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Demand-Driven Technical Change: Evidence from WFH Technologies

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COVID-19 brought a sharp, unanticipated increase in the usefulness and value of technologies that support work from home (WFH). To investigate how this shock influenced the direction of technical change, we examine the text in 5.6 million U.S. patent applications published from 2010 to 2026. The share of patent applications that advances technologies in support of WFH rose by about two thirds within three years after the pandemic struck and remains about 50% above pre-pandemic levels five years later. The lasting rise in the WFH share of new applications concentrates in telecommunications – especially video conferencing, speech recognition, and audio processing. It is driven overwhelmingly by US corporations rather than foreign assignees or universities. In short, we find evidence that a sudden, lasting rise in WFH redirected innovation to technologies that support it.

Keywords: directed technical change, patents, COVID-19, work from home, remote work, video conferencing, text analysis, induced innovation
JEL Codes: O31, O33, J22, L63

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1 Introduction

COVID-19 brought a massive shift to work from home (WFH). In spring 2020, American workers supplied roughly half of paid labor services from home (Bick et al., 2023; Brynjolfsson et al., 2020). Stock prices reflected the shift immediately (Papanikolaou and Schmidt, 2022). Since 2023, the share of full paid workdays performed at home has settled in the 25-30% range, roughly four times the pre-pandemic share (Zarate et al., 2025; Barrero et al., 2021). Aksoy et al. (2022) provide evidence that workers and organizations were, on average, favorably surprised by the effectiveness of WFH.

These observations prompt us to ask whether COVID-19 also shifted the direction of innovation toward technologies that support video conferencing, audio processing, telecommuting, remote interactivity, and other technical advances that support WFH (collectively, "WFH technologies"). Acemoglu (1998, 2002) formalizes a theory of directed technical change, which predicts that innovators allocate effort to technologies that command large markets. The related literature goes back at least to Hicks (1932), who conjectured that relative factor price changes induce innovation to economize on newly expensive factors.

Credible empirical tests of this idea are scarce, in part because market-level shocks that are large enough and sudden enough for clear identification are rare. Previous work finds directed innovation responses to energy price changes (Newell et al., 1999; Popp, 2002), environmental and regulatory changes (Calel and Dechezleprêtre, 2016; Moscona and Sastry, 2022), labor scarcity (Hanlon, 2015), and demographic changes (Acemoglu and Restrepo, 2022). These developments typically unfold gradually, or with some foreshadowing, making it difficult to confidently assess the innovation response.

Motivated by these observations, we assess how the direction of technical change responds to a large, sudden, surprise shift in working arrangements. Specifically, we examine the text in more than 5 million U.S. patent applications, identifying the ones that advance WFH technologies. We construct a dictionary of 49 terms and search for them across patent titles, abstracts, claims, and descriptions. We group our terms into four categories: communication

and collaboration (e.g., video conferencing), remote access and digital infrastructure (e.g., telework), home-based work (e.g., work from home), and flexible and mobile work (e.g., hybrid work). Section 2 provides details.

An earlier version of this analysis, Bloom et al. (2021), documented a sharp rise in the WFH patent share through September 2020. At that point, it was unclear whether the surge reflected a pipeline acceleration effect—firms with nearly completed WFH innovations rushing to patent them—or the beginning of a persistent redirection of inventive effort. This paper resolves that issue. Drawing on patent applications files through mid-2025 (and published by the USPTO by March 2026), we show that the post-COVID surge in WFH patenting is not a transient pipeline effect but a durable shift in the direction of innovation. The WFH share of new U.S. patent applications remains 50% percent above its pre-pandemic level through mid-2025, with no sign of reverting to baseline.

2 Data

Our sample consists of U.S. patent applications filed at the United States Patent and Trademark Office (USPTO).[1] For each application, we observe the filing date, publication date, text (more precisely, title, abstract, claims, and description), Cooperative Patent Classification (CPC) codes, and harmonized assignee information[2] including name and country. Throughout, "description" refers to the first 5,000 characters of the description, which typically contains the invention summary. This approach ensures comparability across patent applications and eases the computational burden. Our sample covers filings published between January 2010 and March 2026, covering application dates from January 2010 through July 2025—approximately 5.6 million patent applications.

If the text of a patent application contains one or more terms from our 49-word WFH

[1] We draw the underlying patent application data from Google's Patents Public Data. More precisely, we focus on the kind code A1 (pre-grant published applications).

[2] We use the raw assignee information harmonized by the data provider, which is imperfect, especially regarding unifying different units of the same firms, name changes, etc. Nonetheless, we do not use this data to make more than descriptive statements at the assignee aggregation level.

dictionary, we classify it as advancing WFH technologies.[3] For each calendar month, we compute the WFH share as the percentage of patent filings classified as WFH. We use this approach for both computational costs reasons, as well as for tractability and transparency.[4]

We manually looked up a few sample titles of patent applications that contain the keywords included in our analysis. These show a broad range of technologies. Some video optimization examples include "Method and System for Elevating a Phone Call into a Video Conferencing Session" (Zoom Video Communications, Inc.), "Optimizing Video Conferencing Using Contextual Information" (Facebook, Inc.), and "Defining Content of Interest for Video Conference Endpoints with Multiple Pieces of Content" (Cisco Technology, Inc.). There is also work in infrastructure, security, and employee management. Some examples in these domains include "Enhancing Remote Work Productivity Data" (Microsoft Corporation), "Work-From-Home Agent Security Compliance" (Avaya Inc.), and advanced tooling such as "Speech Recognition and Summarization" (Google LLC).

