PORTFOLIO INSIGHTS

The global 'work from home' labor force

Market implications of skill-biased tech adoption and lower urban density

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IN BRIEF

- How many people will work from home (WFH) when the dust from the COVID-19 pandemic settles? Extrapolating from the labor market characteristics associated with the WFH trend allows us to estimate how large the WFH labor force might potentially be.
- We find significant gaps between the ability to work from home and the extent to which it happens. In the U.S., where less than a quarter of the labor force works from home on a regular basis, one would expect convergence toward our estimates of closer to 40%. At the global level, about 25% of the workforce is currently able to work outside the office, with growth driven by secular trends in technology adoption, sector composition, educational attainment and demographics. Emerging market convergence along these dimensions is an important potential driver of future economic growth.
- The investment implications of a rising WFH trend are profound, both from the perspective of overall macro dynamics and the relative performance of companies and sectors levered to this phenomenon. For one, it is among the most visible manifestations of the technology trends that we have been highlighting as upside risks to growth and downside risks to inflation in our Long-Term Capital Market Assumptions.
- From a relative value perspective, dominant themes are tech sector exposure and urbanization trends. The tech intensity of working from home will be a tailwind for both providers and adopters, and may even extend to regional equity markets that have higher information technology weights. The spatial distribution of economic activity between central business districts and outlying environs is another likely vector for relative returns, both across types of real estate asset classes and the size distribution of firms.

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AS BROAD SWATHS OF THE GLOBAL ECONOMY HAVE COME TO A SUDDEN STOP DUE TO THE COVID-19 PANDEMIC, MANY OF US HAVE BEGUN TO REIMAGINE THE GEOGRAPHY OF WORK. In an environment where the majority of corporate organizational structures have faced a stark choice—work remotely or cut employment—we may well have observed the current capacity limit of the labor force's ability to work from home (WFH). It is also the case that working from home was not so uncommon prior to the pandemic, with roughly a quarter of U.S. employees working in the same place where they lived for at least part of the time. Where on the spectrum of factory-, farm-, office-, retail establishment- and home-based work will the labor force settle in the future?

In this paper, we review the history of the WFH phenomenon, survey some of the direct estimates of its prevalence and come up with a novel set of indirect estimates for the global

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working-age population. We do so by documenting the key characteristics of WFH labor—including internet connectivity, labor market structure, worker skill and generational preferences—and draw on an array of research relating them to the likelihood of working from home. Projecting these assumptions onto a detailed profile of the global working-age population gives us our estimates.

What emerges is a picture of the global WFH labor force that is both large, at about a quarter of all workers, and steadily growing over time. Growth has largely been driven by secular trends in internet connectivity and to a lesser extent by the increasing share of younger, more tech-savvy workers; rising educational attainment; and service sector shares in the economy. We document two large gaps: between WFH ability and WFH prevalence in the U.S., and between WFH ability in developed market (DM) and emerging market (EM) economies. In the following sections, we discuss the origins and drivers of these gaps, as well as their implications for investors.

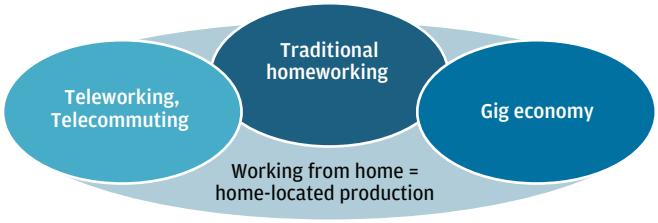
A BRIEF HISTORY OF WORKING FROM HOME

Working from home is not a new phenomenon. There have always been professions where a strict separation between home and work locations is neither necessary nor customary. Indeed, some of the more surprising observations about early post-Industrial Revolution Britain include the small average size of the industrial unit and the prevalence of "outworking"—the practice in which both large and small factories subcontracted production to home-based producers. In the late 19th century, for example, nails and chains were predominantly produced in people's homes, with about half of total supply coming from residences in and around Birmingham.[1]

This type of working from home—in which people undertook predominantly manual, manufacturing-type occupations from their residences—came to be known as "homeworking." There is a rich academic literature focusing on the socioeconomic structure of homeworking, particularly by women.[2] Over time, this type of employment came to be less dominated by blue-collar types of work like machine operation or garment making and was increasingly a middle class activity that included higher end manufacturing or clerical work. A parallel stream of academic literature grapples with the definitional aspects of homeworking, given the proliferation of the types of work done at home today. Definitions of homeworking in modern times need to be careful to exclude professional or artistic activities (the psychologist working from a home office or a painter in a home studio), as opposed to manual and manufacturing-oriented tasks. Homeworking should also exclude those scenarios in which people are living in employer-owned premises and those in which people are working out of their homes (the driver for a ride-hailing app, for instance) rather than specifically at home.[3]

The modern WFH phenomenon combines a diverse array of workers and tasks

EXHIBIT 1: MODES OF WORKING FROM HOME



Source: J.P. Morgan Asset Management. For illustrative purposes only.

