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How will working from home impact productivity?

A literature review

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Work/Place

This project, led jointly by the Policy Institute at King's and the King's Business School, is the first phase of a major programme of work to convene a group of large London-based employers and policy stakeholders to understand how the pandemic has impacted the way Londoners work, what the future of work in the city will look like, and how these changes have affected employers, employees, and London as a whole.

This will be achieved through a place-based, evidence-driven, and co-productive approach, which will develop and identify lessons for London in particular, and UK and international cities in general.

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Authors' note

This is an updated version of the literature review first published in April 2022 as part of the Work/Place project at King's College London. The paper has been updated to include recent research in this area.

Introduction

The Covid-19 pandemic has had a major impact on the global economy. Government intervention, mainly in terms of social assistance, social security, and labour market support (Gentilini et al., 2020), has been underpinned by various fiscal measures, monetary policy adjustments and shifts in the economic burden on the private sector that impacted on economic performance.

In economic terms, Covid-19 has led to decreased investment, an erosion of human capital due to unemployment, and a decline in global trade and supply chains. In the long run, the pandemic could also be associated with a constraint on the ability of economies to raise incomes and a reduction in productivity (The World Bank, 2021, p.xv).

Indeed, the trends that followed the sharp decline in productivity after the 2008 global financial crisis, compounded by a slowdown in the growth of the working-age population and the slowing pace of change towards more diverse and complex forms of production, have already stalled the growth of global value chains. This is likely to be exacerbated by the Covid-19 pandemic (p.xvi).

A considerable number of studies have begun to assess the real-world impact of the pandemic on productivity.[1] While the (negative) effects of Covid-19 seem to be clear at the global level, there is not enough evidence to extrapolate them to the level of all economies, industries and firms. Indeed, the determination of productivity depends on different factors and can be analysed from different approaches.

In the short term, the impact of the pandemic seems to be evident when considering the depletion of the labour force –

1 Studies were mainly identified using academic search engines like Google Scholar, based on keywords such as “productivity”, “pandemic”, and “Covid-19”.

people made redundant, becoming sick and/or on furlough; the tightening of financial conditions; and the disruption of supply chains (World Bank, 2021, p.21).

Similarly, measures to contain Covid-19 have had negative economic consequences, increasing firms' intermediate costs (e.g. considering sanitisation equipment), pushing down value-added relative to sales, and reducing productivity (Bloom et al., 2021a, p.9).

However, there are other effects that are less clear. The pandemic forced most firms to adopt working from home, often without providing their employees (at least initially) with the necessary support, infrastructure and skills required for remote work. Thus, productivity may have decreased due to increased distractions, and communication and coordination costs associated with working from home (Gibbs et al., 2021, p.15). Furthermore, remote work has affected the collaborative network of workers, making it harder for employees to acquire and spread new information in the workplace, and reducing important linkages through 'weak ties' (Carmody et al., 2022; Yang et al., 2022). On the other hand, in this new way of working, greater job autonomy and self-leadership could be reflected in higher individual productivity (Galanti et al., 2021, p.431).

The adoption of working from home has also meant that at least a fraction of the time saved in commuting is devoted to work-related activities, which may increase productivity (Barrero et al., 2021). In addition, the closure of less productive firms due to the pandemic tends to increase average productivity in the short run (Bloom et al., 2021a, p.11).

In the long term, many of the causal mechanisms that could explain productivity changes in the short run may hold. A prolongation of the pandemic would continue to have supply side-effects, mainly in terms of labour depletion and supply chain disruptions. In addition, social isolation, family-work conflicts, and longer working hours can impact workers'

wellbeing and their mental and physical health, negatively affecting their long-term productivity at work. Similarly, it is likely that the time that senior managers have had to devote directly to the pandemic has in part been taken away from other long-term productivity-enhancing activities (Bloom et al., 2021a, p.12).

Furthermore, the effect of lower investment in research and development (R&D) and innovation during the pandemic would start to affect productivity in the long run (p.9). Nevertheless, while the adoption of working from home may have caused negative effects on productivity in the short term, these can in principle be mitigated and even reversed in the long term. There is scope for improving the management of remote working, and labour productivity can be increased by improving the managerial support (Farooq & Sultana, 2021, p.13).