[3]We primarily use the list from Bloom et al. (2021), adding just a few additional words primarily reflecting hybrid work: video conference, video conferencing, video chat, video call, teleconference, teleconferencing, virtual office, virtual-office, telework, teleworking, telecommuting, telecommuter, teleworker, telecommuting specialist, remote work, remote working, remote workplace, distance work, digital workplace, virtual work, virtual worker, virtual employee, working from a remote location, work from a remote location, working from home, work from home, work-from-home, work at home, work-at-home, home office, home-based office, home-based work, home-based worker, home-sourced worker, home-sourced employee, flexible workplace, flexible work, hybrid work, mobile work, mobile working, nomadic worker, nomadic employee, work from anywhere, working from anywhere, work-from-anywhere, working-from-anywhere, work away, work remotely, working remotely.

[4]We exclude months with fewer than 5,000 total filings and report three-month trailing moving averages throughout. There are long and variable lags from filing to publication by the USPTO (mean of about 13 months), but because the lag structure between for WFH and non-WFH patents share is not very different, even looking at patents published about 6 months ago the comparisons will likely not be very distorted. Because of this, we dropped in this version of the paper the adjustment in the initial Bloom et al. (2021) work.

3 Results

3.1 The WFH Share of Patent Applications

Figure 1 reports the share of newly filed patent applications that support WFH technologies at a monthly frequency from January 2010 through mid-2025. We plot two series: one based on searching patent titles and abstracts, and another based on searching descriptions. Both series show the same pattern: a pre-COVID WFH share that fluctuates without a clear trend, followed by a sharp and persistent increase after the pandemic. In the more generous definition, the WFH patents share averages approximately 0.5 percent over 2010–2019 and 0.7 percent after March 2020. In the last year before the pandemic, 2019, the full-year average of WFH patents is 0.42%; the 2023 full-year average is about 0.72%, representing an almost two thirds increase on the last pre-pandemic year. While somewhat lower than the 2022 and 2023 peaks, the share of WFH patents has not returned to its pre-pandemic level even five years after, remaining at more than 50% higher volume across definitions.

We believe this evidence rules out the idea that the companies that may produce WFH technologies simply shifted their innovation faster for them (pipeline acceleration), rather than producing new innovations. If the initial surge had merely reflected firms rushing to patent nearly completed WFH innovations, the WFH share would have returned to its pre-pandemic baseline by 2022 or 2023. Instead, it remains elevated five years later, consistent with a persistent redirection of incentives to innovate toward WFH technologies.

Figure 2 provides further reassurance by decomposing the WFH share across the four text fields that we analyze as part of the patent applications. Each panel shows what patents are captured by searching a specific area: title, title and abstract, claims, or description independently. Every text field shows a consistent post-2020 increase, which suggests this is a genuine change in the substantive content of patent applications rather than an artifact of incidental keyword mentions in any single field.