These definitional issues underscore the fact that, for our purposes, homeworking is a somewhat antiquated and narrow definition of working from home. While we still need to be careful about situations like living at work, both the upskilling of homeworking and the proliferation of nonhomeworking occupations done at home suggest a broader and more modern typology. We adopt a fairly broad and empirically relevant definition of work at home that includes all production of commodities or services in the home for exchange in the market. In their book *In Work, At Home,* Alan Felstead and Nick Jewson refer to this broader definition as "home-located production."[4]

The transition over time from homeworking as the most prevalent manner of working from home to home-located production today implies a massive shift in the characteristics of the WFH labor force (**EXHIBIT 1**). Whereas homeworkers were described

[1] See Bythell, Duncan (1978): *The Sweated Trades: Outwork in Nineteenth-Century Britain,* B.T. Batsford, London.
[2] For detailed historical profiles of homeworking women, see Boris, Eileen (1994): *Home to Work: Motherhood and the Politics of Industrial Homework in the United States,* Cambridge University Press; Boris, Eileen and Cynthia R. Daniels (1989): *Homework: Historical and Contemporary Perspectives on Paid Labor at Home*, University of Illinois Press, Urbana; Pennington, Shelley and Belinda Westover (1989): *A Hidden Workforce: Homeworkers in England,* 1850-1985, Macmillan Education, London.
[3] See Felstead, Alan (1996): "Homeworking in Britain: The national picture in the mid-1990s," *Industrial Relations Journal,* 27:3.
[4] Felstead, Alan and Nick Jewson (2000): *In Work, At Home: Towards an Understanding of Homeworking*, Routledge, New York.

as recently as the 1990s as being predominantly middle-aged married women with average levels of education undertaking goods production and clerical work on a part-time basis,[5] the modern home-located producer skews very differently across demographic, human capital and industry distributions. To be sure, working from home is still more common among part-time workers and holders of multiple jobs, but today's home-located producers tend to be younger, roughly equally distributed by gender, more educated and in white-collar occupations.

These compositional shifts have in turn been propelled by secular trends in technology, organizational behavior and labor market structure. With regard to technology, the secular rise in global internet connectivity and software for working remotely has made possible a subset of home-located production that had once been difficult to perform, including teleworking and certain types of freelancing. As such, those currently working from home are more likely to be high skilled workers. In other words, WFH has a "skill bias." In previous studies, broadband internet in the workplace was shown to increase the productivity and labor market outcomes of high skilled workers while lowering those of low skilled workers.[6] In a twist on the composition of classical homeworking labor, it has also been suggested that high speed internet at home boosts the labor force participation of married women, particularly college-educated women with children.[7] Projecting from these results, as well as from the broader literature on skill-biased technological change, the benefits of internet connectivity related to the WFH trend appear to be greater for high skilled workers.

In terms of organizational behavior, remote teleworking (also known as telecommuting) has been on the rise, reflecting both technological advances and shifts in management practices toward more flexible work arrangements. In a 2014 survey, over half of U.S. firms offered telecommuting as an option for employees, whether on an ad hoc, part-time or full-time basis.[8] In contrast to homeworkers, telecommuters tend to use home as a partial (or part-time) alternative to a primary work location and also tend to work within the organizational boundaries of firms rather than on a contract or freelance basis. As a result, these arrangements tend to concentrate in management, business and financial operations, as well as other professional fields.[9] This concentration in white-collar professions amplifies the skill bias from the underlying remote work technology, implying the WFH incidence should be higher for more highly educated, higher income workers. Work from home of this sort also tilts toward larger firms and occupations with structurally more flexible schedules.

Finally, changes in technology and management practices have both contributed to the rise of the "gig economy," of which home-located production is one part.[10] A segment of the WFH labor force fits quite comfortably into descriptions of the gig economy, whose definitive features are self-employment, short-term contracts and freelance work, though obviously not all WFH labor is gig labor, nor do all gigs occur at home. The size of the gig economy is difficult to measure, as it could, in principle, include any worker without steady employment. But it accounted for at least 10% of the U.S. labor force in 2017, when the Bureau of Labor Statistics (BLS) last surveyed the numbers for alternative work arrangements (defining gig workers as those who identified as independent contractors, consultants or freelancers).[11] A 2017 survey by the Federal Reserve found that 31% of adults were performing some type of gig work, of which 16% came from online services or sales.[12] A JPMorgan Chase Institute study found that 4.3% of adults earned income from the online platform economy in 2016.[13] While the exact overlap between these segments of the workforce and WFH labor is difficult to measure, at a minimum one can say that growth in the gig economy is likely correlated with increases in home-located production. The characteristics of gig economy workers in turn show less of a skill bias and more of a skew toward the younger side of the age distribution.[14]

[5] This was the general description provided for homeworkers in Britain during the mid-1990s in Felstead (1996).

[6] For example, see Akerman, Anders, Ingvil Gaarder and Magne Mogstad (2015): "The Skill Complementarity of Broadband Internet," *Quarterly Journal of Economics*, 130:4, pg. 1781-1824.

[7] Dettling, Lisa J. (2013): "Broadband in the Labor Market: The Impact of Residential High Speed Internet on Married Women's Labor Force Participation," FEDS Working Paper No. 2013-65.

[8] Allen, Tammy D., Timothy D. Golden and Kristen M. Shockely (2015): "How Effective Is Telecommuting? Assessing the Status of Our Scientific Findings," *Psychological Science in the Public Interest*, 16:2.

[9] Bureau of Labor Statistics (2019): "Job Flexibilities and Work Schedules, 2017-2018, Data from the American Time Use Survey."

[10] For an overview of the gig economy in government statistics, see Abraham, Katharine G., John C. Haltiwanger, Kristin Sandusky and James R. Spletzer (2020): "Measuring the Gig Economy: Current Knowledge and Open Issues," in *Measuring and Accounting for Innovation in the 21st Century* (eds. Corrado, Haskel, Miranda and Sichel).

[11] See Bureau of Labor Statistics (2018): "Contingent and Alternative Employment Arrangements—May 2017."

[12] See Board of Governors of the Federal Reserve System (2018): "Report on the Economic Well-Being of U.S. Households in 2017."

[13] See JPMorgan Chase Institute (2016): "The Online Platform Economy: Has Growth Peaked?"

