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Abstract: Full days worked at home account for 28 percent of paid workdays among Americans 20-64 years old, as of mid 2023, according to the Survey of Working Arrangements and Attitudes. That's about four times the 2019 rate and ten times the rate in the mid-1990s that we estimate in time-use data. We first explain why the big shift to work from home has endured rather than reverting to pre-pandemic levels. We then consider how work-from-home rates vary by worker age, sex, education, parental status, industry and local population density, and why it is higher in the United States than other countries. We also discuss some implications of the big shift for pay, productivity, and the pace of innovation. Over the next five years, U.S. business executives anticipate modest increases in the share of fully remote jobs at their own companies and in the share of jobs with hybrid arrangements, whereby the employee splits the workweek between home and employer premises. Other factors that portend an enduring shift to work from home include the ongoing adaptation of managerial practices and further advances in technologies, products, and tools that support remote work.

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Looking back to 1965, full days worked from home were less than half a percent of all paid workdays in the United States. As shown in Figure 1, the work-from-home share rose slowly over the next few decades. In the 1970s, work from home often meant briefcases stuffed with paperwork. By the 1990s, it meant phone calls and floppy disks. In the 21st century, the rise of the internet facilitated collaboration at a distance. By 2019, the work-from-home share had reached seven percent, and it was reasonable to anticipate a gradual rise in the years ahead.

Then came the pandemic. Social-distancing mandates and fear of COVID-19 drove a sudden, massive shift to work from home. Much of that shift has endured. According to data from the U.S. Census Bureau's Household Pulse Survey (2023) and our own Survey of Working Arrangements and Attitudes (Barrero et al., 2023b, and <https://wfhresearch.com/>), full days worked from home account for 28 percent of paid workdays in June 2023 – four times the estimated share for 2019.

The pandemic catalyzed the big shift to work from home, but earlier developments made it possible. Web-based video-conferencing platforms like Teams, Webex, and Zoom; cloud-based file-sharing services like Box, Drive, and Dropbox; and collaboration software like Asana and Slack have become critical tools for remote work. None of them existed in 2000. When the pandemic struck, these tools were ready for adoption and use at scale. Some of these tools function poorly without high-speed broadband. As it turns out, the share of American adults with broadband service at home rose from zero in 2000 to more than seventy percent in 2018 (Pew Research, 2021). Thus, the infrastructure that supports home use of remote-collaboration tools also developed greatly before the pandemic struck. These developments created a foundation for the *possibility* of a big shift to work from home.

A different issue is why the shift persisted after distancing mandates ended and after COVID death rates receded.¹ Why haven't working arrangements reverted to the pre-pandemic status quo? To turn the question around: If the big shift was possible (and highly valued by many, *ex post*), why didn't it happen sooner and more gradually?

¹ COVID-19 deaths fluctuated sharply from February 2020 through March 2022 in the United States, before settling down to comparatively low levels. Weekly deaths per million reached nearly 47 in April 2020, peaked at 70 in January 2021, again rose above 50 in February 2022, and fell sharply in March 2022. Since then, the weekly death rate is less than 10 per million. See "Weekly confirmed COVID-19 deaths per million people" for the United States at <https://ourworldindata.org/covid-deaths> (accessed 4 August 2023).

To see an answer, start with the obvious: The pandemic triggered a mass social experiment in working arrangements. Now consider two hypotheses. First, all of that experimentation generated a flood of new information, altering perceptions about the practicality and effectiveness of work from home. The simultaneity of experimentation across suppliers, producers, customers, and commercial networks also yielded information and experience that were hard or impossible to acquire before the pandemic. Second, employers and workers re-optimized over working arrangements in light of the new information. In particular, those with favorable experiences in the work-from-home mode opted to stick with higher work-from-home rates after the pandemic than before it struck.

To assess these two hypotheses, we surveyed tens of thousands of workers across many countries. In Barrero, Bloom and Davis (2021b), we find that most American workers were favorably surprised by their ability to work from home productively during the pandemic. Similarly, Aksoy et al. (2022) find that the average worker was favorably surprised by his or her ability to work from home during the pandemic in all twenty-seven countries covered by their sample. Both studies also find that the number of work-from-home days that employers plan after the pandemic ends rise strongly with employee assessments of work-from-home productivity surprises. In short, many workers were favorably surprised by their ability to work remotely, and those favorable surprises led to a large, lasting shift to work from home.

The pandemic also spurred other developments that helped drive a lasting shift to work from home: new investments at home and inside organizations to facilitate remote work and improve its performance, learning-by-doing in the work-from-home mode, pandemic-induced advances in products and technologies that support remote work, much greater social acceptance of work from home, and lingering concerns about infection risks that lead some people to prefer remote work. Aksoy et al. (2022) review the evidence for these developments. They also find higher levels of work from home as of mid-2021 and early 2022 – and higher planned levels of work from home after the pandemic ends – in countries and regions with longer, stricter lockdown mandates during the pandemic. Thus, the full story of how the pandemic led to a large, lasting shift to work from home has multiple, reinforcing elements.

How the Big Shift Is Playing Out

New-Found Variety in Working Arrangements

Before the pandemic, most workers had few options when it came to the remote-work intensity of attractive jobs. After the pandemic, choices in this regard exploded, especially for the college-educated. Work from home is now common in many jobs once seen as unsuited to remote work. The flip side of this expanded choice set for workers is a new set of opportunities and challenges for employers. Some organizations have embraced remote work as a means to improve recruitment and retention, moderate pay growth, reduce space needs, and cut overhead costs. Others have resisted remote work, because they see it as detrimental to productivity, innovation, and skills development or antithetical to their workplace cultures.

As of 2023, 59 percent of full-time American employees (20-64 years of age) commute to their employer's worksite or to a client's location each workday. While most employees have resumed a traditional working arrangement, many have not. Twelve percent now work remotely on all or almost all workdays. Nearly 29 percent have a hybrid arrangement, whereby they split the workweek between home and their employer's worksite. Traditional working arrangements continue to prevail in front-line retail jobs, restaurants and bars, hotels, transportation, construction jobs, manufactures, many healthcare jobs, janitorial and cleaning services, onsite security services, and other jobs that require face-to-face contact with customers, clients and coworkers or the use of specialized equipment and dedicated facilities. Even amidst social-distancing mandates in 2020, people in these types of jobs typically worked at their employer's site or not at all.

As these remarks suggest, task requirements and production technologies sharply limit the possibilities for remote work in some jobs. Often, however, a particular job involves a bundle of tasks that differ in their suitability for remote work. In some jobs, e.g., phone-based customer support, the bundle mainly involves tasks that can be performed effectively in an office setting, a home setting, or a mix of the two. In other jobs, e.g., college professors, the bundle includes some tasks that require presence at the employer's worksite (classroom teaching) and other tasks that do not (preparing lectures, grading assignments). More generally, the tasks associated with a given job fall along a spectrum from less to more suitable for remote work.

Unless the tasks for a given job are highly concentrated at the less-suitable end of the spectrum, work-from-home intensity reflects choices about job design, management practices,

organizational culture, and life styles. These choices respond to shifts in perceptions about the productivity of work from home, any stigma associated with the practice, the quality of tools that facilitate remote work, and an organization's capacity to manage remote work. They also respond to shifts in employee desires to work from home, which is perhaps another legacy of the pandemic. When the tasks for a given job cluster near the more-suitable end of the spectrum, even modest shifts in worker preferences, productivity perceptions, stigma, remote-collaboration tools and manager skill sets can yield big changes in the extent of work from home.²

For employees with a hybrid arrangement, a typical pattern is to commute into the office on Tuesday, Wednesday and Thursday and to focus those workdays on meetings, presentations, training, mentoring, lunches with colleagues and clients, and other in-person tasks. Work from home on Mondays and Fridays can then focus on tasks that require individual effort and intense focus. Hybrid arrangements are common in many professional jobs, especially in middle and senior management positions. They have spread to the healthcare sector, where counseling services, prescription renewals, and routine consultations are now sometimes provided remotely, practices that were rare before the pandemic. Fully remote employees tend to work in IT support functions, payroll processing, phone-based customer support and sales, and routine administrative functions that require few in-person interactions. Many fully remote jobs are computer intensive, and most involve limited team work. Typically, the labor inputs in these jobs can be easily monitored, or the individual's work product can be easily assessed.

Table 1 provides information about how working arrangements differ by employer type in the U.S. economy. While 59 percent of full-time employees work onsite each workday, only 33 percent of contractors and gig workers do so, and only 25 percent of other self-employed persons do so. Fully remote work is four times as common for the self-employed as for employees. Given these facts, people with strong desires to work in a fully remote capacity are more likely to choose self-employment, including contract and gig work. Regulations that clamp down on contract and gig work curtail choices and, in doing so, are likely to deter some people from working altogether.

² Dingel and Neiman (2020) exploit data on the nature of work and work activities to identify occupations that can be performed entirely from home. They estimate that 37 percent of American workers held such jobs before the pandemic. In many other jobs, some tasks are suitable for remote work. Thus, their evidence suggests that work-from-home intensity is a choice outcome in half or more of all U.S. jobs.

Working arrangements differ by employer size as well. In firms with fewer than fifty employees, two-thirds travel to their employer's site each workday. In firms with 500 to 4,999 employees, the corresponding share is only 51 percent. Hybrid arrangements are most common in firms with 500 to 4,999 employees, and fully remote jobs are most common in firms with 5,000 or more. Among government employees, the distribution of working arrangements is quite similar to that of all employees.

Work-from-Home Intensity by Industry

Figure 2 reports work-from-home rates by industry as of 2023. The Information sector has the highest work-from-home rate at 2.6 days per week among employees who work at least five days a week. AirBnB, Upwork and Yelp are well-known examples of firms in the Information sector that operate with largely remote workforces. Meta (formerly Facebook), Shopify and Twitter were among the first prominent companies to commit to high levels of remote work after the pandemic struck. They are also in the Information sector. Finance & Insurance and Professional & Business Services have the next highest work-from-home rates.

