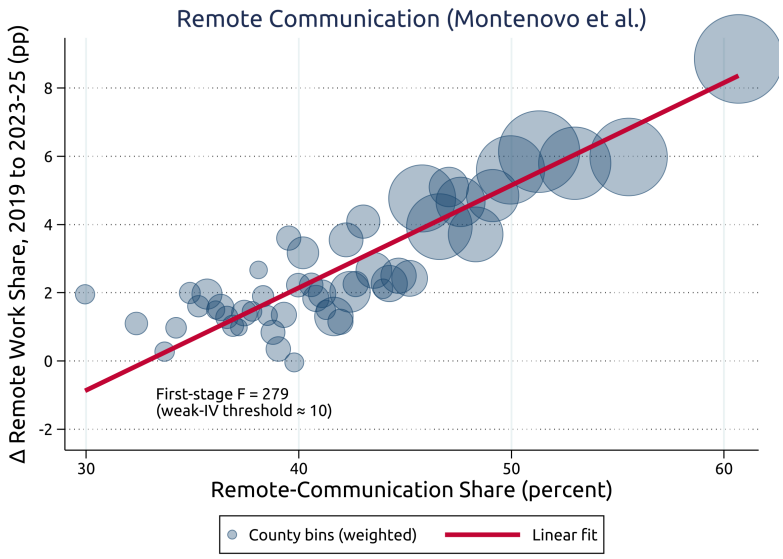
Notes: Trend based on growth rates of detailed population groups, estimated over 1980-2019.
Source: Informa, Wards Data Intelligence Query and Census Bureau.

- A projection based on population growth and estimated over 1980-2019 call for a continued increases in sales in the post-pandemic period.
- Light vehicle sales averaging 10 percent below trend over the 2023-2025 period.

Back

First Stage





- Counties with more teleworkable jobs in 2016 adopted more remote work after 2020
- The relationship is close to linear under both measures

Teleworkability [Dingel & Neiman (2020)] on the left, remote communication [Montenovo et al. (2022)] on the right. Population-weighted binned scatters.

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Reference Period

Base	2019	2018–2019	2017–2019
Government	−3.10***	−3.89***	−4.59***
Firm	−0.99***	−1.23***	−1.43***

Coefficients are percent changes in registrations per 1 pp of remote work. Teleworkability IV. State fixed effects, 2010 population weights, standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.10.

- Government registrations in high-instrument counties dipped in 2018–2019, with no change before
- A 2019 base therefore biases the estimates toward zero
- Controlling for the earlier firm decline lowers firm estimates by about 15 percent, still significant
- With a 2019 base and the income control, government IV estimates remain significant

◂ design ◂ robustness

Controlling for Pre-Pandemic Income

	OLS	IV, Rem. Comm.	IV, Telew.
Total	-0.25^{**}	-0.27^{*}	-0.18
Government	-2.79^{***}	-3.65^{***}	-3.64^{***}
Firm	-1.00^{***}	-1.50^{***}	-1.46^{***}
Retail	-0.21^{***}	-0.31^{**}	-0.25^{**}

Coefficients are percent changes in registrations per 1 pp of remote work. The baseline already controls for income growth. This adds the 2019 log median household income level. State fixed effects, 2010 population weights, standard errors clustered by state. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- Teleworkable counties are richer, so we control for their 2019 income level
- Government, firm, and retail estimates survive, while the total IV estimates shrink
- The college share is too collinear with the instrument to serve as a control

Back

Exposure-Robust Inference

	Coefficient	t, state-clustered	t, exposure-robust
Total	−0.45	−2.82	−6.19
Government	−4.59	−4.81	−19.82
Firm excluding rental	−1.43	−4.60	−19.41

Coefficients are percent changes in registrations per 1 pp of remote work. Teleworkability IV. Exposure-robust inference aggregates to the 525 occupation shocks.

- Inference treats occupation shocks as the unit of assignment [Adão, Kolesár & Morales (2019), Borusyak, Hull & Jaravel (2022)]
- Significance strengthens for all three outcomes, and we keep the larger state-clustered errors as the baseline

Back

Single Post-Pandemic Years

	2023	2024	2025
Total	−0.13	−0.48***	−0.71***
Retail	0.19	−0.13	−0.76***
Government	−4.90***	−4.28***	−3.33***
Firm	−1.14***	−1.31***	−1.67***

Coefficients are percent changes in registrations per 1 pp of remote work. Teleworkability IV. Log change from the 2017–2019 average to the indicated year. Full controls. State fixed effects, 2010 population weights, standard errors clustered by state. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- Government and firm estimates are large and significant in every year
- Retail and total excluding rental fall clearly only in 2025, once the pandemic swings in household demand had passed

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ACS WFH

	OLS	IV, Rem. Comm.	IV, Telew.
Government	−2.05***	−3.98***	−4.13***
Firm	−0.61**	−1.22***	−1.28***
Retail	−0.15	−0.24*	−0.21*

Coefficients are percent changes in registrations per 1 pp of workers at home. ACS 2015–2019 to 2019–2023 five-year estimates. State fixed effects, 2010 population weights, standard errors clustered by state. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- The ACS share measures workers at home rather than new postings, with a rank correlation of 0.32 in changes
- Government and firm estimates hold, and retail falls in the IV estimates

Back

Registrations by Owner, 2017–2019 and 2023–2025

Thousands a year	2017–2019	2023–2025	% change
Rental	1,939	1,411	−27.3
Firm purchase	581	568	−2.3
Firm lease	154	104	−32.7
Government	252	294	+16.9
Commercial	939	1,068	+13.7
Retail	13,368	12,290	−8.1

National counts. Source R.L. Polk & Co.

- Rental is about three quarters of firm and rental registrations combined, so the firm category excludes it
- The national rise in government registrations is a common shift absorbed by state fixed effects

Back

Commercial Fleets

	Full sample	Drop top 3	Drop top 5
Across firms	−50.1***	−27.4**	−19.4*
Within industry	−43.6	−26.2*	−7.9
Within firm	1.1	−2.2	−2.2
Firms	180	177	175

Coefficients are vehicles per 1 pp higher remote share of the firm's postings, 2019 versus the 2023–2025 average. Firms are dropped by 2019 fleet size. Period fixed effects. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- We match 180 of the Top 300 commercial fleets to their own postings, where the remote share rose by about 10 pp
- Remote-intensive firms run smaller fleets, and the gap narrows once the largest fleets are dropped
- Firms whose remote share rose more did not shrink their fleets more

Back