[14] For the U.S., see BLS (2018). For Britain, see Department for Business, Energy and Industrial Strategy (2018): "The Characteristics of Those in the Gig Economy."

WHO IS ABLE TO WORK FROM HOME? DIRECT ESTIMATES

Though not an exact match, the broader definition of home-based production is reasonably close to the empirical definitions of WFH labor shares in official data sources. To get a sense of the existing ranges of those shares, in this section we describe two estimates for the U.S. based on government surveys, as well as our own supplementary estimate inferred from the COVID-19 experience.

The first and most direct estimate comes from the American Time Use Survey (ATUS) administered by the BLS for a sample representative of the U.S. population. A subset of ATUS questions address work location for employed respondents, whether employment is full- or part-time, for single or multiple job holders, stratified by demographic, occupation and income characteristics. By that measure, 24% of employed persons worked from home in 2018. That is about 5 percentage points higher than in 2003, when estimates were first produced, though roughly stable since 2009. In 2017–18, the BLS added a one-off Leave and Job Flexibilities supplement to the ATUS to gather more detailed information on WFH for wage and salary workers (excluding self-employed), including the ability to work from home (rather than who actually does), the structure of WFH time and worker motivations.[15] According to that survey, 29% of workers were able to WFH, 25% actually did, 15% had days they worked exclusively from home, and 9% did so at least one day per week. Survey respondents cited personal preferences, schedule coordination with personal needs and finishing up work as the main motivations to work from home; a job requirement to WFH was less of a factor, with only 16% of workers listing it as the main reason for their WFH arrangement.

Industry-level aggregates for how many of these workers could work from home are shown in **EXHIBIT 2**. The range across industries is between 10% and 30%, for the most part, with professional and business services, information services and financial activities the exceptions at over 50%. At the other end of the range, between 10%–15% are leisure and hospitality, agriculture, transportation and utilities, and wholesale and retail trade.

A second measure of WFH intensity comes from the American Community Survey (ACS), which is administered annually by the U.S. Census Bureau and asks more detailed questions to a smaller set of respondents than the decennial census. One set of questions probes respondents about their commute to work and includes a response for zero commute time/work from home. While not exactly in line with our definition of WFH—given that it includes those who live on work premises and therefore do not commute—these data generally corroborate the overall frequency of WFH found by the BLS: 25% of workers had no commute in 2018, in line with the share who reported WFH in some way in the ATUS. In terms of industry distribution, there is surprisingly little variation, and where there is (e.g., high levels for agriculture and leisure/hospitality), it suggests living on work premises rather than working from home. But the ACS is nonetheless useful as a rough baseline for WFH intensity pre-COVID-19, at around 20% of workers.

Our final direct measure of WFH capability derives from lived experience over the past few months, given the large swaths of the economy forced to shut down in response to the global pandemic. The shutdown led to a massive wave of unemployment but also to an equally large shift in corporate behavior to WFH, where feasible, for those not deemed essential workers.[16] Essential workers are those expected to perform their duties throughout the shutdown period, which in most cases means working from their primary work location. We use this natural experiment to calibrate the ability of the U.S. labor force and specific industries to work remotely, defining the WFH share as the nonessential workers who were able to keep their jobs in the wake of the COVID-19 shock.

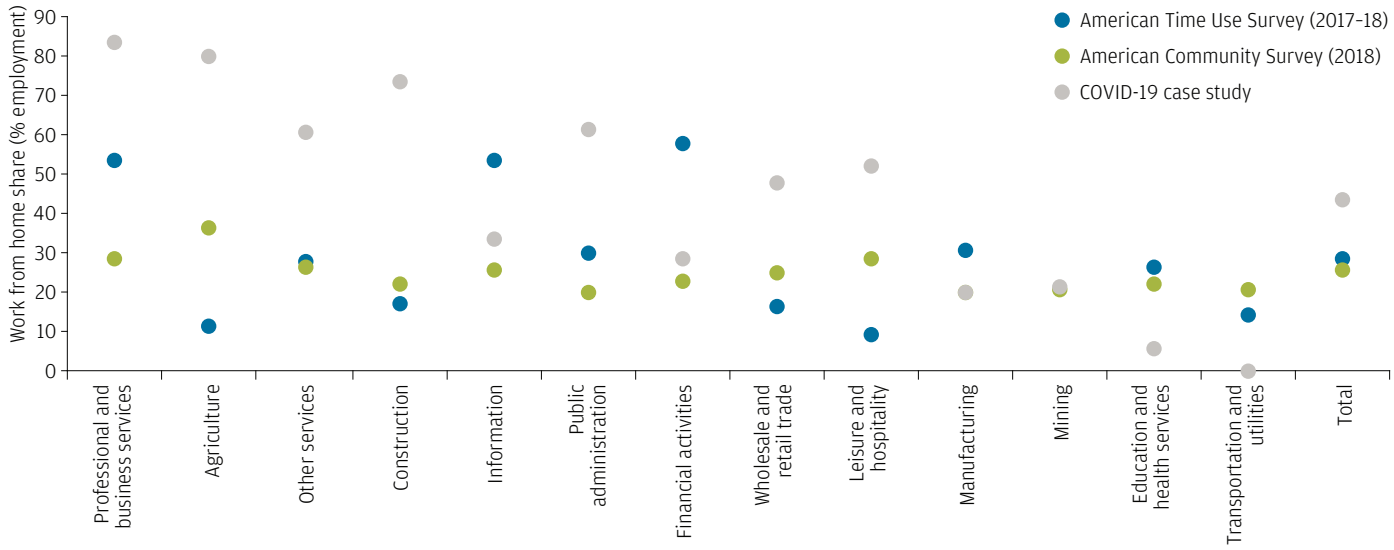
For U.S. employment as a whole, 43% of workers were classified as essential at the beginning of the shutdown period and a further 14% subsequently lost their jobs (according to the BLS establishment survey between February and April 2020), implying that the remaining 43% were highly likely to be working from home. Of course, this measure is subject to a degree of error based on our underlying assumptions. For one, we assume that all nonessential workers are working remotely,

[15] BLS (2019).