These three sectors share certain characteristics that facilitate or incentivize work from home: Staff are well paid, jobs are often analytical or computer-intensive in nature, and firms tend to cluster in major cities. Higher earners typically have nicer homes with more room for a home office. They also face higher marginal tax rates, intensifying the tax incentive to work from home. To see this point, suppose your boss offers the following choice: Work at the office five days a week and get a six percent raise, or split the workweek between home and office for a two percent raise. Your cost of the hybrid option is three percent of after-tax pay at a 25 percent marginal tax rate but only two percent at a 50 percent marginal tax rate. Turning to another point, many computer-intensive jobs lend themselves to remote work. And many analytically oriented jobs require periods of intense focus, which is easier to find at home for many workers. Finally, because firms in these sectors cluster in dense urban centers, many of their employees face long commutes to the office. That makes it all the more appealing to avoid the commute, thereby saving time, money and aggravation.

At the other end of the industry distribution, employees in retail, hospitality, food services, transportation and manufacturing have low work-from-home rates, ranging from 0.7 to 0.9 days per week. Most jobs in these industries require a physical presence to engage consumers

or to work with specialized equipment and dedicated facilities. Because staff work mainly onsite, so do their managers.

There are also some striking differences in work-from-home rates across employers in the same industry. To draw out this point, Hansen et al. (2023) exploit granular data on millions of job vacancy postings. In one of their examples, they consider U.S. automobile manufacturers recruiting for engineers. In 2022, and restricting attention to engineering positions, the share of postings that say the job allows some remote work was zero for Tesla, 8 percent for Ford, 23 percent for General Motors, and 45 percent for Honda. It was near zero for all four companies in 2019. This example illustrates two of our key messages. First, work-from-home intensity is an outcome of choices about job design, managerial practices, and workplace culture. Organizations can make different choices in this regard, and they do so in the post-pandemic economy. Second, the variety of working arrangements on offer has exploded in the wake of the pandemic.

Work from Home and Population Density

Our observations about how and why the work-from-home rate varies by industry suggest that it also varies systematically with local population density. That turns out to be the case, and powerfully so. To develop this point, we first assign zip codes to individual workers based on where they live (home location) or where their employer locates (job location). Next, we use data on residential population to sort zip codes (and workers) into population density bins. Finally, we compute full work-from-home days as a percent of all paid workdays in each bin.

Figure 3 displays the results, using blue dots when sorting by home location and red dots when sorting by job location. The same pattern emerges either way. The figure also highlights selected zip codes. For example, zip code 84720 falls into the second-lowest density bin and is one of two zip codes for Cedar City, Utah. Zip code 11225 falls into the top density bin and is one of more than a hundred zip codes for Brooklyn, New York. The most sparsely populated zip codes, accounting for one-fifth of U.S. population, are to the left of the dashed line.

In these sparsely populated areas of the United States, the average work-from-home rate is 25 percent and varies little with population density. In the rest of the country, the work-from-home rate rises strongly with population density. In the top density bin, for example, work-from-home days account for more than forty percent of all paid workdays. Industry mix, occupation mix, and local workforce demographics (age, sex, education) account for half of the density-related differences in work-from-home rates highlighted by Figure 3 (Buckman et al., 2023).

Longer commutes also encourage high work-from-home rates in dense urban areas. High-quality internet service, which is more readily and widely available in urban settings, facilitates work from home and raises its productivity (Barrero et al., 2021a).

Other types of data tell a consistent story. As of July 2022, foot traffic in central business districts had recovered to nearly pre-pandemic levels in cities with fewer than 150,000 employees but to only 60 percent of those levels in cities with 1.5 million or more employees (Monte et al., 2023). As of December 2022, the residential price premium for living near downtown returned to pre-pandemic in small cities but remained considerably smaller than before the pandemic in large cities (Monte et al., 2023). From February 2020 to November 2022, Zillow's U.S. home price index rose 40 percent in exurban areas, 32 percent in suburban areas, 18 percent in high-density areas, and only nine percent in city centers (Arjun and Bloom, 2022). As of May 2023, U.S. public transit ridership was only 70 percent of its May 2019 level.³ All of these statistics confirm that the big shift to work from home is concentrated in high-density areas.

Work from Home and Demographic Characteristics

Education: Work-from-home intensity rises steeply with education in the post-pandemic economy. Among Americans 20-64 years of age with a high school education or less, full days worked from home account for 20 percent of all paid workdays. The corresponding figure is 26 percent for those with some college, 34 percent for those with a four-year college degree, and 36 percent for persons with a graduate degree.⁴ As one might anticipate from this pattern, work-from-home intensity also rises steeply with earnings (Barrero et al., 2021b).

In line with our remarks about jobs as task bundles and the evidence in Dingel and Nieman (2020), occupation and industry are strong predictors of whether someone works from home. Highly educated workers are concentrated in Information, Finance & Insurance, and Professional & Business Services. These industry sectors – and the people who work in them – have high work-from-home intensities for the reasons discussed above.

³ See U.S. Bureau of Transportation Statistics, Public Ridership Transit, retrieved from FRED, Federal Reserve Bank of St. Louis, <https://fred.stlouisfed.org/series/TRANSIT>, on 29 August 2023.

⁴ These statistics reflect data from the January-June 2023 waves of the Survey of Working Arrangements and Attitudes.

Age: Figure 4 shows how work-from-home intensity varies by age in the United States. It is lowest among people in their early twenties and peaks among those in their thirties. People in their twenties have high returns to professional networking, on-the-job training, and mentoring – activities that benefit greatly from in-person interactions. Young workers may also place more value on socializing at the workplace or nearby. They are more likely to live in small or shared apartments, which reduces the appeal of work from home. People in their thirties and early forties are more likely to live with children and face long commutes, raising the appeal of work from home. Older employees may be less keen to work from home because they no longer have childcare responsibilities, or simply because they like to socialize at the workplace.

In unreported results, we investigate the role of children and marital status in the life-cycle pattern of Figure 4. Consider the raw gap of 5.7 percentage points in work-from-home intensity between workers who are 30-34 years old and those who are 20-24. When we use regression methods to control for the presence of children under 14 in the household, this gap shrinks by one percentage point. Controlling for marital status has no effect on the gap, and marital status itself is statistically insignificant. Similarly, controlling for the presence of children shrinks the raw gap of 4.8 points between workers who are 30-34 and those who are 60-64 by about 1.6 points, with no impact of marital status. In short, the timing of children over the life cycle partly explains the pattern in Figure 4.

Sex: Figure 5 shows, perhaps surprisingly, that American women work from home at only modestly greater rates than men. In the first half of 2023, full days worked from home are 29.3 percent of paid workdays among women, 20-64 years old, as compared to 27.0 percent among men. This gap is statistically significant but small compared to the gap between college and non-college workers and to the changes over time. Higher levels of education among women push up their work-from-home rates, other things equal. When we use regression methods to control for educational attainment, the gap between women and men shrinks to 1.3 points. When we also include industry and occupation fixed effects in the regression specification, the gap between men and women is 1.5 percentage points. In other research, Le Barbanchon, Rathelot and Roulet (2021) find that women place more value than men on reductions in commuting time. That aspect of their preferences pushes in the direction of higher work-from-home intensity for women relative to otherwise similar men.

Parents: People who live with children more highly value the ability to work from home. In a cross-section of advanced and middle-income countries, workers living with children under fourteen express a greater willingness-to-pay for the option to work from home two or three days a week, as compared to observationally similar workers without children (Aksoy et al., 2022). The effect holds for men and women and is pervasive across countries.

Moving from preferences to outcomes, we find that people with children do indeed work from home at higher rates, as foreshadowed by our discussion of Figure 4. Table 2 develops this point more fully, again drawing on data from the Survey of Working Arrangements and Attitudes (Barrero, Bloom, and Davis, 2023b). All specifications control for five-year age bins and month fixed effects. The coefficient on “Female” in Column (2) says that full days worked from home (as a percent of all paid workdays) are 1.0 percentage points higher for women than men, the omitted group. The other coefficient in Column (2) says that full days worked from home are 4.5 percentage points higher for workers who live with children under fourteen. Column (3) adds a term to capture the interaction between “Female” and “Children under 14.” The -2.3 coefficient on this term is statistically significant at the five percent level. In other words, living with children is associated with a larger marginal increase in work-from-home intensity for men than women. The coefficient on the main effect for Children under 14 is now 5.5 percentage points.

Finally, when we add controls for the worker’s education, industry and occupation in columns (4) and (5), we continue to find higher work-from-home rates among those who live with children. The results in columns (4) and (5) also confirm that education is a powerful predictor of work-from-home intensity. (Here, the omitted group is persons with no post-secondary education.) However, the coefficients on the main and interaction effects for women are no longer statistically significant.

Let’s summarize the demographic patterns. First, work-from-home intensity rises strongly with the education of individual workers. This pattern is highly robust to controls for other demographic characteristics, marital status, and the presence of children at home. The presence of children is also robustly associated with more work from home. Women work from home slightly more than men, but this already-small difference shrinks further or disappears altogether when controlling for women’s greater education. Finally, the small R-squared values

in the Table 2 regressions warrant attention, because they imply that many other factors also influence who works from home and how much.

Other Countries

The extent of work from home differs greatly across countries, although it's hard to say exactly how much. One useful source of information is Google Workplace Mobility which, until October 2022, tracked the frequency of workplace visits by country and month. As of October 2022, workplace visits in the United States were down about 25 percentage points relative to the January 2020 benchmark. That drop roughly matches the corresponding jump (relative to 2019) in work-from-home days shown in Figure 1. Canada and the United Kingdom show similar-sized drops in workplace visits (again, as of October 2022, and relative to the pre-pandemic benchmark). A selection of European countries (France, Germany, Italy, Spain, the Netherlands, Sweden, and Portugal) shows a smaller drop of 21 points. Elsewhere, the drops are smaller yet. For example, workplace mobility is down only nine points in Australia as of October 2022, and by even less in Japan, South Korea, Singapore and Taiwan.