Thus, the analysis of different approaches and particularities can provide important insights into the challenges and opportunities that the Covid-19 pandemic has initiated in terms of labour, productivity and economic performance.

This working paper aims to analyse different approaches used to capture the impact of Covid-19 on labour productivity. To this end, it presents a brief framework for understanding the concept of productivity and the measures most commonly used to determine it. Then, it reviews different empirical studies that have assessed the impact on the Covid-19 pandemic on productivity in particular economies, sectors and firms. Considering the results of such studies, it is reasonable to conclude that the effects of the pandemic on labour productivity are mainly negative; however, workers' preferences and firms' investments in work-from-home adaptation seem to be important elements to understand the possible consequences of this crisis on labour (and productivity) dynamics.

How do we measure productivity?

In simple terms, productivity describes the relationship between output and the inputs needed to generate that output (Schreyer & Pilat, 2001, p.128). While such a relationship can be directly associated with the level of efficiency in production (Syverson, 2010, p.5), its determination can also be related to technical changes, real cost savings in production, the benchmarking of production processed and even the evolution of living standards (OECD, 2001, p.11-12). Thus, there is no single measure of productivity and the use of one or the other depends on the specific objectives of the analysis and the quantity and quality of the statistical information available.

In general, the most commonly used productivity measures relate productivity factors – labour, capital and intermediate inputs such as energy, material and services – individually or in combination, to certain levels of gross output or value added. Among these, labour productivity and total factor productivity are the most frequently used measures.

TABLE 1: OVERVIEW OF THE MAIN PRODUCTIVITY MEASURES (IN SCHREYER & PILAT, 2001)

	Type of input measure			
Type of output measure	**Labour**	**Capital**	**Capital & labour**	**Capital, labour & intermediate input (energy, materials, services)**
Gross output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital – labour MFP (based on gross output)	KLMES multi-factor productivity
Value-added	Labour productivity (based on value-added)	Capital productivity (based on value-added)	Capital – labour MFP (based on value-added)	-
	Single factor productivity measures		**Multi-factor productivity (MFP measures)**	

Source: Schreyer & Pilat, 2001, p.129.

Labour productivity is measured as output per worker, using the number of hours worked or number of persons employed as the unit of labour input. While this method has advantages in terms of measurement and readability, it does not take into account the quality of the labour force – influenced by the level of education, training and health of the workers – or its intensity – influenced by the number of people involved in the production process or the different working arrangements considered. However, its use is often justified for short time periods (less than a decade) and when there are doubts about the quality and comparability of capital stock data estimates (Sargent & Rodriguez, 2000).

Since the level of productivity of a given factor is affected by the intensity of use of those factors, and this is excluded from the analysis, researchers often use the measure known as total factor productivity (TFP). Differences in TFP reflect the variation in output obtained from a fixed set of inputs (Syverson, 2010, p.5). This method decomposes labour productivity into contributions from various factor inputs – such as labour input and the level of human capital (see Caselli, 2004) – or into physical and human capital intensities (see Hsieh & Klenow, 2010). Productivity is then calculated as a residual of labour productivity growth after subtracting the variation of the indices used in the decomposition, weighted by their respective participation in the assumed production function (e.g. a Cobb-Douglass production function with constant returns to scale; Solow, 1957). While this approach is simple and easy to interpret, relies heavily on the assumed functional form of the production function and is vulnerable to measurement errors in estimates of factor inputs or capital intensities.

Although there are widely used methods for determining productivity, their results vary significantly across countries, sectors and firms. For instance, Bernard & Jones (1996), analysing a sample of 14 OECD countries and six sectors between 1970 and 1987, found that these countries have converged in output, labour productivity and TFP, yet

individual sectors showed a wide variety of output paths – sectors do not show the same patterns of trend or dispersion over time, and countries do not behave similarly across sectors (p.139).

At the firm level, differences in productivity may include elements originating in production practices and the external operating environment. Indeed, it is plausible that differences in the level of productivity across firms reflect different worker skills and technology used, but also different management practices toward workers (Freeman & Shaw, 2009; Syverson, 2010). Similarly, producer practices can have indirect effects on productivity levels in other firms, as can pressures from competitors and different forms of regulation (Oulton, 1998; Syverson, 2010).