[16] Our empirical definition of essential workers derives from the U.S. Department of Homeland Security Cybersecurity and Infrastructure Security Agency's "Guidance on the Essential Critical Infrastructure Workforce" (see DHS [2020]: "Advisory Memorandum on Identification of Essential Critical Infrastructure Workers During COVID-19 Response," April 17). We adopt the mapping used in a recent Brookings Institution note to translate this list into 121 four-digit North American Industry Classification System (NAICS) industries (see Brookings [2020]: "How to Protect Essential Workers During COVID-19," Adie Tomer and Joseph W. Kane, March 31).

COVID-19 has pushed the boundaries, even in industries where the WFH share is generally low

EXHIBIT 2: THE WORK FROM HOME SHARE ACROSS U.S. ECONOMIC SECTORS



Source: Bureau of Labor Statistics, J.P. Morgan Asset Management; data as of June 2020.

when some might be reporting to their nonhome work location in a manner consistent with social distancing guidelines. In agriculture, for instance, the COVID-19-implied WFH share is very high, though those workers are unlikely to be newly working from home. On the other hand, that upward bias to our overall WFH share estimates is offset to some extent by the fact that not all essential workers are on the job away from home, as might be the case in the information and financial services industries, where the implied shares are on the low end of other direct measures. In terms of industry distribution, the COVID-19-implied shares for public administration, other services, wholesale/retail trade and leisure/hospitality show WFH capabilities considerably higher than their previously estimated relatively low levels. On the other end of the spectrum, the COVID-19 natural experiment reinforces the lower WFH share estimates for manufacturing, mining, health services and transportation/utilities.

WHO IS ABLE TO WORK FROM HOME? INDIRECT ESTIMATES

Given the patchwork nature of the direct estimates we have discussed, along with the significant regional differences in definitions and data quality, we draw on a set of characteristics of WFH labor to construct globally consistent, though indirect, estimates of the WFH labor force. For example, while we might not have comparable direct measures of WFH prevalence for the U.S. and China, we can make inferences from the characteristics of the labor force that tend to correlate with WFH and the extent to which each country's labor force exhibits them. To do so, we focus on four characteristics of the labor force that exhibit notable variation across traditional and WFH modes of employment:

- internet access
- labor market structure
- knowledge economy
- demographics

Given measures of these characteristics from the World Bank's World Development Indicators (WDI) database,[17] in tandem with assumptions about the WFH intensity of each one, we compile an array of WFH share estimates for each country or region. The assumptions we use for WFH intensity are summarized in **EXHIBIT 3**. For a more detailed description of how we computed our estimates, see "Estimating WFH shares indirectly."

Internet access

Given the connectivity requirements across the telecommuting and gig economy segments of the WFH workforce described above, and perhaps for modern incarnations of homeworking tasks as well, our first proxy for WFH ability is a broadband

[17] Data accessed in April 2020 from: https://datacatalog.worldbank.org/dataset/world-development-indicators.

The profile of the WFH labor force is more educated, white collar and younger

EXHIBIT 3: WFH VARIATION BY INTERNET CONNECTIVITY, SECTOR, EDUCATION, OCCUPATION AND AGE

WFH share based on		
INTERNET ACCESS		
P(WFH | Internet)		100%
LABOR MARKET STRUCTURE		
	P(WFH | Sector & Non-gig)	P(WFH | Sector & Gig)
Services	40%	40%
Manufacturing	35%	10%
Agriculture	10%	0%
KNOWLEDGE ECONOMY		
Education level		
P(WFH | College)		55%
P(WFH | Non-college)		20%
Salary level		
P(WFH | White collar)		45%
P(WFH | Blue collar)		10%
DEMOGRAPHICS		
P(WFH | Youth)		50%
P(WFH | Non-youth)		30%

Source: Bureau of Labor Statistics, Gallup, J.P. Morgan Asset Management; data as of June 2020.

internet connection. Using WDI data on the number of broadband internet connections per capita, we estimate the broadband intensity of the workforce and use that as a sufficient condition for a WFH arrangement.

Labor market structure

Our review of WFH trends and drivers also suggested a heavy sector slant in WFH ability, insofar as some jobs are inherently more conducive to remote work. For example, it is more difficult or nearly impossible for average laborers working on a manufacturing line, serving customers on a cruise ship or harvesting crops on a commercial farm to stay gainfully employed and productive away from their primary work location. In order to leverage the sector categories in the WDI, we summarize the ATUS data from Exhibit 2 as follows: 40% of services industry workers WFH, compared with 35% in manufacturing and only 10% in agriculture. We also took into account the sector mix in the gig economy, which also tilts toward services (at 40%) vs. manufacturing (at 10%).[18]

Knowledge economy

In line with the skill bias of technology discussed above, several empirical sources suggest that the WFH labor force is both more educated and more involved with white-collar occupations. We think this aspect of the WFH trend is tied to the "knowledge economy"—the share of the workforce that relies more on intellectual capital than physical capital for delivering products or services. It stands to reason that individuals in these sectors should have a greater ability to deliver these products or services remotely. We use tertiary education levels and salary as proxies to estimate the shares of these "knowledge workers." The WFH intensity of these groups is then assumed to be in line with levels reported in ATUS (over 50% of respondents with a college degree say they could work remotely, compared with only 4% with less than a high school diploma) and a Gallup survey that details WFH by occupation type (43% of white-collar workers WFH relative to 8% of blue-collar workers).[19]