Along with co-authors in Aksoy et al. (2022, 2023b), we have developed another source of data on work-from-home intensity that covers many countries: The Global Survey of Working Arrangements (<https://wfhresearch.com/gswadata>), which samples full-time employees who have at least a secondary education. According to these data, full-time employees worked from home 1.4 days a week in the United States as of March-April 2023, more than any other country except Canada (1.7 days) and the United Kingdom (1.5 days). By way of comparison, the average across 15 countries in continental Europe is only 0.8 days a week, with a maximum of 1.0 days in Germany and The Netherlands. The average across six Asian countries (China, Malaysia, Japan, Singapore, South Korea and Taiwan) is 0.7 days a week.

Why does the U.S. have a higher work-from-home intensity than most other countries? We think several factors are at work. First, residences tend to be larger in the U.S. than in Europe and Asia, making it easier to accommodate a home office. Second, the U.S. has an unusually high share of workers in Information, Finance & Insurance, and Professional & Business Services. As discussed earlier, these sectors share several characteristics that facilitate or encourage work from home. Third, managerial practices around performance measurement and evaluation tend to be more advanced at U.S. firms than at firms in other countries (e.g., Scur et

al., 2021). Strong practices in this regard are especially beneficial when managers (and co-workers) cannot observe employees directly as they perform their work-related activities.

Finally, most countries in Asia and many in Europe were more successful than the U.S. in mitigating COVID-related deaths and hospitalizations. And they often did so without tight, extended clampdowns on commercial activities. South Korea and Taiwan are especially striking examples in this regard. Because of their less dire COVID experiences – and, in many cases, their more limited clampdowns on commercial activity – people and organizations in other countries experimented less with remote work, made fewer investments in systems and management practices that support remote work, had less learning-by-doing in work-from-home mode, and had smaller shifts in attitudes and norms around remote work. In short, several factors that reinforced the big shift to work from home in the United States acted with less force in most other countries.

What the Big Shift Means for Pay, Productivity, and Innovation

Labor Costs and the Wage Structure

The rise of remote work affects labor costs and wages in several ways. For one thing, it can have important effects on productivity, which feeds into labor costs and wages. For the moment, and for the sake of analytical clarity, let's consider how remote work affects labor costs and wages net of any productivity effects. The rise of remote work makes it easier for firms situated in high-wage areas to recruit and employ staff in areas with lower wages. There is also evidence that quit rates and turnover costs fall when a firm lets its employees adopt hybrid working arrangements (Bloom, Han and Liang, 2023). And standard economic models imply that the rise of remote work puts downward pressure on real wages through labor supply effects.

To see this last point, start by observing that most people prefer to work remotely part of the week. On average, Americans value the option to work from home two or three days a week at eight percent of pay, according to data from the Survey of Working Arrangements and Attitudes (Barrero et al., 2021b). The experimental study by Mas and Pallais (2017) finds similar estimates for a narrower group of workers. In the textbook model of a competitive labor market, a new-found job amenity raises the supply of labor at any given wage. In addition, when employees work from home, they devote part of their commute-time savings to their jobs (Aksoy et al., 2023). That also adds to labor supply. Finally, the big shift creates new job opportunities

for people who live in remote locations and economically depressed areas, couples facing joint-location constraints, parents who want to be near their children while working, people with mobility impairments that make it hard to commute, and those who find it hard to cope with face-to-face interactions in the workplace. New job opportunities afforded by work from home will draw some of these people into the labor force, expanding labor supply. For any given labor demand curve, outward shifts in labor supply reduce the equilibrium real wage. In an inflationary environment, this real wage drop can come about through slower nominal wage growth.

Bargaining models also imply that the rise of remote work puts downward pressure on wages. In this class of models, the employer and employee each get a share of the value generated by the employment relationship. Initially, employees captured the full amenity value of the big shift to work from home, because wages reflected bargains made before the surprise onset of the pandemic. Over time, as compensation packages adjust, employers capture a portion of the amenity-value gains associated with the rise of remote work. Employer benefits take the form of slower wage growth during the transition to a new equilibrium with pay packages that reflect higher remote work levels.

Has the rise of remote work actually exerted a material influence on wages and other labor costs? If so, how much? Thus far, these questions have attracted scant attention from researchers. In Barrero et al. (2022), we provide some initial evidence. We surveyed more than 600 business executives at U.S. firms in April and May 2022 as part of the Survey of Business Uncertainty. We asked each executive the following question: “Over the past 12 months, has your firm expanded the opportunities to work from home (or other remote locations) as a way to keep employees happy and to moderate wage-growth pressures?” If the executive says “Yes” – and about four-in-ten do so – we then ask, “What is your best estimate for how much expanded remote-work opportunities have moderated wage-growth pressures at your firm in the past 12 months?” We also ask analogous questions about work-from-home plans in the next 12 months. When we aggregate over all responses to the look-back and look-ahead questions, we obtain a cumulative wage-growth moderation of 2.0 percentage points over two years, centered on spring 2022. In computing this average, we include the majority of executives who say work from home has not impacted their firm’s wages.

This effect of 2.0 percentage points is a material restraint on nominal wage growth. It came during a critical period for monetary policy, as the Fed sought to curtail the strong

inflationary pressures that emerged in the latter part of 2021 and 2022. The same survey also uncovers evidence that the rise in remote work is associated with more reliance on part-time employees (at 26 percent of firms), more use of independent contractors (23 percent), more use of leased workers (11 percent), more offshoring of jobs (8 percent), and more employment of physically-challenged persons. These developments also tend to reduce labor costs.

The big shift to work from home is likely to alter the structure of wages as well. To see how, recall that the shift is concentrated among college-educated workers and in certain industry sectors (Figure 2). The amenity-value benefits associated with the big shift are concentrated among these same workers and sectors. A long line of thinking in economics says that wages are lower, other things equal, in jobs with amenity attributes that workers like.⁵ Thus, we hypothesize that the big shift shrank the college wage premium and put more downward pressure on wages in sectors with larger increases in work-from-home intensity.

While limited, the available evidence favors this hypothesis. In their survey of business executives, Barrero et al. (2022) find smaller wage-growth moderation effects in sectors with few jobs that are suitable for remote work and larger moderation effects in sectors with many such jobs. Autor et al. (2023) document a large and “unexpected compression” in the U.S. wage distribution after the pandemic struck, including a reduction in the college wage premium. Their explanation stresses the pandemic’s effects on labor market tightness and wage markdowns, but they observe that amenity-value shocks may also play a role.

There is room for much more research into how the big shift affects labor costs and the wage structure. In addition to the channels we have stressed, work from home has the potential to profoundly influence spatial competition in labor markets, including the extent of monopsony power in local labor markets. Especially in fully remote jobs, competition from workers in other countries can exert a powerful influence on wages. See Brinatti et al. (2022), who develop evidence using data from a web-based job platform with global reach.

Productivity Effects

The productivity implications of the big shift to work from home have sparked vigorous debate among business leaders, researchers, and pundits. Managers differ greatly in their views

⁵ Rosen (1986) offers a classic statement of this theory of “equalizing differences” or “compensating differentials.” As he notes, the basic idea originates in *The Wealth of Nations* by Adam Smith.

about how remote work affects productivity in their own organizations (Bloom et al., 2023a). Worker perceptions also differ greatly in this regard (Barrero et al., 2021b).

The controversies and disagreements surrounding the productivity effects of work from home reflect the complex nature of the issue. Jobs and tasks differ greatly in their suitability for remote work. As do workers, managerial styles, and workplace cultures. Thus, there is no sound reason to expect the productivity effects of remote work to be uniform across jobs, workers, managers, and organizations. In addition, communications, performance evaluations, and management practices must adapt to new working arrangements, if they are to work well. Adaptation often requires new skills, perhaps especially for managers. The adaptation process itself involves a good deal of trial and error and learning-by-doing. Thus, the productivity effects of work from home are likely to unfold over months or years.

With these cautions in mind, we now offer several remarks on how productivity relates to working arrangements. For us, the chief question of interest is the following: How will a large, lasting shift to work from home affect productivity outcomes when working arrangements are a matter of choice rather than necessity, and when organizations and individuals have adapted to their preferred working arrangements? Previous studies differ in whether, and how clearly, they throw light on the answer to this question.

Productivity concepts: From a manager's perspective, it makes sense to think of labor productivity as work output per paid time unit. This labor productivity concept corresponds to what statistical agencies typically seek to measure. For employees, in contrast, it makes sense to count commuting time as part of the total time devoted to their jobs. This approach also makes sense from a societal perspective, because commuting time is part of the resources expended in producing market output.

This conceptual distinction matters. Recall from Figure 1 that full days worked from home rose by 21 percentage points from 2019 to June 2023. That corresponds to 1.05 fewer commuting days per week. When working from home (rather than on employer premises), the average daily savings in commuting and grooming time is 65 minutes for American workers. So, the big shift generates time savings of 68 minutes per week per worker, which is about 2.8

percent of a 40-hour workweek. Standard productivity measures published by statistical agencies miss this source of productivity gains associated with the big shift.⁶

Productivity perceptions: On balance, workers hold more favorable views about productivity in work-from-home mode than managers. Much of this difference in perceptions turns on the same conceptual distinction. Consider someone who works eight paid hours a day, lives thirty minutes from the office, and accomplishes the same amount whether working from home or the office. In this example, total time devoted to work is nine hours per day when commuting, and eight hours per day when working from home. So, the worker perceives (correctly) that he or she accomplishes the same amount in 11 percent less time when working from home – a big productivity boost! From the manager’s vantage point, however, the productivity effect of work from home is nil in this example. Thus, managers and workers can quite reasonably hold different views about the productivity effects of work from home.

According to data from the Survey of Working Arrangements and Attitudes covering January to June 2023, 43 percent of workers able to work from home say they are more productive when working from home, and 14 percent say they are less productive. The rest say their productivity is about the same either way. Probing further, workers attribute the self-assessed productivity benefits of work from home mainly to the savings in commute time (Barrero et al, 2021b). When we net out the productivity benefit that workers attribute to commute time-savings, the manager-worker gap in perceptions about the productivity effects of work from home shrinks to a small difference.