Productivity measurement is of great interest as a key indicator of economic performance. Undoubtedly, the comparability of productivity measures still has limitations in terms of data and their proper interpretation (Schreyer & Pilat, 2001, p.163). However, events such as the Covid-19 pandemic have opened the door to different practical methods of measuring productivity in various economies, sectors and firms, considering the different, often structural, changes experienced on both the supply and demand side of goods and services.

How has Covid-19 impacted productivity?

In general terms, the evidence indicates that labour productivity growth has been driven by innovation, improved education and investment in physical capital, complemented by supportive institutions and policies (The World Bank, 2021, p.19). During adverse events, such as the Covid-19 pandemic, not only are labour and supply chains affected, but also financial stresses are generated with long-lasting effects on productivity. Indeed, the epidemics since 2000 (SARS, MERS, Ebola, and Zika) are estimated to have reduced labour productivity by a cumulative 4 per cent over three years, mainly through their impact on investment and labour (p.158). Due to its global reach and disruptions to production and transport, as well as health measures and changes in consumer behaviour, the impact of the Covid-19 pandemic on productivity is likely to be significantly worse (p.144).

But what do recent and growing empirical studies that have assessed the impact of Covid-19 on productivity say?

Determining productivity

Due to the specific objectives of each study, the availability of relevant information and the complexity of measuring productivity in practical terms, research has focused on analysing the effects of the pandemic on productivity in specific economies, sectors and firms, mainly considering the effects of WFH as a measure to prevent the spread of Covid-19. Although measurements in this context are diverse, three main practical assessment methodologies can be identified in recent literature.

Firstly, there are studies that determined labour productivity on the basis of mass accounting or numerical information from statistical databases.

One of them is the study developed by Bloom et al. (2021a), which assessed the impact of Covid-19 on labour productivity and TFP in UK firms, considering data from the Decision Maker Panel (DMP) firm-level survey, between July 2020 and August 2021. In general terms, the authors determined firm-level productivity in the pre-pandemic period and then estimated the impact of Covid-19 from the effects reported through the survey in terms of both inputs (capital and labour) and outputs (output and prices).

Thus, the estimation of the impact of the pandemic on productivity considered (i) the average hours worked of active employees and the percentage of employees on leave; (ii) the unit costs associated with the implementation of Covid-19 containment measures; (iii) an estimated annual depreciation rate on the capital stock; and (iv) changes in output prices over the last year. In this way, labour productivity was calculated as real value added, i.e. considering operating profits and labour costs adjusted by the aggregate GDP deflator, while TFP was determined as the residual of a production function defined by the authors.[2]

Examining the effects of the pandemic on sectoral productivity in 16 OECD countries and eight Latin American and Caribbean countries, Ahumada et al. (2022) used data on labour productivity and capital stock per worker and the TFP index from the KLEMS databases[3] between 1995 and 2015. This database was supplemented with high-frequency information for 2020, whose data on sectoral output was

2 $l(VA_{it})=(2/3)\ln(L_{it})+(1/3)\ln(K_{it})$, where VA_{it} is real value-added of firm i in year t, L is labour input, measured as total remuneration (wag bill), and K is capital, measured as total real fixed assets (Bloom et al., 2021a, p.7).

3 Eight countries were covered by the LAKLEMS project; twelve countries from the EUKLEMS dataset; and six countries from the World KLEMS dataset.

collected mainly from the national statistical institutions of the respective countries analysed.

The analysis used by the authors was based on panel vector estimation (PVAR) of productivity growth rates, considering each country in the sample and endogenous variables associated with sectoral productivity expressed as log differences. In this case, labour productivity was expressed as thousand gross value added (2010 PPP dollars per person engaged), whose information was extracted directly from the database used.

Secondly, it is possible to observe studies that determine labour productivity on the basis of employee activity monitoring systems. For instance, Gibbs et al. (2021) studied monthly data on the time worked by more than 10,000 professionals in an Asian IT services company before and during the WFH period due to the pandemic. Specifically, the authors used information from two systems used by the company to track employee activity and performance. The active time of workers using applications or websites was considered as the input variable (average working hours per working day), while the performance of workers in completing their objectives was considered as the output variable (variable with values between 0 and 100). In this way, productivity was estimated by the authors as the ratio between the aforementioned output and input variables.