Demographics

Finally, given that gig workers skew younger, we incorporated age as a stand-alone demographic factor. More specifically, our hypothesis is that millennials and younger generations who have grown up in the digital age value the flexibility of working from home and are more comfortable doing so than older generations. According to Gallup, 50% of millennials want flexibility in work location relative to 30% of Gen Xers.[20]

THE WFH LABOR FORCE IS MORE EDUCATED AND WHITE COLLAR, AND YOUNGER

EXHIBIT 4 presents our analysis of the global WFH share and its underlying drivers. We estimate the overall WFH share at 26%, up 8 percentage points since 2001 and growing fairly steadily. In other words, well before COVID-19 the global WFH

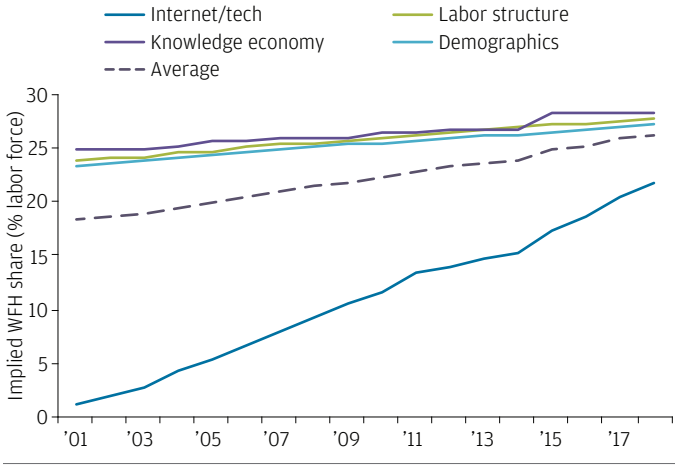
[18] These are rounded averages for NAICS industries of individual proprietorships as a proportion of total payroll employment, computed from the 2017 Nonemployer Establishment Survey conducted by the U.S. Census Bureau.

[19] For the latter, see Gallup (2015): "In U.S., Telecommuting for Work Climbs to 37%," Jeffrey M. Jones, August 19. https://news.gallup.com/poll/184649/telecommuting-work-climbs.aspx.

[20] See Gallup (2017): "State of the American Workplace."

A quarter of the global population can now work from home

EXHIBIT 4: INDIRECT ESTIMATES OF THE GLOBAL WFH LABOR FORCE



Source: J.P. Morgan Asset Management; data as of June 2020.

labor force was expanding at an annual rate of almost 2%. The current level is a reflection of the underlying drivers converging in the 20%-30% range. While the implied shares from sector structure, education levels and demographics have been drifting up modestly in the mid-20s, the share of internet penetration has been catching up at a more rapid clip.

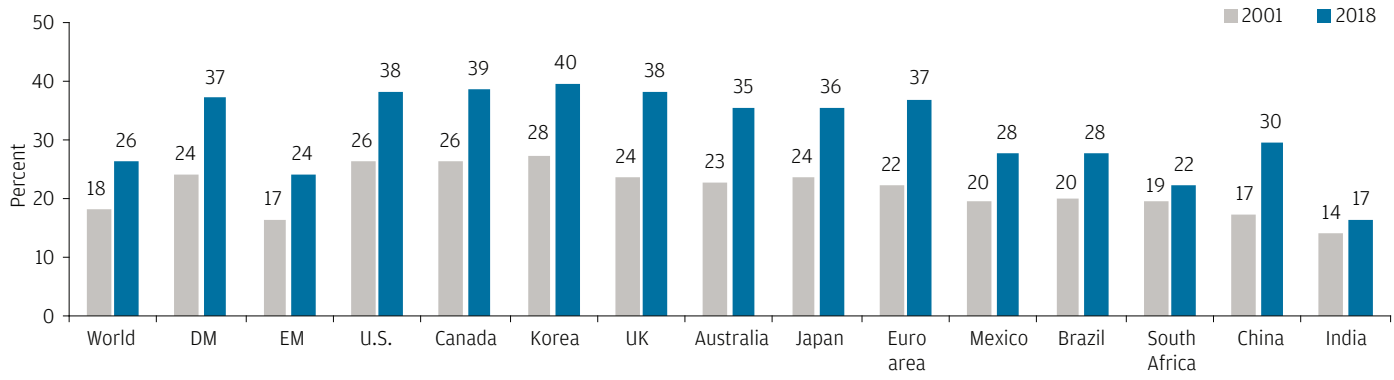
In recent decades, rising internet penetration likely explains the lion's share of growth in working from home. In 2001, there were 0.83 fixed broadband subscriptions per 100 people, compared with 14.5 in 2018. Translating these figures from per capita into per worker terms, this indicator implies a rise in WFH share from 1% to 22% over that period. The modest increase in the labor structure indicator is driven by the shift in sector shares from agriculture to services. In 2001, around 40% of the global workforce was employed in agriculture, compared with 27% today. Relatively WFH-intensive services employment made up 40% of the global workforce in 2001 and now stands at 50%. The increase in the knowledge economy indicator is driven primarily by the gradual growth of the college-educated share of the workforce, which increased from 15% in 2001 to 28% today. In a parallel trend, the proportion of white-collar workers has increased from 46% to 53%. The youth share of the workforce (defined as millennials or younger) has been growing steadily, at 54% in 2018 vs. 17% in 2001. Going forward, a larger proportion of the workforce will be composed of workers who have grown up in the digital age and are thus more likely to embrace WFH flexibility. Extrapolating from United Nations forward projections,[21] millennials and younger generations will account for 76% of the workforce by 2030.