There is a broader lesson here: Disagreements about the productivity effects of work from home turn partly on what counts as productivity. Workers regard commute time-savings as a source of productivity gains, while managers do not. Workers may be blind to the managerial challenges of remote work. Managers, especially senior ones, are probably more concerned about its implications for workplace culture. Remote work may let seasoned employees accomplish more in the near term while, at the same time, detracting from the transmission of

⁶ A fuller analysis of the missing productivity gain would account for three other factors. First, the big shift is concentrated among workers with higher earnings, who also tend to have longer commutes. Adjusting for these patterns would raise the 2.8 percent figure, especially on an earnings-weighted basis. Second, workers devote between 30 and 40 percent of their commute time-savings to their jobs. Adjusting for that would lower the 2.8 percent figure. Third, hours worked are observed with error in the data that statistical agencies use to measure labor productivity, and the observational errors may be correlated with the big shift itself. See Davis (2022) additional discussion.

their knowledge to younger coworkers – with detrimental effects on the organization’s productivity over the longer term.

Fully Remote Work: Several studies find that fully remote work yields lower productivity than on-site work. Emanuel and Harrington (2023) analyze data from a Fortune 500 firm that, before the pandemic, operated call centers with both remote and on-site employees in the same jobs. In response to the pandemic, the firm shifted all employees in these jobs to fully remote work. Productivity among formerly onsite employees fell four percent relative to that of already-remote employees. Emanuel and Harrington also find evidence that the closure of physical call centers reduced call quality, especially among less experienced employees. These findings are noteworthy, in part, because they involve a firm with prior experience in managing fully remote call-center workers. Presumably then, the firm had already adapted its systems and practices to manage fully remote workers.

Gibbs et al. (2023) study productivity outcomes for skilled professionals at a large Indian technology services company. In March 2020, the company abruptly shifted all employees to fully remote work in response to the pandemic. Immediately after the shift, average worktime rose by 1.5 hours per day and output fell slightly according to their primary performance measure. Gibbs et al. estimate that the shift to remote work lowered average labor productivity (output per hour worked) by 8 to 19 percent. They also provide evidence that greater communication and coordination costs drove much of the measured productivity drop. In particular, time spent on meetings and coordination activities rose, crowding out time devoted to a concentrated focus on work tasks.

Here as well, the productivity concept matters. Their Table 2 reports an average two-way commute time of 1.3 hours per day. That is, the savings in commute time largely offsets the extra 1.5 hours per day that employees put into their jobs after the transition to fully remote work. From the worker’s perspective, and from a societal perspective as well, the company’s shift to remote work had small effects on productivity. The larger point is that the commute time-savings from remote work can offset sizable drops in productivity, as conventionally measured.

Gibbs et al. also find that employees “narrowed the scope of their networks” after shifting to fully remote work, engaging in fewer contacts inside and outside the organization. Other studies also find scope-narrowing and siloing effects associated with remote work. For example, Yang et al. (2021) find that communications among 61,000 Microsoft employees became more

asynchronous after a pandemic-induced shift to remote work, and collaborations became more static and siloed. Battiston et al. (2021) find that police dispatchers work faster, especially in busy periods, when they sit in the same room as other dispatchers. These three studies suggest, in various ways, that remote work can slow communications, impede the diffusion of knowledge within an organization and narrow the scope of collaborative efforts.

Many managers and workers also express concerns about mentoring and learning in remote settings. According to a survey by the Pew Research Center, 36 percent of American employees who work from home all, most, or some of the time believe that teleworking hurts their opportunities to be mentored at work “a lot/a little” (Parker, 2023). But ten percent think it helps. With respect to “Chances of getting ahead in their job” and “Whether they are given important assignments,” large majorities think that working from home neither helps nor hurts, and the rest are evenly split between helps and hurts. One interpretation of these results is that the impact of work from home on mentoring and job advancement depends on the person, the job, and the way the organization manages its remote workers.

In a study of mentoring practices and team relations, Emanuel, Harrington and Pallais (2023) consider software engineers at a large technology firm. Some engineering teams were housed in the same building, and other teams were split across two adjacent buildings. Before the pandemic, employees housed in the same building as teammates received 21 percent more comments on their code from coworkers. These comments provide suggestions on how to improve code, and they play an important role in employee learning and performance gains. When the pandemic struck, all employees shifted to work from home. The comment rate difference between co-located and other teams vanished, and overall comment volume fell by almost half. The volume drop was largest for junior employees, reinforcing concerns that remote work impedes knowledge transmission to younger workers.

Other concerns about the productivity effects of remote work center on motivation and self-control. As one gag line has it, the three enemies of working from home are the bed, the fridge, and the TV. Indeed, college students sometimes study in libraries as a commitment device even though grades, self-esteem, and future career prospects would seem to provide powerful incentives. So, it is perhaps unsurprising that some people struggle with motivation when working in a remote capacity. Armed with a bit of self-knowledge, they may also choose to work at their employer’s site despite the attractions of work from home.

A fuller analysis of why organizations employ fully remote workers, even when it means lower labor productivity, would look to other cost savings. We discussed how remote work can lower labor costs. In addition, fully remote employees don't require office space and the overhead costs that come with a physical footprint. These cost savings must be considered along with the productivity consequences, now and in the future, when optimizing over working arrangements. At the organizational level, this optimization problem is a complex one, because a shift in working arrangements also requires new skills and work habits, new managerial practices and new organizational capabilities if remote work is to be effective.

Hybrid Arrangements: Studies of hybrid working arrangements often find productivity gains (relative to traditional arrangements) or no discernable effect. In an early study, Bloom et al. (2015) consider a field experiment with 250 call-center employees at cTrip.com, a large Chinese travel agent. Employees were randomly allocated between two groups. One group continued working five days a week in the office, and the other group switched to a hybrid arrangement with four home workdays and one office workday each week. Average daily output rose by 13 percent among switchers. Nine percentage points of this output gain arose from extra worktime due to shorter breaks and less sick leave. The other four points reflect greater efficiency in the form of more calls handled per work hour.

In another pre-pandemic experiment, Choudhury et al. (2021) study the productivity of patent examiners employed by the U.S. Patent and Trademark Office. Starting in 2006, several hundred examiners were allowed to shift to a hybrid arrangement with up to four home workdays per week. The shift took place in a staggered manner, with exogenous timing at the worker level, facilitating the estimation of causal effects. Patent actions rose by 5 percent, on average, after examiners switched to the hybrid arrangement. The switch had no impact on the incidence of rework, indicating that quality did not suffer. Later, starting in 2012, patent examiners were allowed to live anywhere in the contiguous United States with periodic travel to headquarters at their own expense. Patent actions rose by an additional 8 percent among those who switched from the hybrid to the work-from-anywhere arrangement. Choudhury et al. provide evidence that these productivity gains reflected greater effort by patent examiners.

Three other aspects of the setting in this study warrant attention. First, patent examinations are performed by individuals, not teams. Second, examiners were required to spend at least two years working in the office before transitioning to the hybrid arrangement and more

time in that arrangement before transitioning to a work-from-anywhere arrangement. Third, individual examiners chose whether to switch from a traditional working arrangement to the alternative arrangements. Thus, the selection process into the alternative arrangements reflects individual preferences and self-knowledge about ability to work remotely.

Other recent studies analyze more modest shifts from traditional to hybrid working arrangements. Choudhury et al. (2022) consider an organization in Bangladesh that randomly assigned administrative staff to three groups: high work-from-home intensity (more than 40 percent of workdays), intermediate intensity (23-40 percent), and low intensity (0-23 percent). Staff in the intermediate group sent more emails to more people, drafted more complex emails, reported better job satisfaction, felt more connected to colleagues, and received stronger performance evaluations from managers. Bloom, Han and Liang (2023) conduct a randomized control trial with 1600 highly educated employees (software engineers and marketing and finance professionals) at cTrip.com. Those born on even-numbered dates continued to work onsite five days a week, while the rest had the option to work from home on Wednesday and Friday. The experiment ran for six months, yielding zero or small productivity gains from the hybrid arrangement. Employees highly valued the hybrid arrangement, except for managers. Angelici and Profeta (2023) consider a nine-month experiment that injected flexibility into the working arrangements of full-time employees at a large Italian firm. The control group stuck to a traditional arrangement that prescribes time and place of work throughout the week. In the treated group, white-collar employees chose where and when to work – and blue-collar employees chose when – one day a week. Productivity rose ten percent, on average, among the treated relative to the controls, as measured by self-assessments and by supervisors. The treated group also reported higher levels of well-being and work-life balance. Greater flexibility for treated workers had no apparent effect on the productivity of co-workers on the same team.

All three of these studies suggest that working from home one or two days a week improves productivity and leads to happier employees. This pattern supports the view that, in many jobs, some tasks are well suited for remote work. The productivity gains associated with hybrid working arrangements in these studies could reflect greater effort levels by happier employees, quieter work environments at home, and the time savings that employees put back into their jobs.

The Pace of Innovation

Face-to-face interactions in the workplace can foster the diffusion of knowledge and the generation of new ideas. Looking beyond a single workplace, cities have long functioned as hubs for knowledge spillovers across workers, firms, and industries and as centers of invention, innovation, and entrepreneurship.⁷ In this light, the big shift to work from home raises concerns about its potential to slow the pace of innovation and the growth rate of productivity.

In one study that speaks to these concerns, Brucks and Levav (2022) designed and fielded commercial innovation experiments in cooperation with employers in Finland, Hungary, India, Israel and Portugal. More than 800 engineering teams were tasked with suggesting new uses for an existing product, with teams randomly assigned to meet in person or via videoconference. In-person teams proved to be more effective in that their product ideas received higher external ratings. When it came to selecting ideas (rather than developing them), teams performed as well, or even better, when they met by videoconference. These results suggest that brainstorming activities benefit from in-person meetings, but some other aspects of the innovation process do not. In a similar spirit, Lin, Frey and Wu (2023) develop evidence that collaboration at a distance is especially challenging in the early stages of research “when an idea is hard to articulate and knowledge is tacit.” They show that inventor teams that collaborate remotely make fewer breakthroughs, as measured by patent citations. The same pattern holds for scientific publications. Lin et al. also show that collaboration in dispersed teams is more focused on technical tasks, including data collection and analysis, rather than idea generation and research design. Both studies suggest that in-person communications are particularly valuable in the early stages of the innovation process but less so in later stages and in technical tasks.