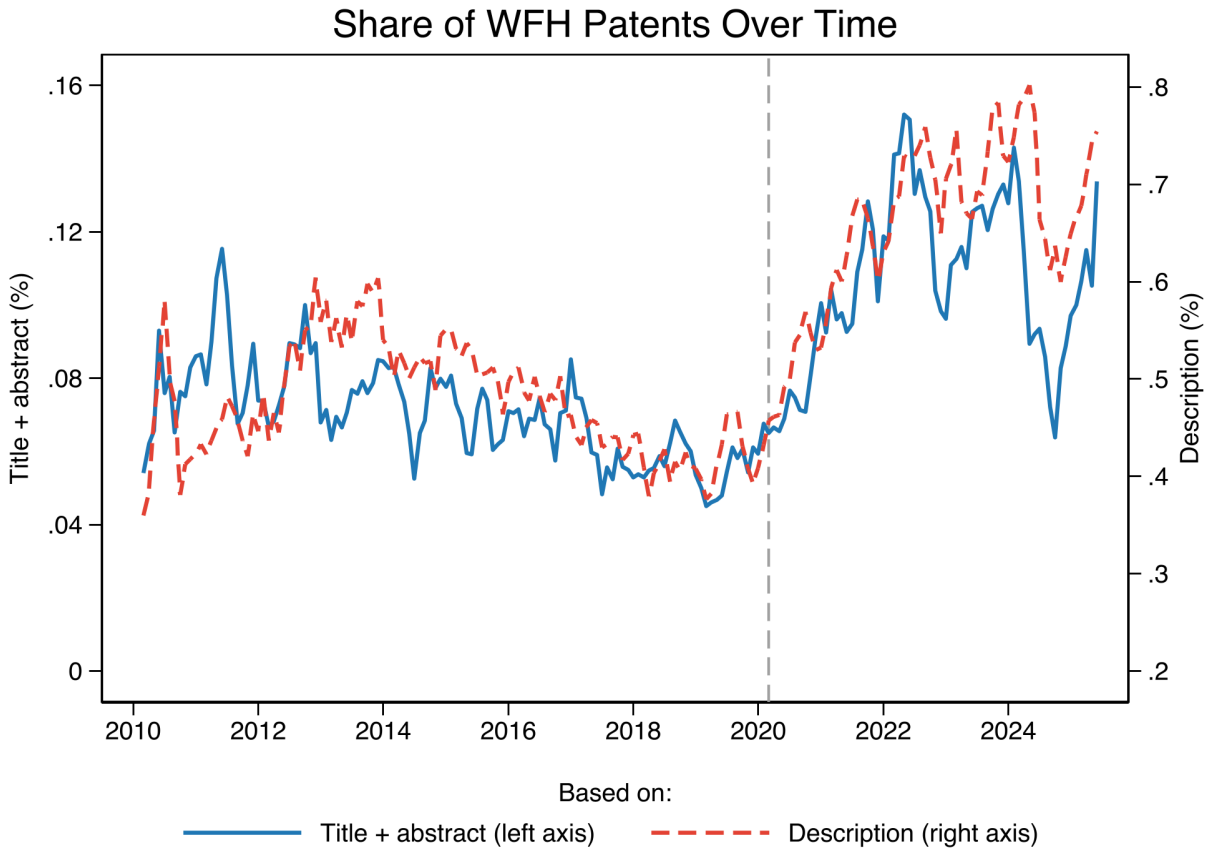


Figure 1: Share of WFH Patents Over Time

Notes: Monthly share of US patent applications containing at least one term from the 49-word WFH dictionary (see Section 2 for the full list of terms). The solid line searches patent titles and abstracts. The dashed line searches the description (first 5,000 characters) independently. The two series measure different, partially overlapping sets of patents: the title+abstract series captures patents where WFH terms appear prominently, while the description series captures patents where WFH terms appear in the technical exposition. Three-month trailing moving average. The vertical dashed line marks February 2020, the month before the WHO declared the novel coronavirus a global pandemic. The sample is patent applications filed January 2010 through July 2025, and published by March 24, 2026. Months with fewer than 5,000 total filings (corresponding to patent applications not yet published by March 2026) are excluded to avoid noise from thin samples. Analysis of USPTO patent applications.

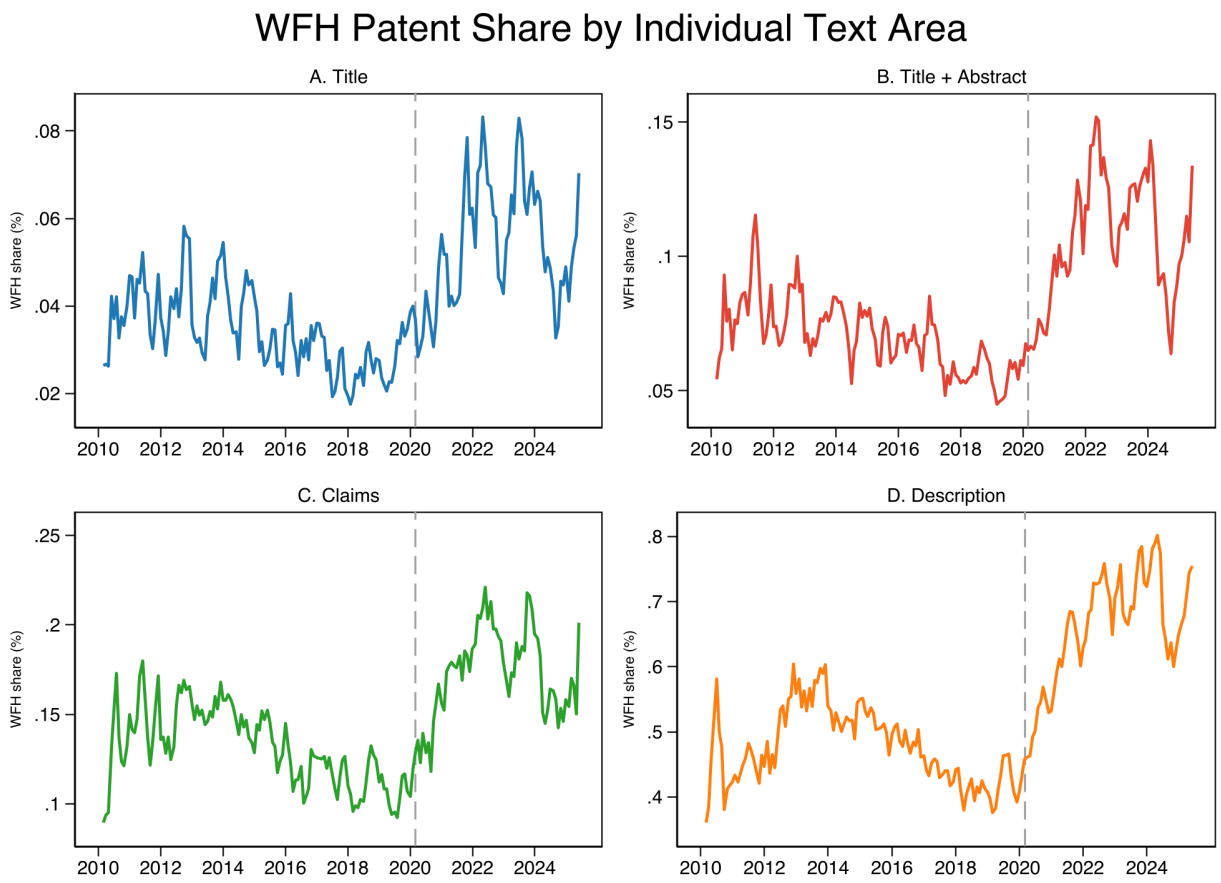


Figure 2: WFH Patent Share by Individual Text Area

Notes: Each panel shows the share of US patent applications containing at least one WFH term when searching a specific text field. Panel A: patents with at least one WFH term found in the title alone. Panel B: share based on searching the title and abstract jointly. Panel C: share based on searching the claims text independently. Panel D: share based on searching the description (first 5,000 characters) independently. Three-month trailing moving average. Vertical dashed line marks February 2020. The sample is patent applications filed January 2010 through July 2025, and published by March 24, 2026. Months with fewer than 5,000 total filings (corresponding to patent applications not yet published by March 2026) were excluded. Analysis of USPTO patent applications.