The starkest regional difference appears between developed and emerging market economies, with implied WFH shares of 37% and 24%, respectively. These aggregates are based on the dozen economies in **EXHIBIT 5**, which together account for 57% of the global workforce. In the U.S., for example, the overall share is 38%, reflecting 47% broadband connectivity, 79% services, 59% college educated and 29% youth shares. There is not a tremendous amount of variation across developed market economies, with Korea looking broadly similar. In a country like India, on the other hand, the implied WFH share is 17%, reflecting a paltry 3% broadband connectivity, 32% services, 9% college educated and 22% youth shares.

[21] See: population.un.org.

A stark divide between developed and emerging market economies

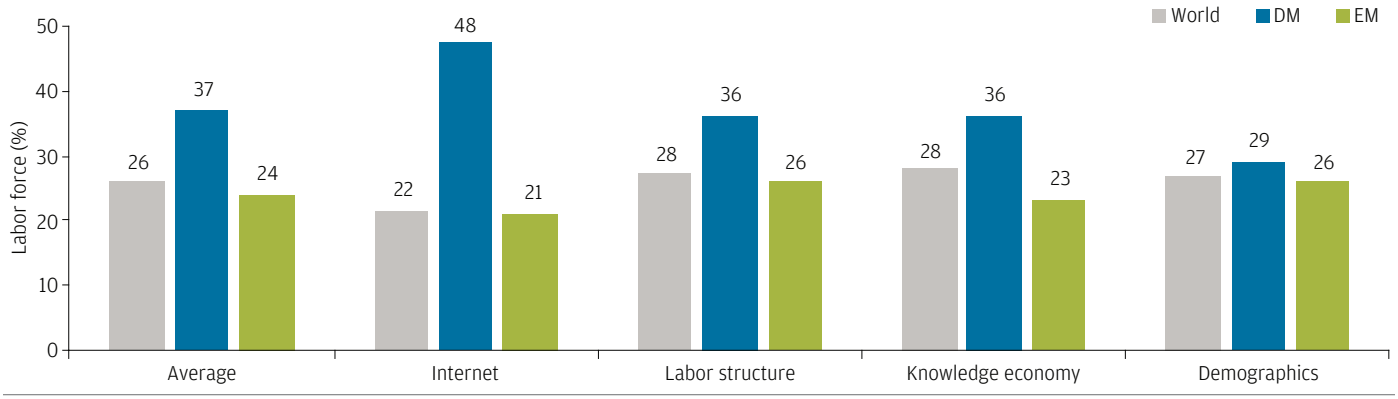
EXHIBIT 5: GROWTH OF THE WFH LABOR FORCE ACROSS THE GLOBAL ECONOMY



Source: J.P. Morgan Asset Management; data as of June 2020.

A stark divide, driven primarily by internet penetration, separates developed and emerging market economies

EXHIBIT 6: REGIONAL ESTIMATES OF THE WFH LABOR FORCE AND THEIR UNDERLYING DRIVERS



Source: J.P. Morgan Asset Management; data as of June 2020.

These differences underlie the gap between developed and emerging market economies, as shown in **EXHIBIT 6**. The higher WFH share for developed markets is driven by higher levels of internet penetration and a higher proportion of workers employed in services and white-collar jobs, as well as a more educated workforce. The level of internet penetration is the most significant causal factor, with DM rates more than twice those of the subset of EM economies we examined (i.e., 35 fixed broadband subscriptions per 100 people in DM economies relative to 16 for emerging markets). Labor structure and sector composition also varied across countries, with the DM service share at 76% relative to 46% in China and 32% in India. Developed countries had a higher proportion of the workforce employed in white-collar jobs, at 88% vs. China at 53% and India at 23%. Education levels have a wide dispersion even within developed countries. The U.S. had the highest share of college-educated workers at 59%, and the UK had the lowest at 28%. In EM economies, Korea had the most college-educated workers at 53% and South Africa had the lowest at only 3%. Demographic differences between EM and DM economies in aggregate did not translate into large differences in implied WFH share. EM countries had a higher youth share of the population at 53% relative to 45% for their DM counterparts, but this is offset by a lower labor force participation rate in EM countries.

In terms of growth, while DM economies had a higher change in WFH share in absolute terms, EM growth rates kept pace. At the individual country level, China's share growth was the fastest, fueled by a rapid increase in internet penetration (29 fixed broadband subscriptions per 100 people in 2018, compared with close to zero in 2001). China's mirror image is Korea, which had high internet penetration to start and currently has among the highest in the world, with 42 fixed broadband subscriptions per 100 people. Through this lens, the fact that India (1 subscription/100 people) and South Africa (2 subscriptions/100 people) remain mired at very low internet penetration rates presents both a challenge for WFH and an opportunity for its future growth.[22] Education is another factor that may give rise to convergence in future WFH shares. For example, Mexico and Brazil had the fastest-growing population of college-educated workers since 2001.