Profit-oriented firms have strong incentives to recognize and respond to the internal costs and benefits of working arrangements. However, if those arrangements yield idea spillovers beyond the boundaries of the firm, outcomes need not be efficient or socially desirable. Monte et al. (2023) pursue this theme. In their calibrated model, a city can settle at a low or high work-from-home intensity. The low-intensity equilibrium yields more spillovers, greater productivity, and higher social welfare in their large-city calibration. Still, that equilibrium can be disrupted by a shock that, for a period time, renders it infeasible or unattractive to commute to the worksite.

⁷ The literature is vast and diverse. See Carlino and Kerr (2015) and Combes (2015) for reviews.

Even after the shock ends, workers and firms can settle at a new equilibrium with less commuting (a benefit), lower productivity (a cost), and lower social welfare.

Their model offers an alternative explanation for the enduring character of the big shift to work from home after the pandemic. Although Monte et al. focus on how work-from-intensity affects the level of productivity, a similar point applies to the pace of innovation. In other words, it's possible that a shock-induced shift to work from home could slow the pace of innovation by undermining the idea-generating capabilities of cities.

Despite these reasons for concern, we are optimistic about the outlook for the pace of innovation, at least as it relates to working arrangements. The same developments that facilitated a big shift to work from home also created greater reach and higher quality in one-way and two-way communications at a distance. These include the rise of the internet, better broadband infrastructure, better videoconferencing, the emergence of the cloud, and better software tools for remote collaboration.

Chen, Frey and Presidente (2022) also study the relationship of remote collaboration to the impact of scientific articles, as reflected in citations. Before 2010, remote collaboration produced articles that were more incremental in nature and less likely to yield “disruptive” advances, echoing the findings in Lin et al. (2023). However, Chen et al. also show that the quality discount on articles written by dispersed teams shrinks over time, vanishes around 2010, and then becomes a premium. A plausible explanation is that advances in remote-collaboration technologies made it easier and cheaper to coordinate a broader range of specialized and geographically scattered complementary inputs. In the model of Becker and Murphy (1992, Section 6) such a fall in coordination costs raises the innovation rate.

In an earlier study, Forman and van Zeebroeck (2012) examine patenting activity inside firms before and after the adoption of internet technologies, which happened at different times in different firms. Adoption led to more patent-producing collaborations by geographically dispersed teams within the firm. Evidently, internet access lowered coordination costs among geographically dispersed scientists in the same firm. In later work, Forman and van Zeebroeck (2019) find that the spread of internet connectivity increased knowledge flows across locations, as reflected in between-location patent citations within firms.

In conversations with work-from-home skeptics, we often hear some version of the following claims: Working from home means a loss of serendipitous encounters in and around

the workplace. Or, knowledge flows more readily among people who work in the same location. Another claim is that people generate more and better ideas, and bring them to fruition more quickly, when they work in close proximity. Even if these claims are true, they miss much.

First, there's an opportunity cost to chatting with your co-worker in the next-door office: You could be collaborating with your far-away coauthor via Zoom. It's hardly obvious that serendipitous encounters in the workplace foster innovation better than planned encounters selected from a much larger universe. Second, remote-collaboration technologies tremendously expand the opportunities to form teams that are optimized for particular research projects and questions. This advantage in team formation is especially valuable in projects that call for the cooperation of many scientists with distinct skills and types of expertise. Third, if some aspects of the innovation process truly benefit from in-person communications, then researchers have strong incentives to focus on those aspects when they are in the same location. Hybrid working arrangements, in particular, don't prevent in-person meetings. They only require more forethought and coordination to make them happen.

Looking Ahead

At the outset of this essay, we explained how the pandemic catalyzed a big shift to work from home and why it will endure. Statistical evidence confirms this conclusion. According to Figure 1, the U.S. work-from-home rate in 2023 has settled at about four times the 2019 level. Office occupancy statistics from Kastle Security Systems (undated) also indicate that work-from-home intensity has stabilized in 2023.

As part of the July 2023 Survey of Business Uncertainty, fielded by the Atlanta Fed, we asked U.S. business executives about the work-from-home outlook at their own firms. The survey responses cover about 500 firms distributed widely across industries, states, and firm size categories. Specifically, we asked: "Looking forward to five years from now, what share of your firm's full-time employees do you expect to be in each category [fully in person, hybrid, fully remote] in 2028?" We asked a parallel question about the firm's current working arrangements. Compiling the results, executives anticipate modest increases over the next five years in both the fully remote share and the hybrid share (Bloom et al., 2023b). This finding holds whether we weight each firm equally or in proportion to its number of employees.

Another reason to anticipate steady or slowly rising work-from-home rates over the next several years is that organizations will continue to adapt their practices to better manage hybrid and fully remote workers. That will raise productivity in work-from-home mode. Where experience teaches that remote work is unsuitable, organizations will revert to traditional arrangements, if they not have done so already.

Yet another reason involves the innovation incentives created by the big shift. Schmookler (1966) argues that a growing market incentivizes investments in innovations to serve that market. The U.S. market for technologies and products that support remote work is now four times as large as in 2019. It has also become much larger in the rest of the world. To assess the force of the Schmookler effect, Bloom et al. (2021) consider the monthly flow of newly filed applications for U.S. patents. They use automated text readings to determine which ones claim to advance technologies in support of video conferencing, telecommuting, remote collaboration, and work from home. Patent applications that advance these technologies double as a share of all newly filed U.S. patent applications from January to September 2020. In ongoing research with Mihai Codreanu, we find that this re-direction of innovation efforts has continued through at least early 2022. So, it's reasonable to anticipate that remote-collaboration technologies and tools will continue to advance at a rapid pace for some years to come, further reinforcing the shift to remote work.

We see the outlook for fully remote jobs as less secure than the one for hybrid arrangements. Cost pressures encourage firms to shift fully remote jobs to countries with lower wages, including countries with many English-proficient workers. Of course, that process has been underway for decades. The new element in that firms now have better information about which jobs and tasks are well suited for remote work. The automation of call-center jobs and routine administrative tasks may also reduce the number of fully remote jobs in the U.S..

Work-from-home rates will continue to differ sharply across industries, occupations, cities and worker education levels. One corollary is that an economic downturn concentrated in remote-intensive sectors could lower the overall work-from-rate for a time. Another corollary is that the amenity-value benefits of the big shift will also remain unevenly distributed across sectors, occupations and demographic groups. As a result, we think the big shift will have lasting effects on the structure of wages. It may also profoundly influence the nature and intensity of competition in the labor market.