3.2 Communication and Remote Access Technologies

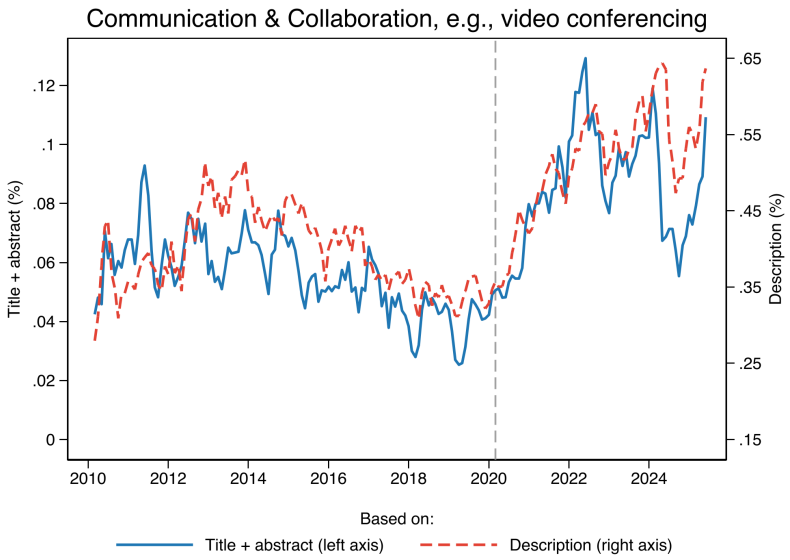
Figure 3a and 3b focuses on what we classify as the two largest WFH subcategories: communication and collaboration (Panel A) and remote access and digital infrastructure (Panel B).[5] Communication and collaboration terms mostly identify patents that help real-time video conference interaction, which is the core functionality of platforms like Zoom, Microsoft Teams, and Cisco Webex that became much more common during the pandemic. Remote access terms capture the broader infrastructure that help employees perform their jobs outside a traditional office. Having a manual look through a number of patents that are picked-up by this definition, these are often secure network connections, cloud-based work environments, and organizational tools. Together, these two subcategories account for the majority of WFH-flagged patents in our sample.

Both subcategories show roughly the same qualitative pattern whether we search titles and abstracts or descriptions: a sharp and persistent increase after the pandemic, that seems to be sustained at about 50% higher volume of patent application 5-years later. As shown in our previous work, these jumps in early 2020 are quite immediate post-Covid onset, suggesting firms were able to redirect their innovative effort quickly.

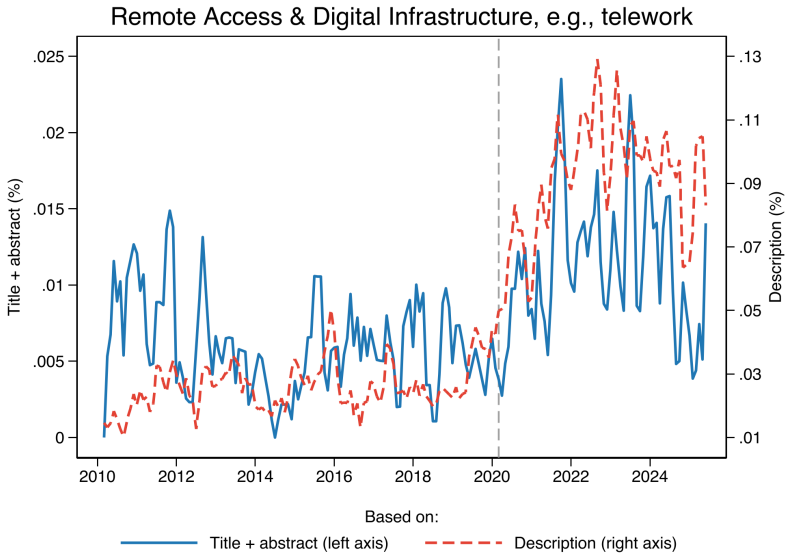
3.3 Which Technology Classes Respond?

Tables 1 and 2 identify the patent technology classes where the WFH share increased most from the pre-COVID period (January 2010 through February 2020) to the post-COVID period (March 2020 onward). At the 3-digit CPC level, audio and speech processing (G10), computing (G06), telecommunications (H04), healthcare IT (G16), and optics (G02) show the largest gains. These are exactly the technologies helping video conferencing, voice-

[5]The communication & collaboration subcategory includes 8 terms: video conference, video conferencing, video chat, video call, teleconference, teleconferencing, virtual office, virtual-office. The remote access & digital infrastructure subcategory includes 16 terms: telework, teleworking, telecommuting, telecommuter, teleworker, telecommuting specialist, remote work, remote working, remote workplace, distance work, digital workplace, virtual work, virtual worker, virtual employee, working from a remote location, work from a remote location.