INVESTMENT IMPLICATIONS

The shift toward working from home, which the COVID-19 health crisis has accelerated behaviorally and technologically, is indeed a paradigm shift. At a minimum, our research suggests that there are large estimated gaps between the ability to work from home and the extent to which it actually happens—gaps that are likely to narrow. In the U.S., where less than a quarter of the labor force works from home on a regular basis, one would expect convergence toward our estimates of closer to 40%. Globally, we estimate that about 25% of the workforce is currently able to work remotely, with future growth driven by secular increases in technology adoption, changing sector composition, rising educational attainment and the greater

[22] Interestingly, mobile phone subscription rates for DM and EM economies are far more comparable than for internet connections, with 125 mobile phone subscriptions per 100 people for developed markets and 103 for emerging countries. The growth rate of mobile phone access in emerging markets is 10%, more than double that of developed markets. We note that as the nature of WFH evolves, it may do so in a way that turns EM mobile phone access into more of an advantage, implying greater convergence in WFH shares than we see at present.

ESTIMATING WFH SHARES INDIRECTLY

Our analysis segments the global labor force by four key dimensions: internet access, labor market structure, the knowledge economy and demographics. For each pillar, we apply the assumed WFH intensities in Exhibit 3 to WDI estimates of the size of each group. Our global and regional estimates are simple averages across the four pillar estimates. The structure of the assumptions for each pillar is as follows:

a) Internet access. We use the World Bank's data on fixed broadband subscriptions per 100 people to estimate internet access, P(Internet Access), and further assume that all broadband subscriptions in the population are accessible by members of the labor force (participation rate =P(Labor Force).

$$\mathrm{P}\big(\text{Implied WFH Share (\% labor force)}\big)_{\text{Internet}} = \mathrm{P}(\text{Internet Access}|\text{Labor Force}) = \frac{\mathrm{P}(\text{Internet Access})}{\mathrm{P}(\text{Labor Force})}$$

b) Labor market structure. We use the WDI data for employment in manufacturing, agriculture and services, P(Sector), and assume that the sector composition was the same for gig and nongig. The probabilities of WFH conditional on sector and gig employment reference ATUS and Gallup data in Exhibit 3. To compute the labor market structure implied WFH share, we assume that 35% of the population works in the gig economy (Gallup survey), i.e., P(Gig) = 35%.

$$\mathrm{P}\big(\text{Implied WFH Share (\% labor force)}\big)_{\text{Labor Structure}} = \mathrm{P}(\text{WFH}|\text{Nongig})\mathrm{P}(\text{Nongig}) + \mathrm{P}(\text{WFH}|\text{Gig})\mathrm{P}(\text{Gig})$$

$$\mathrm{P}(\text{WFH}|\text{Nongig}) = \sum \mathrm{P}\big(\text{WFH} \,\big|\, \text{Sector \& Nongig}\big)\mathrm{P}(\text{Sector})$$

$$\mathrm{P}(\text{WFH}|\text{Gig}) = \sum \mathrm{P}\big(\text{WFH} \,\big|\, \text{Sector \& Gig}\big)\mathrm{P}(\text{Sector})$$

c) Knowledge economy. To estimate the share of knowledge workers based on education level, we used the Barro-Lee data set[1] and the population share with tertiary education, P(College). To estimate based on salary level, we used WDI data on wage and salary workers, P(White Collar). WFH conditional on education and occupation is from ATUS and Gallup.

$$\mathrm{P}(\text{WFH}|\text{Education Level}) = \mathrm{P}(\text{WFH}|\text{College})\mathrm{P}(\text{College}) + \mathrm{P}(\text{WFH}|\text{Noncollege})\mathrm{P}(\text{Noncollege})$$

$$\mathrm{P}(\text{WFH}|\text{Salary Level}) = [\mathrm{P}(\text{WFH}|\text{White Collar})\mathrm{P}(\text{White Collar}) + \mathrm{P}(\text{WFH}|\text{Blue Collar})\mathrm{P}(\text{Blue Collar})]$$

d) Demographics. We proxy the WFH share directly with the millennial share of the labor force from UN population data.[1]

$$\mathrm{P}\big(\text{Implied WFH Share (\% labor force)}\big)_{\text{Demographics}} = \mathrm{P}(\text{Millennial}) * \mathrm{P}(\text{Labor Force})$$

[1] United Nations (2019): "World Population Prospects 2019."

relative importance of younger demographic segments. EM convergence along those dimensions will be an important contributor to the global trend.

The investment implications of a rising WFH trend are equally profound, both from the perspective of overall macro dynamics and the relative performance of the companies and sectors levered to this trend. For one, it is among the most visible manifestations of the technology forces that we have been highlighting as upside risks to aggregate productivity growth in our Long-Term Capital Market Assumptions.[23] The extent to which social distancing has further catalyzed recent waves of tech innovation and adoption implies that these upside risks to real growth and downside risks to inflation are that much more likely to take effect.

The coronavirus pandemic has rekindled an animated debate over whether the WFH phenomenon translates into higher or lower labor productivity, with much of the effect hinging on the specific conditions of WFH (e.g., commute times saved, children present, adequate space, effect on privacy), as well as managers' ability to monitor the quantity and quality of their employees' work. Certainly, the pandemic experience has boosted internet connectivity and strengthened the gig structure of work, and the two trends' respective direct influences on productivity. A related idea is that the role of technology in firms' production function is evolving from being an option to being a necessity. We have come a step closer to the limit of the tech adoption argument, in which the internet has become a utility.

The relationship between the work from home trend and inflation is an ongoing subject of discussion among economists and market participants more broadly. The pass-through effects of the WFH phenomenon to inflation are a function of two distinct channels: lower marginal costs of production as an extension of the productivity enhancements we have just discussed, and an erosion of labor bargaining power, weighing on wage growth, as individual work arrangements become more common. We have already seen incipient signs of this trend as firms adjust salaries to align with the lower cost of living in home locations. On a related note, some of the same legal ambiguities that plagued homeworkers through the ages are now cropping up in the gig economy. For example, do workers on gig platforms have the same legal standing vis-à-vis employers as direct employees or independent contractors?[24] Increased work from home may also exacerbate income inequality: As a skill-biased technology, working from home may contribute to a further widening of the relative wage gap between high and low skill workers.