Similarly, Bao et al. (2021) used a dataset of the daily activities of developers in one of China's largest IT companies, both before and after the start of WFH. In this case, the authors determined the effect of the pandemic on productivity by comparing the productivity of each period based on aggregate developer logs groups by day, considering the number of commits submitted; the number of lines of code reviewed, inserted, and deleted; and the number of builds and releases performed by each developer.

Finally, there are a large number of studies that analyse labour productivity from a self-assessment point of view, i.e. considering the workers' own perception of their performance.

Mustajab et al. (2020) interviewed 50 informants (30 female and 20 male), using snowball sampling, to explore and explain the impact of WFH on employee productivity in Indonesia.

Etheridge et al. (2020) use the Covid-19 module from the UK Household Longitudinal Survey, which provides data on home worker's self-reported productivity towards the end of the lockdown period in the UK, to examine how productivity varies across job and worker types. Specifically, respondents were asked as follows: *"Please think about how much work you get done per house these days. How does that compare to how much you would have got done per hour back in January/February 2020?"*, and the responses were categorised using a Linkert-type scale of 1 to 5 ranging from *"I get much more done"* to *"I get much less done"*.

For their part, Ramos & Prasetyo (2020) investigated the impact of WFH on worker productivity in the Philippines by administering 250 electronic questionnaires that considered five factors perceived to influence productivity: *"Job satisfaction"*, *"Commuting satisfaction"*, *"Job performance"*, *"Work from home factor"* and *"Job stress"*. This included questions such as the following, recorded on a five-point Likert scale from *"strongly disagree"* to *"strongly agree"*: *"I am more productive when I am less distracted by my co-workers"*, *"I am more productive when I avoid commuting"*.

Rahman & Arif (2020) obtained secondary data from various articles and primary data via an online survey using a semi-structured questionnaire for a sample of professionals WFH during Covid-19 in Dhaka city, Bangladesh (N = 100). The authors investigated the perceived productivity of WFH by considering response categories in comparison to office work such as *"fairly productive"* and *"very productive"*.

Using a questionnaire administered to employees from three private companies in Bihor, Romania, Bucurean (2020) evaluated how working from home impacts productivity during the pandemic through 10 different questions, including *"How full-time work from home arrangement influences your productivity?"*, whose response was categorised into *"negatively"* and *"positively"*.

Feng & Savani (2020) used a sample of employed women and men from dual-career families who were WFH since Covid-10 lockdowns started in the US (N = 286). Participants were asked to report their work productivity before and since Covid-19 lockdowns (for example, *"Before the Covid-19 pandemic, most of the time I produced high-quality work"* and *"Before the Covid-10 pandemic, most of the time I worked efficiently"*, and *"Right now, most of the time I try new ways to improve productivity"*, respectively), responding on a seven-point scale ranging from "1 = strongly disagree" to "7 = strongly agree".

Ipsen et al. (2020) collected data in the period March-May 2020 with 4,643 responses from participants from eight European countries that worked fully from home since the Covid-19 lockdown. The survey conducted by the authors included questions comparing the pandemic situation with a normal situation, considering, for example, to what extent they agreed with the following statement regarding their productivity (on a 5-point Likert scale): *"During these times I get less work done than normally"*.

In an investigation associated with the impact of WFH during the pandemic on workers' productivity, engagement and stress, Galanti et al. (2021) used data collected through an online questionnaire completed by 209 employees from public and private organisations in Italy. Perceived WFH productivity was measured in a section of the questionnaire that required comparing the current (pandemic) situation of WFH with traditional office work in the past though a single

item formulated as follows: *"When I work remotely, I am more productive."*

Awada et al. (2021) examined how different worker, workplace and work-related factors affect productivity and time spent in the workplace/WFH during the pandemic. To do so, the authors used an online questionnaire covering 988 respondents in 40 US states between April and June 2020. They generated a job performance variable based on workers' perceived level of productivity – using a five-point Likert scale with one indicating *"much lower productivity"*, three indicating *"the same as before"*, and five indicating *"much higher productivity"* – and the reported difference in time spent at the workplace during the WFH period, comparing both to pre-pandemic levels.