(a) Communication & Collaboration, e.g., video conferencing



(b) Remote Access & Digital Infrastructure, e.g., telework

Figure 3: WFH Patent Share: Communication and Remote Access Subcategories

Notes: Panel (a) shows the monthly share of US patent applications containing at least one communication & collaboration term (video conference, video conferencing, video chat, video call, teleconference, teleconferencing, virtual office, virtual-office). Panel (b) shows the share containing at least one remote access & digital infrastructure term (telework, teleworking, telecommuting, telecommuter, teleworker, telecommuting specialist, remote work, remote working, remote workplace, distance work, digital workplace, virtual work, virtual worker, virtual employee, working from a remote location, work from a remote location). In each panel, the solid line (left axis) searches patent titles and abstracts; the dashed line (right axis) searches the description (first 5,000 characters) independently. The two axes use different scales to make the post-COVID increase visible in both series. Three-month trailing moving average. Vertical dashed line marks February 2020. The sample is patent applications filed January 2010 through July 2025, and published by March 24, 2026. Months with fewer than 5,000 total filings (corresponding to patent applications not yet published by March 2026) were excluded. Analysis of USPTO patent applications.

over-IP, and real-time communication platforms (the technologies that we have seen that they increased the most in Figure 3a). At the more disaggregated 5-digit level, the same subclasses dominate including terms regarding video telephony and transmission (WFH share rises from about 24 to 31 percent), telephone exchange systems, speech recognition, audio signal processing and document scanning.

Table 1: Top 5 CPC Classes by Increase in WFH Patent Share, Pre- vs. Post-COVID

CPC Class	Description	WFH Share (%) Pre-COVID	Post-COVID	Change (pp)	% Change
G10	Audio/speech	2.079	3.466	1.387	66.7
G06	Computing	0.886	1.275	0.389	44.0
H04	Telecom	2.622	3.002	0.381	14.5
G16	Healthcare IT	1.029	1.405	0.376	36.6
G02	Optics	0.225	0.530	0.305	135.7

Notes: This table reports the five Cooperative Patent Classification (CPC) classes (3-digit level) with the largest increase in WFH patent share, measured in percentage points, from the pre-COVID period to the post-COVID period. A patent application is classified as WFH if it contains at least one term from a 49-word dictionary searched in the title, abstract, claims, and description (first 5,000 characters). The WFH share is 100 times the number of WFH-flagged applications divided by total applications in that CPC class. Pre-COVID covers filing dates from January 2010 through February 2020; Post-COVID covers March 2020 onward. "Change (pp)" is the post-COVID share minus the pre-COVID share. "% Change" is the percentage change relative to the pre-COVID share. The sample is patent applications published between January 2010 and March 24, 2026. To ensure reliable estimates, we restrict to CPC classes with at least 10,000 pre-COVID and 5,000 post-COVID patent applications. CPC class descriptions follow the International Patent Classification scheme maintained by WIPO. Analysis of USPTO patent applications.

3.4 Which Firms Respond?

In the Appendix, Table 4 ranks assignees by the increase in WFH patent volume from pre- to post-COVID. Unsurprisingly, Zoom shows the largest increase in terms of patents produced (they have seen an increase not just in WFH patents, but also total patents that we don't directly show here). Huawei, Sony Group, Dell, and Google also show large increases. Notably, two foreign owned companies, Beijing Dajia Internet Information Technology and Tencent America also have more than 150 additional post-COVID WFH filings. Appendix Table 3 provides additional details, ranking assignees by total WFH patent volume and by WFH share of their overall portfolios. As expected, we see the same type of firms appearing

Table 2: Top 10 CPC Subclasses by Increase in WFH Patent Share, Pre- vs. Post-COVID

CPC Subclass	Description	WFH Share (%) Pre-COVID	Post-COVID	Change (pp)
H04N7	Video telephony and transmission	24.27	30.80	6.53
H04M3	Telephone exchange systems	12.08	17.09	5.01
H04N5	TV signal details (e.g. synchronising)	1.77	6.20	4.43
G10L2	Speech recognition	4.60	8.30	3.70
H04R3	Audio signal processing	3.55	6.07	2.53
H04N1	Document scanning/facsimile	4.82	7.06	2.25
H04L1	Transmission error detection	2.72	4.65	1.93
G16H4	Information and Communication Technology (healthcare informatics)	1.63	3.50	1.87
H04L6	Transmission of real-time digital information	3.11	4.55	1.43
G11B2	Recording/reproducing signals	0.95	2.32	1.37

Notes: This table reports the ten CPC subclasses (first 5 characters of the CPC code) with the largest increase in WFH patent share, measured in percentage points, from the pre-COVID period to the post-COVID period. A patent application is classified as WFH if it contains at least one term from a 49-word dictionary searched in the title, abstract, claims, and description (first 5,000 characters). The WFH share is 100 times the number of WFH-flagged applications divided by total applications in that subclass. Pre-COVID covers filing dates from January 2010 through February 2020; Post-COVID covers March 2020 onward. "Change (pp)" is the post-COVID share minus the pre-COVID share. The sample is patent applications published between January 2010 and March 24, 2026. To ensure reliable estimates, we restrict to subclasses with at least 2,000 pre-COVID and 1,000 post-COVID patent applications. Analysis of USPTO patent applications.

high in these rankings as well, with a bias towards larger companies in the rankings by absolute WFH patent volume.

3.5 Corporations vs. Universities and US vs. Non-US Assignees

Figure 4 examines heterogeneity in the innovation response. Panel A shows that corporations drive the WFH innovation response, their WFH share rises from roughly 0.5% to about 0.8%. On the other hand, the university WFH share shows no discernible increase. This aligns with models of directed technical change.[6] In Acemoglu (2002)'s framework, the direction of innovation responds to profit incentives determined by market size. Unsurprisingly, we find that universities, whose research agendas are likely shaped less by profit incentives compared to firms, are less responsive than corporations.

Panel B shows that US-based assignees respond more strongly than non-US assignees filing at the USPTO. The US WFH share rises from roughly 0.7% before COVID to above 1%, while the non-US share rises from about about 0.35 to 0.5%. This is consistent with the broader evidence that remote work adoption has been more extensive and persistent in the United States than in most other countries (Aksoy et al., 2022; Barrero et al., 2021).