References

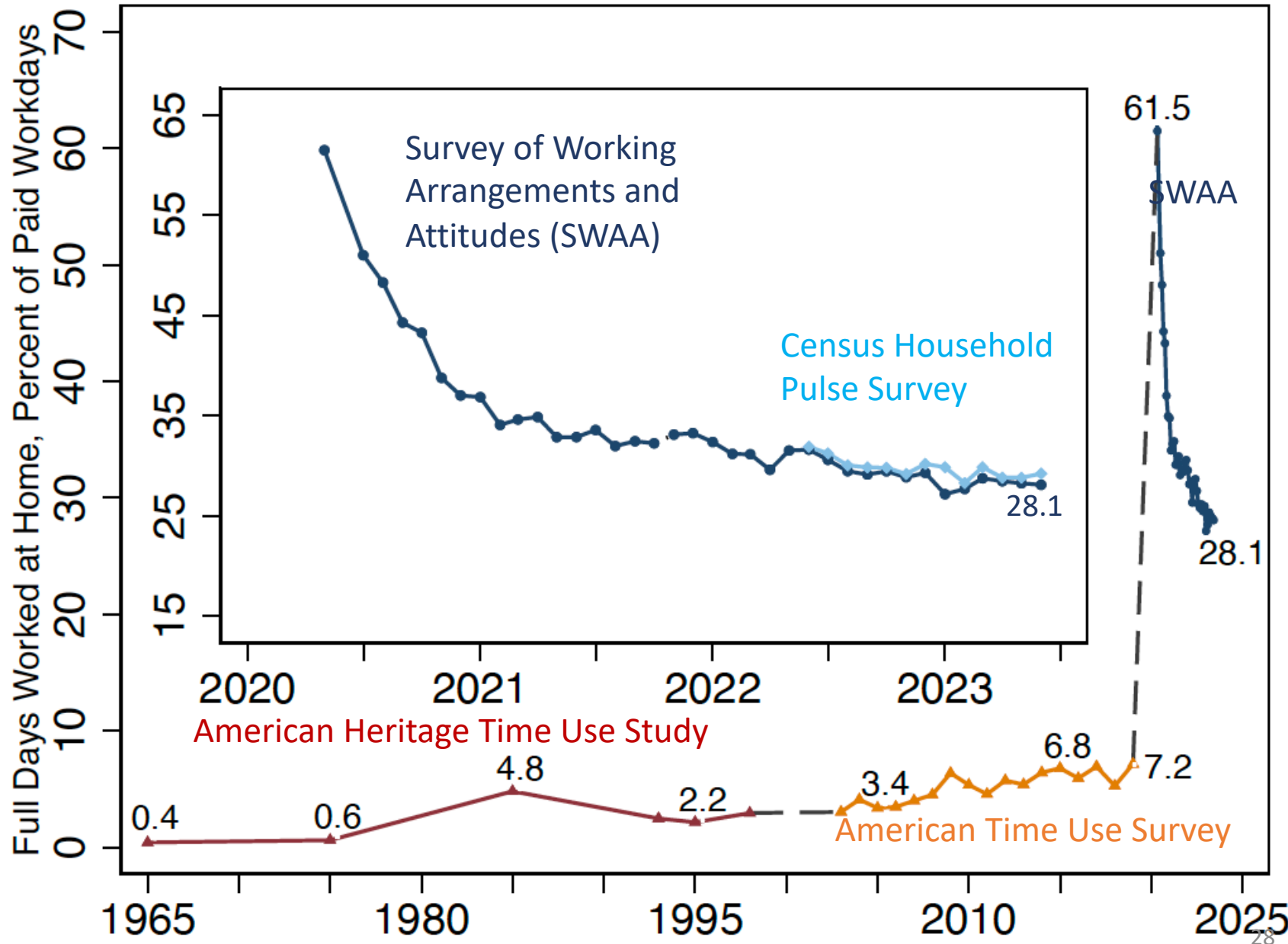
- Aksoy, Cevat Giray, Jose Maria Barrero, Nicholas Bloom, Steven J. Davis, Mathias Dolls and Pablo Zarate, 2022. “[Working from Home Around the World](#),” *Brookings Papers on Economic Activity*, Fall.
- Aksoy, Cevat Giray, Jose Maria Barrero, Nicholas Bloom, Steven J. Davis, Mathias Dolls and Pablo Zarate, 2023a. “Time Savings When Working from Home,” *AEA Papers & Proceedings*, 113 (May).
- Aksoy, Cevat Giray, Jose Maria Barrero, Nicholas Bloom, Steven J. Davis, Mathias Dolls and Pablo Zarate, 2023b. “[Working from Home Around the Globe: 2023 Report](#),” 28 June.
- Angelici, Marta and Paola Profeta, 2023. “Smart Working: Flexibility without Constraints,” *Management Science*. <https://doi.org/10.1287/mnsc.2023.4767>.
- Arjun, Ramani and Nicholas Bloom, 2022. “The Donut effect of COVID-19 on Cities,” NBER Working Paper 28876, revised.
- Autor, David, Arindrajit Dube, and Annie McGrew. 2023. [The unexpected compression: Competition at work in the low wage labor market](#). NBER Working Paper 31010.
- Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis. 2021a. [Internet Access and its Implications for Productivity, Inequality, and Resilience](#),” in *Rebuilding the Post-Pandemic Economy*, Melissa S. Kearney and Amy Ganz, eds. (Aspen Institute Press).
- Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis, 2021b. “[Why Working from Home Will Stick](#),” National Bureau of Economic Research Working Paper 28731.
- Barrero, Jose Maria, Nicholas Bloom, Steven J. Davis, Brent Meyer, and Emil Mihaylov, 2022. “[The Shift to Remote Work Lessens Wage-Growth Pressures](#),” NBER WP 30197.
- Barrero, Jose Maria, Nicholas Bloom, Shelby Buckman, and Steven J. Davis, 2023a. “[SWAA February 2023 Updates](#).”
- Barrero, Jose Maria, Nicholas Bloom, Shelby Buckman, and Steven J. Davis, 2023b. “WFH Code and Data: May 2020 to August 2023 [dataset].” Available WWW: <https://wfhresearch.com/data-restrict/>
- Battiston, Diego, Jordi Blanes i Vidal, and Tom Kirchmaier, 2021. “Face-to-Face Communication in Organizations,” *Review of Economic Studies* 88, no. 2, 574-609.
- Becker, Gary and Kevin M. Murphy, 1992. “[The Division of Labor, Coordination Costs, and Knowledge](#),” *Quarterly Journal of Economics*, 107, no. 4 (November), 1137-1160.

- Bloom, Nicholas, Jose Maria Barrero, Steven J. Davis, Brent Meyer, and Emil Mihaylov, 2023a. "[Research: Where Managers and Employees Disagree About Remote Work](#)," *Harvard Business Review*, 5 January
- Bloom, Nicholas, Jose Maria Barrero, Steven J. Davis, Brent Meyer and Emil Mihaylov, 2023b. "[Survey: Remote Work Isn't Going Away – And Executives Know It](#)," *Harvard Business Review*, 28 August.
- Bloom, Nicholas, Steven J. Davis, and Yulia Zhestkova, 2021. "COVID-19 Shifted Patent Applications toward Technologies that Support Working from Home." *American Economic Association, Papers & Proceedings*, May.
- Bloom, Nicholas, Roubing Han and James Liang, 2023. "How Hybrid Working from Home Works Out," NBER Working Paper 30292.
- Bloom, Nicholas, James Liang, John Roberts, and Zhichun Jenny Ying, 2015. "Does working from home work? Evidence from a Chinese experiment," *Quarterly Journal of Economics*, 130, no. 1, 165-218.
- Brinatti, Agostina, Alberto Cavallo, Javier Cravino, and Andres Drenik, 2022. "The International Price of Remote Work," NBER Working Paper 29437, revised.
- Brucks, Melanie S. and Jonathan Levav, 2022. "Virtual communication curbs creative idea generation," *Nature*, 605: 102-112.
- Buckman, Shelby, Jose Maria Barrero, Nicholas Bloom and Steven J. Davis, 2023. "The Demographics of Work from Home," working paper.
- Carlino, Gerald and William R. Kerr, 2015. "[Agglomeration and Innovation](#)," Chapter 6 in *Handbook of Regional and Urban Economics*, Volume 5A, edited by Gilles Duraton, J. Vernon Henderson and William C. Strange, Elsevier B.V.
- Chen, Chinchih, Carl Benedikt Frey and Giorgio Presidente, 2022. "[Disrupting Science](#)," Oxford Martin Working Paper Series on Technological and Economic Change No. 2022-04.
- Choudhury, Prithwiraj, Cirrus Foroughi, and Barbara Zepp Larson, 2021. "Work-from-anywhere: The productivity effects of geographic flexibility," *Strategic Management Journal*, 42, no. 4.
- Choudhury, Prithwiraj, Tarun Khanna, Christos A. Makridis and Kyle Schirmann, 2022. "Is Hybrid Work the Best of Both Worlds? Evidence from a Field Experiment," working paper.

- Combes, Pierre-Phillipe, 2015. “[The Empirics of Agglomeration Economies](#),” Chapter 5 in *Handbook of Regional and Urban Economics*, Volume 5A, edited by Gilles Duraton, J. Vernon Henderson and William C. Strange, Elsevier B.V.
- Davis, Steven J., 2022. “[The Big Shift to Working from Home](#).” Slides prepared for the NBER Macroeconomics Annual Conference, 1 April.
- Dingel, Jonathan and Brent Neiman, 2020. “[How Many Jobs Can Be Done at Home](#),” *Journal of Public Economics*, 189 (September), 104325.
- Emanuel, Natalia and Emma Harrington, 2023, ““Working Remotely? Selection, Treatment and the Market for Remote Work,” Federal Reserve Bank of New York Staff Reports, no. 1061.
- Emanuel, Natalia, Emma Harrington and Amanda Pallais, 2023. “The Power of Proximity to Coworkers,” Training for Tomorrow or Productivity Today?” working paper, 23 July.
- Fisher, Kimberly, Jonathan Gershuny, Sarah M. Flood, Joan Garcia Roman and Sandra L. Hofferth, 2018. “American Heritage Time Use Study Extract Builder: Version 1.2 [dataset],” Minneapolis, MN: IPUMS. <https://doi.org/10.18128/D061.V1.2>
- Flood, Sarah M., Liana C. Sayer, Daniel Backman and Annie Chen, 2023. “American Time Use Survey Data Extract Builder: Version 3.2 [dataset],” College Park, MD: University of Maryland and Minneapolis, MN: IPUMS.
- Forman, Chris and Nicolas van Zeebroeck, 2012. “From Wires to Partners: how the Internet Has Fostered R&D Collaborations within Firms,” *Management Science*, 58, no. 8,
- Forman, Chris and Nicolas van Zeebroeck, 2019. “Digital Technology Adoption and Knowledge Flows within Firms: Can the Internet Overcome Geographic and Technological Distance,” *Research Policy*, 48, no. 8, 103687.
- Gibbs, Michael, Friederike Mengel and Christoph Siemroth, 2023. “[Work from Home and Productivity: Evidence from Personnel and Analytics Data on Information Technology Professionals](#),” *Journal of Political Economy Microeconomics*, 1, no. 1 (February), 7-41.
- Hansen, Stephen, Peter J. Lambert, Nick Bloom, Steven J. Davis, Raffaella Sadun and Bledi Taska, 2023. “[Remote Work across Jobs, Companies, and Space](#),” NBER Working Paper 31007.
- Kastle Security Systems, undated. “Getting America Back to Work,” www.kastle.com/safety-wellness/getting-america-back-to-work/-workplace-barometer.

- Le Barbanchon, Thomas, Roland Rathelot and Alexandra Roulet, 2021. “Gender Differences in Job Search: Trading Off Commute against Wage,” *Quarterly Journal of Economics*, 136, no. 1, 381-426.
- Lin, Yiling, Carl B. Frey, and Lingfei Wu. 2023. “Remote Collaboration Fuses Fewer Breakthrough Ideas,” *Computers and Society*, 21 February. [arXiv:2206.01878](https://arxiv.org/abs/2206.01878)
- Mas, Alexandre and Amanda Pallais, “Valuing alternative work arrangements,” *American Economic Review*, 2017, 107, no. 12, 3722–59.
- Monte, Ferdinando, Charly Porcher and Esteban Rossi-Hansberg, 2023. “Remote Work and City Structure,” NBER Working Paper 31494, July.
- Parker, Kim, 2023. “About a Third of U.S. Workers Who Can Work from Home Now Do So All the Time,” 30 March. <https://pewrsr.ch/3nwMOap>.
- Pew Research Center, 2021. “Internet/Broadband Fact Sheet,” www.pewresearch.org/internet/fact-sheet/internet-broadband/#home-broadband-use-over-time.
- Rosen, Sherwin, 1986. “The Theory of Equalizing Differences,” Chapter 12, *Handbook of Labor Economics*, Vol. I, edited by Orley C. Ashenfelter and Richard Layard, North-Holland.
- Schmookler, Jacob, 1966. *Innovation and Economic Growth*. MIT Press.
- Scur, Daniela, Raffaella Sadun, John Van Reenen, Renata Lemos and Nicholas Bloom, 2021. “The World Management Survey at 18: Lessons and the Way Forward,” *Oxford Review of Economic Policy*, 37, no. 2, 231-258.
- U.S. Bureau of Census, 2023. “Household Pulse Survey Public Use Files (PUFs): Week 46 (June 1 to June 13, 2022) to Week 58 (June 7 to June 19, 2023) [datasets],” available WWW: <https://www.census.gov/programs-surveys/household-pulse-survey/datasets.html>
- U.S. Bureau of Economic Analysis, 2023. “Personal Consumption Expenditures: Chain-type Price Index [PCEPI] [dataset],” retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/PCEPI>, August 17, 2023.
- Yang, Longqi, David Holtz, Sonia Jae and others, 2022. “[The Effects of Remote Work on Collaboration among Information Workers](#),” *Nature Human Behavior*, 6, 43-54.