The main implications of the WFH trend from a relative value perspective pertain to tech sector exposure and broad urbanization trends. The tech intensity of WFH will be a tailwind for companies that provide the hardware and software tools to enhance WFH productivity, and may even extend to the regional equity markets that have higher tech sector weights. As more information is exchanged virtually, cybersecurity will also be an increasingly important aspect of firms' production functions. Our findings present a somewhat ambiguous result for emerging markets insofar as the large tech sector exposure in the EM equity index is at odds with our findings of relatively limited technological infrastructure in its larger country constituents. Whether emerging market economies are a convergence story in terms of fixed broadband and 5G internet or whether they continue to lag in that respect remains an open question.

Even modest shifts in the global frequency of working from home may have significant implications for the way that cities are designed and used. The spatial distribution of economic activity between central business districts and outlying environs is a likely dimension for change across a wide array of business and household activities. Residential vs. commercial real estate is one asset-class manifestation, though it is not a clear win for residential real estate, given its distribution across both urban and suburban areas. There may also be large company-level differences in adoption that translate into heterogeneous WFH cost savings. For larger firms, the returns to scale of office buildings for a large employee base may still make sense, or at least more sense than they would for smaller firms. Industries geared toward daily commutes and corporate travel are more obvious examples of the losers, with business passengers representing 75% of airline profits but only 12% of passengers. The relative challenges for transportation and other affected sectors may also correlate with ESG (environmental, social, governance) filters based on carbon emissions. From the employee perspective, savings in commuting time and money may well make their way into enhancements for the home.

[23] See J.P. Morgan Asset Management (2019): "New economy, same old returns? The future impact of e-commerce on the economy," *2020 Long-Term Capital Market Assumptions,* and J.P. Morgan Asset Management (2017): "Technology, productivity and the labor force: The impact of technology on long-term potential economic growth," *2018 Long-Term Capital Market Assumptions.*

[24] See Cherry, Miriam A. (2016): "Beyond Misclassification: The Digital Transformation of Work." *Comparative Labor Law and Policy Journal*, 37:3, pg. 577-602.

CONCLUDING THOUGHTS

This report presents what we see as the plausible range of current global WFH activity, as well as its underlying drivers. As more people transition to working from home, where we ultimately end up on the spectrum and the extent of pass-through to the economy and markets will depend on the duration and breadth of corresponding adjustments. In our view, the COVID-19 shock is turning out to be sufficiently persistent as to prompt what might be lasting behavioral changes. It is also important to note that the same factors enabling work from home are also facilitating wider adoption of a "virtual lifestyle," with WFH and e-commerce as simply its most visible facets.

The spatial redistributions of WFH and the disruptive influences of e-commerce on traditional retail business models are running in parallel to other, equally profound changes in household and corporate behavior, including digital education, social media connectivity, e-health care and virtual leisure activities such as fitness and recreational events. What are the relative benefits and drawbacks of sitting in a classroom, visiting the doctor's office, working out at the gym or consulting a financial professional in person if one can receive comparable service or content online? Is the technology such that, for instance, one could attend a live sporting or music event in a satisfactory way through virtual reality? And, crucially, what is the limit of this trend in terms of the optimal balance of physical vs. virtual experiences?

The wide array of activities circumscribed by these trends is also sure to raise significant measurement challenges. Will the labor productivity effects of WFH be adequately captured by current official surveys, or will they lead to similar underestimates of real activity, as have been found for e-commerce? From the underlying technological innovations to their adoption and measurement, all of these questions are fruitful areas for future research. For the time being, they are left as exercises for the reader, whether at the office or from home.

Appendix: Country-level estimates of WFH share (%)

	World	DM	EM	U.S.	Canada	Korea	UK	Australia	Japan	Euro area	Mexico	Brazil	South Africa	China	India
2001	18	24	17	26	26	28	24	23	24	22	20	20		17	14
2002	19	25	17	27	27	30	24	23	25	23	20	20	19	17	14
2003	19	26	17	28	28	30	25	24	27	24	20	20	20	18	14
2004	19	27	18	29	29	31	27	25	28	25	20	21	20	18	15
2005	20	29	18	31	32	31	29	27	30	27	21	21	20	19	15
2006	21	31	18	32	33	33	31	30	30	29	22	22	20	19	15
2007	21	32	19	33	34	34	32	31	31	30	23	22	21	20	15
2008	21	33	19	34	34	34	33	32	32	31	24	23	21	20	15
2009	22	33	19	34	35	35	34	32	32	32	24	23	21	21	15
2010	22	34	20	35	35	36	34	33	33	33	25	24	21	22	15
2011	23	34	21	35	36	37	35	33	33	33	25	25	22	23	16
2012	23	35	21	36	36	37	36	33	34	34	26	25	22	23	16
2013	23	35	21	36	36	37	36	33	34	34	26	26	22	24	16
2014	24	36	22	37	37	38	37	34	34	35	26	26	22	24	16
2015	25	36	23	37	37	39	37	34	35	35	27	27	22	26	16
2016	25	37	23	38	38	39	38	35	35	36	27	27	22	28	16
2017	26	37	24	38	38	39	38	36	35	36	27	27	22	29	17
2018	26	37	24	38	39	40	38	35	36	37	28	28	22	30	17
CAGR	2.0	2.4	2.1	2.1	2.1	2.0	2.7	2.4	2.3	2.8	1.9	1.8	0.8	3.1	0.9

Source: J.P. Morgan Asset Management; data as of June 2020.

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