3.6 Limitations of our Analysis

There are perhaps three main limitations in the interpretation of our results. First, we measure the WFH share of patent applications, so our findings could in principle reflect a relative decline in non-WFH filings rather than an absolute increase in WFH innovation. In practice, total patent applications volume rises over our post-COVID period, so the share increase is not driven by a collapse in the denominator. Of course, other factors may influence

[6] We classify an assignee as a university if its harmonized name contains terms such as: "university," "univ," "college," "ecole," "universidad," "politecn," "polytechnic," "akadem," "regents of," "board of trustees," "school of medicine," "school of engineering," "trustees of, etc. We exclude entities whose names also contain corporate suffixes (e.g., Inc., LLC, Ltd., Corp., GmbH, PLC) to avoid misclassifying university-affiliated spinoffs or corporate research labs. Patents with no assignee (e.g., filed by individual inventors) are excluded from the entity-type analysis due to small and volatile quarterly counts.

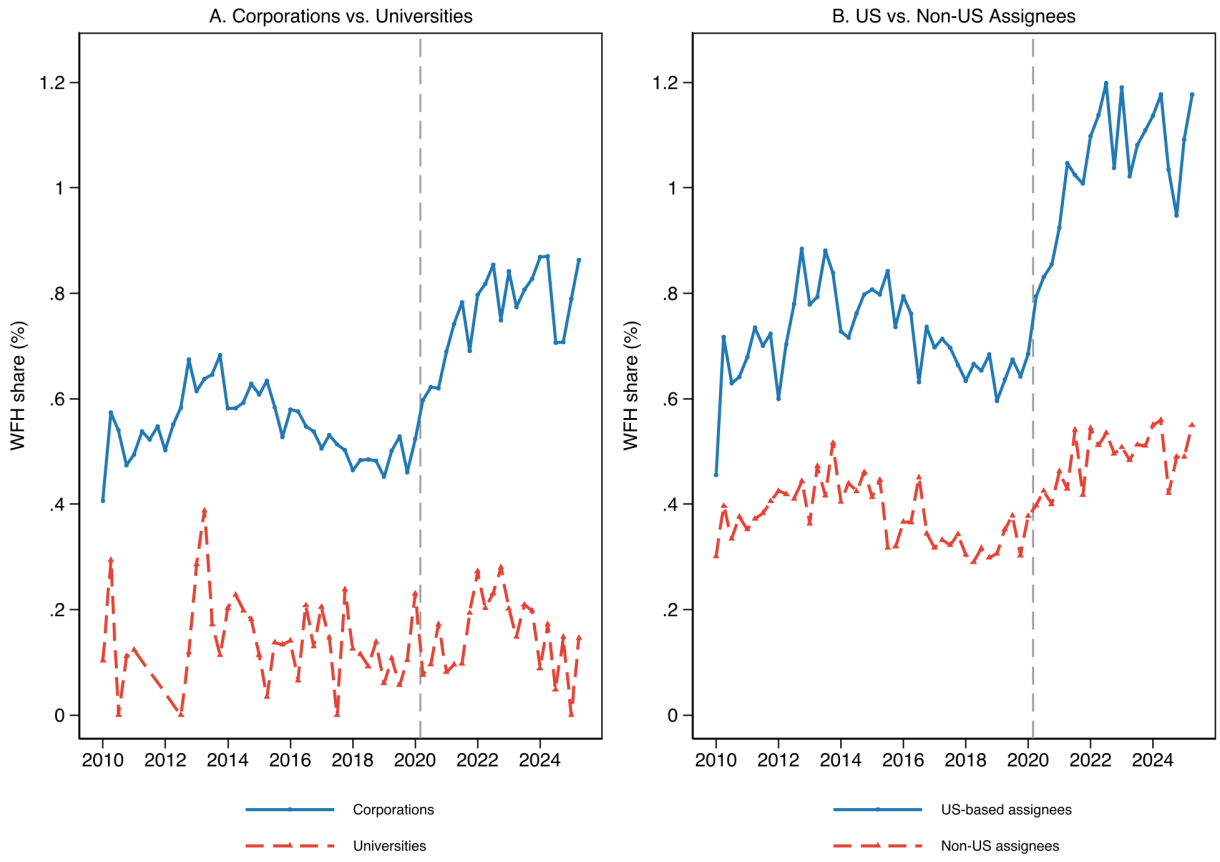


Figure 4: WFH Patent Share: By Entity Type and Assignee Country

Notes: Quarterly share of US patent applications containing at least one WFH term from the 49-word dictionary, searched in title, abstract, claims, and description (first 5,000 characters). Panel A splits by assignee entity type. Corporations: any assignee not classified as a university or individual inventor. Universities: entities whose harmonized assignee name contains "university," "college," "institute of technology," or equivalent academic identifiers, excluding entities with corporate suffixes (Inc., LLC, Ltd., Corp., GmbH, PLC). Individual inventors (unassigned patents) are excluded due to small and volatile quarterly counts. Panel B splits by assignee country. US-based: first harmonized assignee has country code "US." Non-US: first harmonized assignee has a non-US country code. Patents with no assignee country information are excluded. Both panels use quarterly aggregation to smooth noise. Vertical dashed line marks February 2020. The sample is patent applications filed January 2010 through July 2025, and published by March 24, 2026. Quarters with fewer than 5,000 corporate or 500 university applications (Panel A) or 500 applications per group (Panel B) are excluded. Analysis of USPTO patent applications.

the overall levels of WFH and non-WFH patent applications.

