COVID-19 Shifted Patent Applications toward Technologies that Support Working from Home
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3 September 2020

This note develops evidence that COVID-19 shifted the direction of innovation toward new technologies that support video conferencing, telecommuting, remote interactivity, and working from home (collectively, WFH). To do so, we use automated readings to parse the subject matter content of U.S. patent applications, identifying those that advance WFH technologies.

We start with the raw XML files of new patent applications, which are published by the United States Patent and Trademark Office (USPTO) every Thursday. These files include the patent application date, publication date, application ID, inventor name, assignee (entity that owns the patent), patent class, title, and full text of the invention description. Our analysis sample covers published patent applications from 7 January 2010 through 3 September 2020 and patent application filings from 1 January 2010 to 21 May 2020. There are about 3.5 million patent applications in our dataset, 20,173 of which pertain to WFH technologies according to our classification algorithm described below.

We examine the text content of invention descriptions to identify patent applications that cover WFH technologies. As a first step, we construct a dictionary of terms that pertain to the relevant technologies. To construct this dictionary, we manually selected twenty articles that discuss working from home technologies, platforms and software for telecommuting. We used these articles to create our dictionary, which contains the following terms:

‘telecommuting’, 'telework', 'teleworking', 'working from home', 'mobile work', 'remote work', 'flexible workplace', 'work from home', 'mobile working', 'remote working', 'work remotely', 'working remotely', 'remote workplace', 'telecommuter', 'teleworker', 'home-sourced worker', 'home-sourced employee', 'work-at-home', 'work at home', 'telecommuting specialist', 'nomadic worker', 'nomadic employee', 'work-from-home', 'work-from-anywhere', 'video conference', 'video conferencing', 'virtual office', 'distance work', 'flexible work', 'virtual work', 'virtual office', 'virtual employee', 'home office', 'home-based office', 'home-based work', 'work from anywhere', 'working from anywhere', 'work-from-anywhere', 'digital workplace', 'video chat', 'video call', 'teleconference', 'teleconferencing', 'working from a remote location', 'work from a remote location’

Second, we execute computer-automated readings of the text in the patent application that summarizes the main features of the invention and describes its potential application. If this text section contains one or more terms in the dictionary above, we regard the patent application as one that supports WFH technologies. Results are similar when we require this text section to contain two or more terms in the dictionary.
Before turning to the results of our classification exercise, we note that there are long and variable lags from the filing of new patent applications till publication by the USPTO. That means our data involve some right censoring of patent filings, which becomes more severe as we approach the end of the period covered by our analysis sample. To assess the extent of right censoring, Figure 1 shows the histogram of the lags for all published patent applications that were first filed from 1 January 2010 to 31 August 2018. The mean lag from the filing of a new patent application to its publication by the USPTO is 13.0 months for all applications and 11.6 months for those that support WFH technologies. The similarity of mean lags suggests that WFH and other patent applications involve similar degrees of right censoring. This observation suggests that right censoring is unlikely to seriously bias our estimates for the share of patent application filings that support WFH technologies, even as we approach the end of our sample period.

**Figure 1.** Histogram of Lag from Filing of Patent Application to Publication by the USPTO, Using Data for All Patent ApplicationsFiled from 1 January 2010 to 31 August 2018


³ Once the USPTO regards a patent application filing as complete, which can itself be a lengthy process, the application is assigned for examination. The examination process can also be lengthy. The publication of approved patent applications takes about fourteen weeks. The USPTO has various programs and initiatives to assist in the patent application process, some of which involve additional fees for an expedited process. For more information, see [https://www.uspto.gov/web/offices/pac/mpep/s1120.html](https://www.uspto.gov/web/offices/pac/mpep/s1120.html), [https://www.uspto.gov/patents-getting-started/patent-process-overview#step6](https://www.uspto.gov/patents-getting-started/patent-process-overview#step6), and [https://www.uspto.gov/patent/initiatives/uspto-patent-application-initiatives-timeline](https://www.uspto.gov/patent/initiatives/uspto-patent-application-initiatives-timeline).
Figure 2 reports the percentage of newly filed patent applications that support WFH technologies at a monthly frequency from January 2010 through May 2020. We compute this percentage as 100 times the ratio of (a) patent application filings in the month that support WFH technologies (by the classification method described above) to (b) all patent application filings in the month.

Interestingly, the WFH share of new patent applications rises from 0.53 percent in January 2020 to 0.77 percent in February, before the World Health Organization declared the novel coronavirus outbreak a global pandemic (Muccari et al., 2020). China reported the first death from COVID-19 in early January and imposed a lockdown in Wuhan on 23 January. By the end of January, the virus had spread to many other countries, including the United States. Figure 2 suggests that these developments had already – by February – triggered the beginnings of a shift in new patent applications toward technologies that support WFH.

By March, COVID-19 cases and deaths had exploded in many localities and countries around the world. Government-mandated lockdowns and voluntary social distancing responses led to an extraordinary collapse in economic activity. By April and May, half or more of paid work in the United States was performed by persons working from home (Barrero et al., 2020ab, Bick et al., 2020 Brynjolfsson et al., 2020). As Figure 2 shows, the WFH percentage of new patent applications from March to May are well above the January level. The March and May values are nearly twice as large as the January value. Thus, we find clear evidence that COVID-19 has shifted the direction of innovation toward technologies that support WFH. It will be interesting to see whether this development continues and intensifies in the coming months.

The impact of COVID-19 on WFH activity and technologies is also evident in the stock market. Papanikolaou and Schmidt (2020) report daily equity returns in 2020 for firms sorted by the share of employees able to work remotely. From 14 February 2020 to 15 June, the cumulative return differential between the top and bottom quartiles is 19.4 percentage points, with the bulk of the differential emerging by mid-March. Pagano et al. (2020) also find much higher returns in the wake of COVID-19 at firms that are “resilient” to social distancing, as measured by ability to perform jobs at home and without interactions in physical proximity. Davis et al. (2020) find that bad news about the COVID-19 pandemic in February and March raised the relative stock prices of U.S. firms with direct and indirect exposures to cloud computing, telecommunications, optics and key inputs in the manufacture of semiconductors.

Our text-based evidence on the directional shift in innovation activity toward WFH technologies and the complementary evidence from firm-level equity returns suggest that we may can expect to see continuing improvements in WFH technologies and the tools and platforms that support WFH activity even after the COVID-19 pandemic comes under control.
**Figure 2.** Percent of Patents that Support WFH Technologies, January 2010 to May 2020

Notes: This chart reports the percentage of U.S. patent application *filings* that support WFH technologies by month from January 2010 to May 2020. We calculate this percentage using our automated classification of invention descriptions in patent applications *published* through 3 September 2020.

**References**