Figure 1. Work from Home over Time in the United States



Notes to Accompany Figure 1

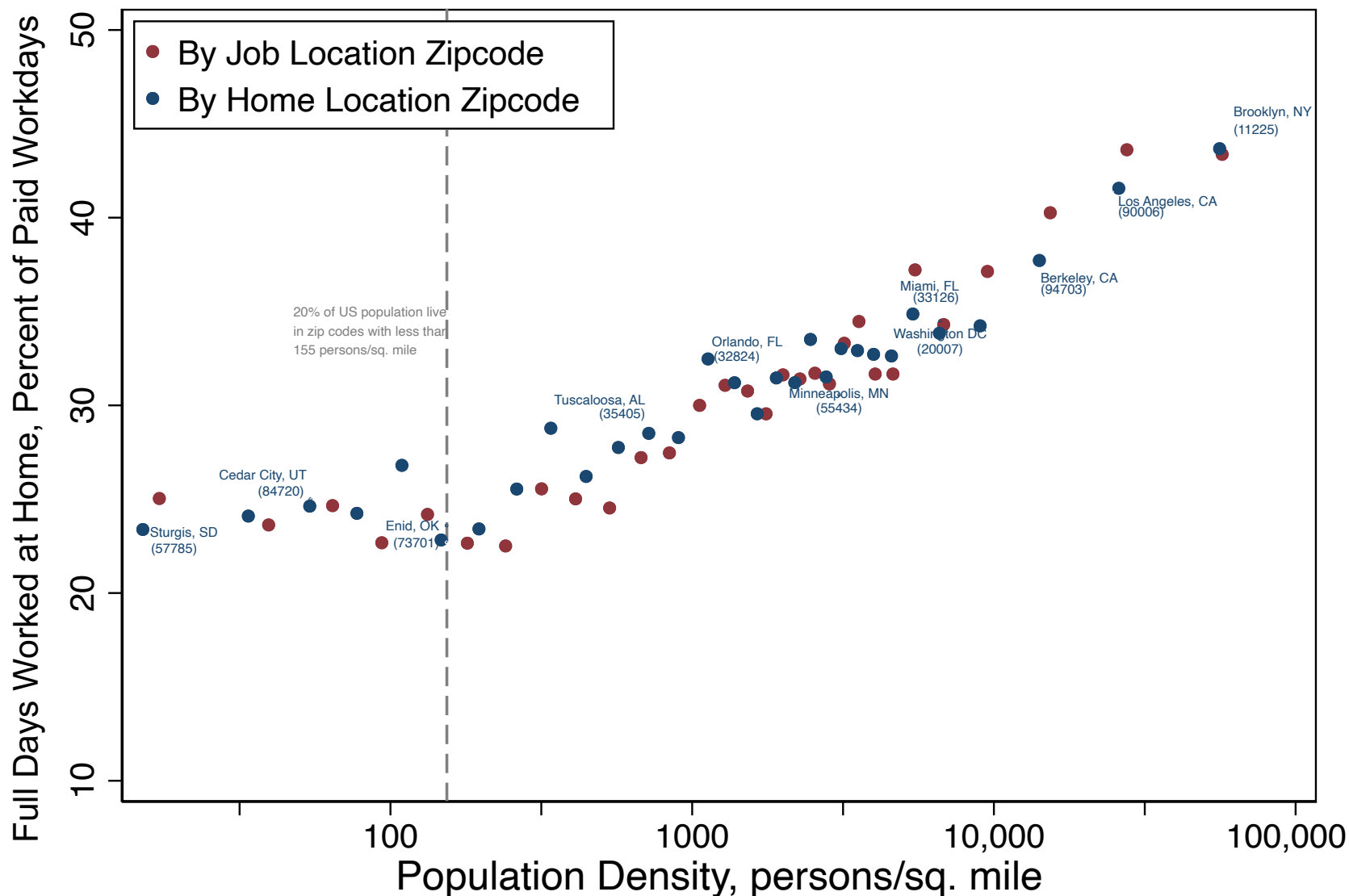
Notes: The figure reports estimates for full days worked from home as a percent of all paid workdays for persons 20-64 years of age, drawing on the American Heritage Time Use Study (AHTUS, Fisher et al, 2018) for 1965, 1975, 1985, 1993, 1995 and 1998; the American Time Use Survey (ATUS, Flood et al. 2023) from 2003 to 2019 by year; the Survey of Working Arrangements and Attitudes (SWAA, Barrero et al. 2023b) for May 2020 and from July 2020 to June 2023 by month; and the Census Household Pulse Survey (HPS, U.S. Bureau of Census, 2023) from May 2022 to June 2023 by month. We use regression methods to adjust the SWAA data for question design changes. When using SWAA data, we restrict to persons who meet a prior-year earnings requirement of \$20,000 in the March 2021 and prior survey waves, and \$10,000 in the later waves. We weight the individual-level SWAA data to match the distribution across age-sex-education-earnings cells in the Current Population Survey. When using HPS data, we restrict to persons with household income greater than \$25,000 and use the provided population weights. When using the ATUS, we restrict to persons with annual earnings of more than \$20,000 in 2019 dollars calculated as 52 times weekly earnings deflated by the GDP deflator for Personal Consumption Expenditures (PCE, U.S. Bureau of Economic Analysis, 2023). In the ATUS, we count paid workdays as ones in which the individual devotes six or more hours of work to their main job, regardless of work location, and we count work-from-home days as ones in which the individual works six or more hours on their main job at home. This approach corresponds to the SWAA-based measure. We use ATUS sample weights and drop the roughly two percent of observations flagged as “low quality.” We follow the same approach in the AHTUS as in the ATUS, except an absence of data prevents us from imposing the earnings requirement in 1965, 1993, 1995 and 1998. We use AHTUS sample weights and drop the two-to-four percent of observations flagged as low quality.

Figure 2. U.S. Work-from-Home Rates by Industry Sector in 2023, Employees Who Work Five or More Days per Week



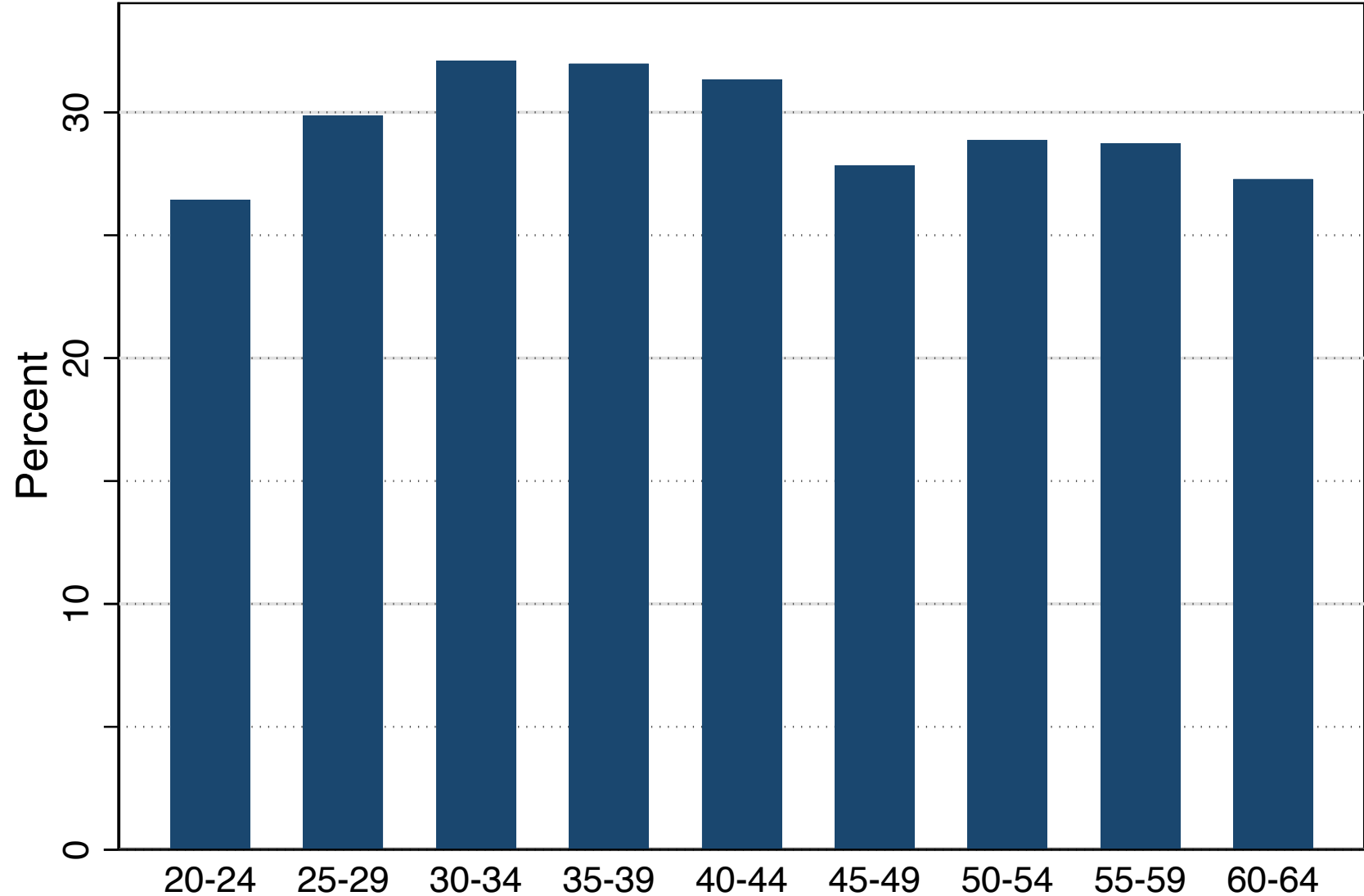
Notes: The chart reports mean values for the number of full days worked from home by employees, 20-64 years of age, who worked five or more days in the survey reference week, based on data from the January through June 2023 waves of the U.S. Survey of Working Arrangements and Attitudes (Barrero et al., 2023b). Due to small samples, we omit values for Mining and Agriculture. We drop respondents who fail our attention-check questions. N = 22,341