Second, our keyword-matching approach cannot distinguish true demand-driven redirection of technical advances from a shift in the language describing them. The concentration of measured changes in technology classes with obvious commercial value, and our evidence that corporations rather than universities drove the re-direction of patent applications, is consistent with a demand story, but it could also reflect deficiencies in our keywords and the strategic use of language in patent applications.

Third, publication lags mean that patents filed closest to our 2025 endpoint are underrepresented in our sample, which could understate the most recent WFH/non-WFH patents levels. This limitation will fade in relevance with the passage of time as fuller data on recent patent applications becomes available.

3.7 Other Types of Evidence

Other evidence also points to strong commercial incentives to acquire existing WFH technologies in the wake of the pandemic. Verizon acquired BlueJeans, a video conferencing firm, for almost $500 million in April 2020. Zoom acquired Keybase, a virtual identity management firm, in May 2020. Adobe acquired Workfront, a work management platform, for $1.5 billion in November 2020. And Salesforce agreed to acquire Slack, a workplace software company, for $27.7 billion in December 2020. These acquisitions complement our patent evidence: they show that established firms were not only innovating internally but also paying large premiums to acquire WFH technologies and capabilities.

4 Discussion and Conclusion

The COVID-19 pandemic brought a sharp, unanticipated rise in the extent of work from home. That development led to more patent applications for technologies that support WFH and remote interactivity more broadly.

To appreciate the magnitude of this induced innovation response, consider: In the period since 2023, and focusing on the United States, the share of full paid workdays performed at home or other remote location is three to four times the pre-pandemic share.[7] This shift to WFH led to a rise of two-thirds in the share of patent applications for technologies that support WFH. Five years after the pandemic struck, the share of patent applications for technologies that support WFH remains 50% above its pre-pandemic share. Our evidence supports the sensible, but rarely tested, hypothesis that greater market size spurs more innovation to serve that market.

This innovation response to WFH mainly reflects patent applications by corporations rather than universities, consistent with the idea that it is driven by profit motives. US-based assignees responded more strongly, in line with the relatively large shift to WFH in the United States (Aksoy et al., 2025). The technology classes with the largest gains – video conferencing, audio processing, and speech recognition – have widespread commercial applications in remote work. And the firms with the largest gains in patent applications for these technologies, Zoom for example, have obvious and deep commercial stakes in serving people and organizations that engage in remote work.

While the COVID-19 shock is unusual in its speed and breadth, the mechanism it reveals is likely general. Other large, sustained shifts in demand, for example due to climate change or population aging, may similarly redirect inventive effort. The challenge in those settings, as in ours before the pandemic, is isolating the causal effect of demand on innovation from confounding trends. Natural experiments at the scale of COVID-19 are rare.

Our study also helps explain why WFH rates have endured at much higher levels long after the pandemic subsided. Barrero et al. (2021) identify several mechanisms that can drive a persistent shift to work from home after the pandemic: better-than-expected WFH experiences, investments in physical and human capital that enable remote work, and a greatly diminished stigma associated with work from home. Our evidence adds a technology

[7]The share of work meetings that involve at least one remote participant has risen even more sharply. See Davis (2024) for evidence and discussion.

channel to this list. By redirecting innovation toward WFH technologies, the pandemic triggers improvements in the quality of remote work that further reinforce its adoption, creating what may be a virtuous cycle between demand-driven innovation and demand-driven adoption.

It will be interesting to continue tracking the flow of new WFH patent applications in the coming years. As of mid-2025, there is no evidence that the post-COVID surge in patents that support WFH is returning to baseline. By improving the quality and productivity of remote work, WFH technologies will continue to reinforce the shift to work from home and hybrid arrangements (Bloom et al., 2024). We also think that this is just one example of demand-driven technological change. We are interested in using other historical events to study similar phenomena in other settings, particularly as firms shift their attention to applications of artificial intelligence and associated technologies.

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A Appendix

Table 3: Top Assignees of WFH Patents

Assignee	Total Patents	WFH Patents	WFH Share (%)
Panel A: Ranked by WFH patent volume			
Qualcomm	43,193	1,857	4.30
Apple	30,361	1,144	3.77
Samsung Electronics	93,607	840	0.90
Huawei Tech	35,981	833	2.32
Microsoft	22,560	778	3.45
IBM	82,188	731	0.89
Sony	21,780	599	2.75
Cisco	11,218	567	5.05
Zoom Video Communications	796	541	67.96
Google	13,611	474	3.48
Panel B: Ranked by overall WFH patent share			
Zoom Video Communications	796	541	67.96
Polycom	179	107	59.78
RingCentral	267	96	35.96
Shure	241	80	33.20
Unify	247	70	28.34
Plume Design	188	51	27.13
Avaya Management	193	49	25.39
Corephotonics	326	80	24.54
Beijing Dajia Internet Tech	765	183	23.92
Avaya	1,147	221	19.27

Notes: This table characterizes assignee-level WFH patenting over the full sample period. A patent application is classified as WFH if it contains at least one term from a 49-word dictionary searched in the title, abstract, claims, and description (first 5,000 characters). Panel A ranks assignees by the total number of WFH-flagged patent applications. These are typically large technology firms that file many patents overall; a high WFH count may reflect portfolio size rather than WFH specialization. Panel B ranks assignees by WFH patent share, the percentage of the assignee's total patent applications that are WFH-flagged. Assignee names are drawn from the harmonized assignee field in Google Patents Public Data. The sample is patent applications published between January 2010 and March 24, 2026. We require a minimum of 150 total patent applications to avoid noise from very small assignees. Analysis of USPTO patent applications.

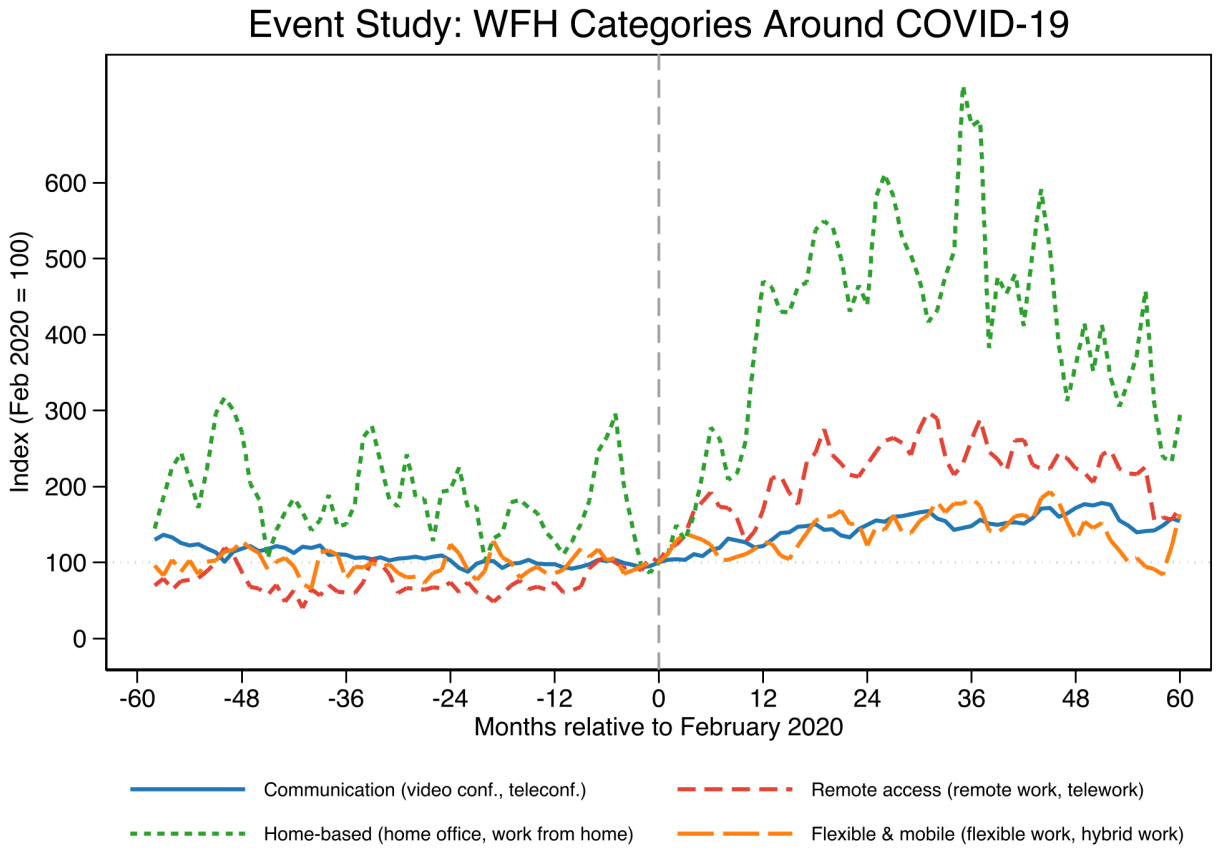

Figure 5: Event Study: WFH Patent Categories Around COVID-19

Notes: Sample: patent applications filed February 2015 through February 2025 (60 months on each side of the event date). Each series shows the monthly share of US patent applications with at least one term from the respective WFH subcategory (searched in title, abstract, claims, and description). The three-month trailing moving average is computed first, then normalized so that the smoothed February 2020 value equals 100. Values above 100 indicate a higher WFH patent share than at the onset of COVID-19; values below 100 indicate a lower share. Communication & collaboration includes 8 terms (e.g., video conference, teleconference). Remote access & digital infrastructure includes 16 terms (e.g., remote work, telework). Home-based work includes 11 terms (e.g., work from home, home office). Flexible & mobile work includes 14 terms (e.g., hybrid work, work remotely). The horizontal dotted line marks the baseline (index = 100). The vertical dashed line marks February 2020 (month 0). Months with fewer than 5,000 total filings are excluded. Analysis of USPTO patent applications.

Table 4: Top 10 Assignees by Increase in WFH Patent Volume

Assignee	Change
Zoom Video Communications	533
Huawei Tech	375
Sony Group	333
Beijing Dajia Internet Tech	183
Dell Products	156
Tencent America	153
Google	140
Apple	104
Snap	77
Rovi Guides	72

Notes: This table ranks assignees by the absolute increase in the number of WFH-flagged US patent applications from the pre-COVID period to the post-COVID period. A patent application is classified as WFH if it contains at least one term from a 49-word dictionary searched in the title, abstract, claims, and description (first 5,000 characters). Pre-COVID covers filing dates from January 2010 through February 2020; Post-COVID covers March 2020 onward. "Change" is the post-COVID WFH patent count minus the pre-COVID count. Assignee names are drawn from the harmonized assignee field in Google Patents Public Data; related corporate entities (e.g., Sony Corp and Sony Group Corp) may appear separately if their harmonized names differ. The sample is patent applications published between January 2010 and March 24, 2026. We require a minimum of 150 total patent applications (WFH and non-WFH combined) over the full sample period to avoid very small assignees. Analysis of USPTO patent applications.