Figure 3. Work from Home Rises with Population Density, U.S. Data



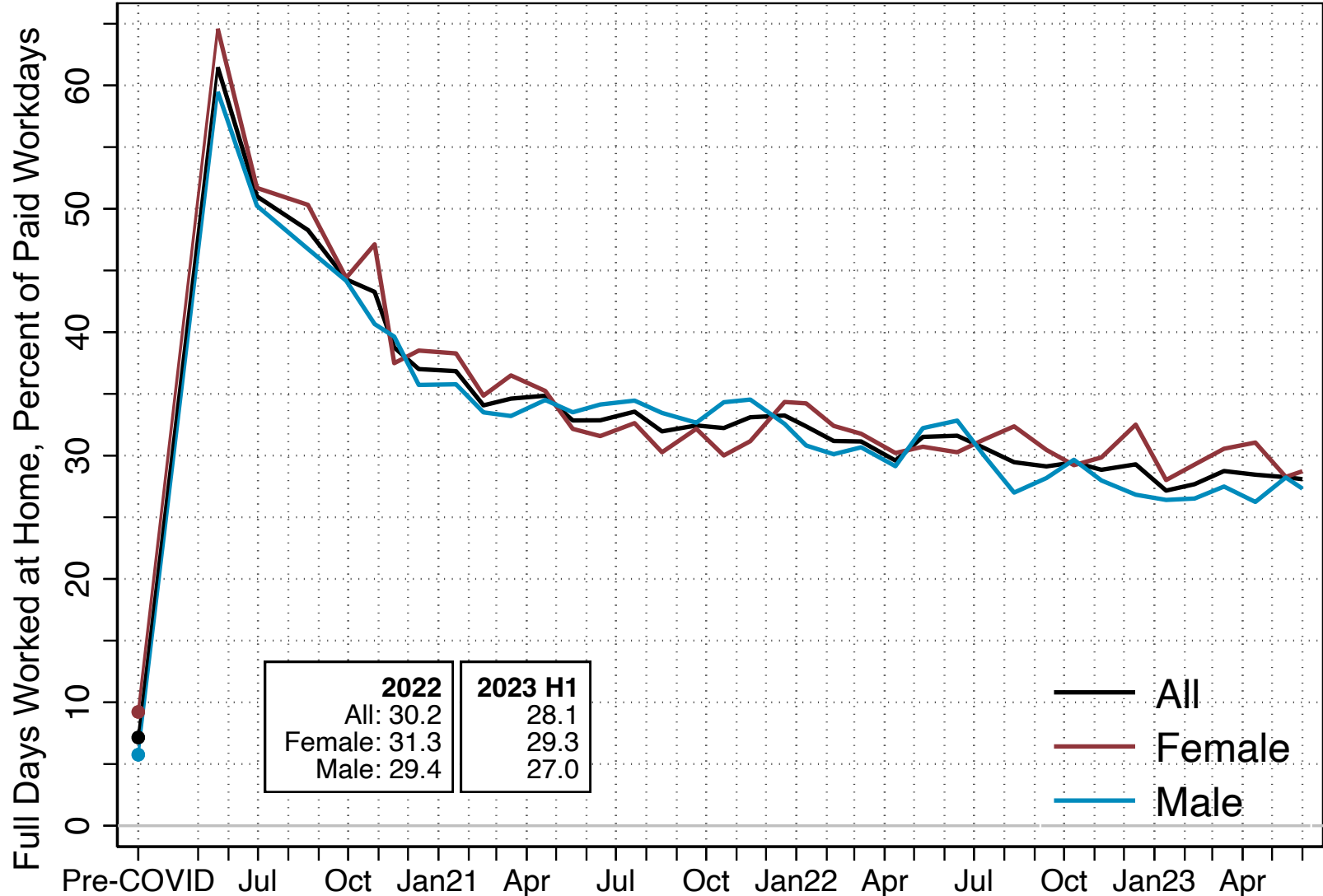
Notes: The chart shows full days worked from home as a percent of all paid workdays for population density bins. The data are from the Survey of Working Arrangements and Attitudes (Barrero et al., 2023b), January 2021 through June 2023, restricted to persons 20-64 years of age with prior-year earnings of at least \$10,000. Each density bin is a collection of zip codes and the workers in those zip codes based on their job location (red) or home location (blue). N = 119,922 (Job location data). N = 122,714 (Home location data).

Figure 4: Work-from-Home Intensity Peaks Among Persons in their Thirties
Percentage of paid full days worked from home



Notes: The chart reports full days worked from home as a percent of all paid workdays by age group in the Survey of Working Arrangements and Attitudes (Barrero, Bloom, and Davis, 2023b). We drop respondents who fail our attention-check questions. The sample runs from January 2022 through June 2023. N = 71,000. 32

Figure 5: Women and Men Work from Home at Similar Rates, U.S. Data



Notes: The chart reports full days worked from home as a percent of all paid workdays for men and women in the Survey of Working Arrangements and Attitudes (SWAA, Barrero et al., 2023b) and 2019 American Time Use Survey (ATUS, Flood et al., 2023). The SWAA data cover May 2020 and each month from July 2020 through June 2023. We restrict samples to workers 20-64 years of age and 2019 earnings of at least \$20,000 before March 2021 and then transition to a \$10,000 threshold in 2019 or the prior year. We re-weight the SWAA to match the distribution across age-sex-education-earnings cells in the Current Population Survey. We use regression methods to adjust for changes in the question design over time, as detailed in <https://wfhresearch.com/tracking-wfh/>. We obtain the pre-COVID numbers from ATUS by determining whether respondents worked for at least six hours in a day, and whether the location of that work was their home. N = 1885 (2019 ATUS) and N = 143,410 (SWAA).

Table 1: Full-Time Working Arrangements in the U.S. as of 2023, Percentage Distributions

	(1) Fully Onsite	(2) Hybrid Arrangement	(3) Fully Remote	(4) Percent of All Workers
All Workers	55.9	28.6	15.5	100
Self-Employed, Excluding Contactors and Gig Workers	24.9	26.8	48.3	7.4
Contractors and Gig Workers	32.9	22.7	44.4	3.3
All Employees	59.3	29	11.8	89.3
In Firms With 1 to 9 Employees	67.5	17.6	14.9	7.1
In Firms With 10 to 49 Employees	68.3	24.1	7.6	14.2
In Firms With 50 to 99 Employees	57.2	34.1	8.7	13.3
In Firms With 100 to 499 Employees	56.5	32.4	11.2	19.7
In Firms With 500 to 4999 Employees	50.7	37.7	11.6	19.6
In Firms With More Than 5000 Employees	63.5	18.8	17.8	15.3
Government Employees, Excluding the Armed Forces	59.7	27	13.3	3.9

Notes: This table considers full-time American workers who are 20-64 years old as of the survey, where "full-time" means working for pay five or more days in the survey reference week. "Fully Onsite" refers to those who worked at their employer's worksite (or a client's location) each workday in the reference week. "Fully Remote" refers to those who worked from home on all workdays in the reference week. "Hybrid Arrangement" refers to those who split the workweek between home and their employer's worksite (or client locations). Column (4) reports the sample percentage of persons in the indicated row. "Government Employees" are those who report their industry as "Government," excluding those who say their occupation is "Armed Forces." We sort persons into the row categories based on their main job. We drop respondents who fail our attention-check questions.

Source: Survey of Working Arrangements and Attitudes (Barrero, Bloom and Davis, 2023b) January to June 2023. N = 25,014.

Table 2: How Work-from-Home Rates Covary with Individual Characteristics

	(1)	(2)	(3)	(4)	(5)
	Full Days Worked at Home as Percent of Paid Workdays				
1(Female)	0.9* (0.5)	1.0** (0.5)	1.9*** (0.6)	-0.2 (0.6)	0.6 (0.6)
1(Lives with child under 14)		4.5*** (0.5)	5.5*** (0.7)	2.6*** (0.7)	1.6** (0.7)
1(Female) x 1(Lives with child under 14)			-2.3** (1.0)	-0.0 (0.9)	0.5 (0.9)
1(1 to 3 years of college)				7.0*** (0.7)	5.1*** (0.6)
1(4-year college degree)				16.5*** (0.6)	11.4*** (0.7)
1(Graduate degree)				19.1*** (0.7)	13.4*** (0.8)
Industry and occupation fixed effects					Y
N	48244	48244	48244	48244	48244
r ²	0.01	0.01	0.01	0.04	0.11

Notes: We use data from the Survey of Working Arrangements and Attitudes (Barrero, Bloom, and Davis, 2023b) covering October 2021 to October 2022 (inclusive) and regress full days worked at home as percent of paid workdays on indicators for sex, for whether the respondent lives with a child under 14, and education categories. All columns include monthly survey wave fixed effects, and fixed effects for five-year age bins (e.g. 25 to 29, 30 to 34, etc.). The sample includes respondents who worked during the reference week, pass our attention-check questions, and have non-missing data on occupation and industry of the current or most recent job. We report standard errors in parentheses. *p<0.1, ** p<.05, ***p<.01

Source: Survey of Working Arrangements and Attitudes www.wfhresearch.com (Barrero, Bloom and Davis, 2023b)