Similarly, Farooq & Sultana (2021) assessed the relationship between WFH and productivity during the pandemic using a sample of 250 respondents from the hospitality, banking, and IT sectors in India. The authors measured productivity through five self-reported items, recorded according to a five-point Likert scale from *"totally disagree"* to *"totally agree"* – (i) *"I have a high work performance in the current situation"*, (ii) *"I accomplish tasks quickly and efficiently in this difficult time"*, (iii) *"I set a high standard of task accomplishment during lockdown"*, (iv) *"I achieve a high standard of task accomplishment in the pandemic"*, and (v) *"I continue to beat our team's targets even in the pandemic"*.

Focusing on ergonomic issues when WFH during the Covid-19 pandemic, Guler et al. (2021) conducted an online survey using Qualtrics in the US between October and November 2020. In this survey, the authors assessed productivity during the WFH period with four self-assessment questions associated with (i) total duration of WFH after the onset of the pandemic; (ii) levels of stress or comfort compared to the workplace; (iii) productivity compared to the workplace; and (iv) quality of work compared to the workplace. For example, workers' self-assessment of productivity was determined based on their response to the following question, recorded on a five-point

Likert scale from: *"much better quality"* to *"much poorer quality"*: *"How do you evaluate your productivity/efficiency in the home environment in general compared to working in the workplace?"*

Russo et al. (2021) applied a two-wave longitudinal study among software professionals WFH during the Covid-19 pandemic (N = 192) to cover 50 psychological, social, situational and physiological factors that have previously been associated with well-being or productivity. To compute an overall score of productivity for each participant, the authors used the following formula: (P1/P2) x ((P3 + 100)/100), were P1, P2 and P3, respectively, being the following questions: P1) *"How many hours have you been working approximately in the past week?"*; P2) *"How many hours were you expecting to work over the past week assuming there would be no global pandemic and lockdown?"*; and P3) *"If you rate your productivity (i.e. outcome) per hour, has it been more or less over the past week compared to a normal week?"*. For the last question, responses were given on a bipolar slider measure ranging from *"100% less productive"* to *"0%: as productive as normal"* to *"≥ 100% more productive"*.

Kitagawa et al. (2021) used data from an original survey on WFH productivity during the Covid-19 pandemic, which was conducted in cooperation with four listed manufacturing companies in Japan, considering both blue-collar and white-collar employees. In the survey, productivity was measured based on the following two-stage questions: *"On a scale from 0 to 10 where 0 is the worst job performance anyone could have at your job, 5 is the performance of average workers, and 10 is the performance of a top worker, how would you rate your usual job performance (in the one-year period) before the declaration of the state of emergency?"*, and then questions asked respondents to apply a "O to 10" scale to grade their overall job performance since a specific reference date after the state of emergency due to the pandemic.

Likewise, Morikawa (2021) used data from original surveys conducted in June 2020 and July 2021 in Japan, to analyse

the changes in adoption and productivity of WFH during the pandemic. The survey asked for self-assessed WFH productivity relative to one's productivity in the usual workplace: *"Suppose your productivity at the usual workplace is 100; how do you evaluate your work productivity at home?"*.

Finally, estimating the impact of Covid-19 on productivity in terms of commuting time-savings and workers' perceptions of its efficiency, Barrero et al. (2021) used data from the American Time Use survey for about 10,000 salaried workers between 2017 and 2018, as well as data from the Survey of Work Arrangements and Attitudes (SWAA) to estimate work status and work arrangements during the pandemic. The authors estimated total productivity gains based on the self-assessed efficiency of workers WFH during the pandemic and the fraction of that efficiency that workers associate with reduced commuting time. Specifically, workers' self-assessed efficiency was determined in response to the following question, considering the alternatives *"Better"*, *"About the same"*, and *"Worse"*: *"How does your efficiency working from home during the Covid-19 pandemic compare to your efficiency working on business premises before the pandemic?"*.

From the studies taken as examples in each grouping, we can see that the measurement of *"productivity"* with regard to changed working practices during the pandemic can refer not only to economic performance, but also to workers' wellbeing and self-assessment during the pandemic. This is associated with the use of different practical methods applied to a variety of economies, sectors and firms. That is, in the literature we have reviewed, there is no single measure of productivity and the choice of one method or another depends strongly on the objectives of the study and the information available.

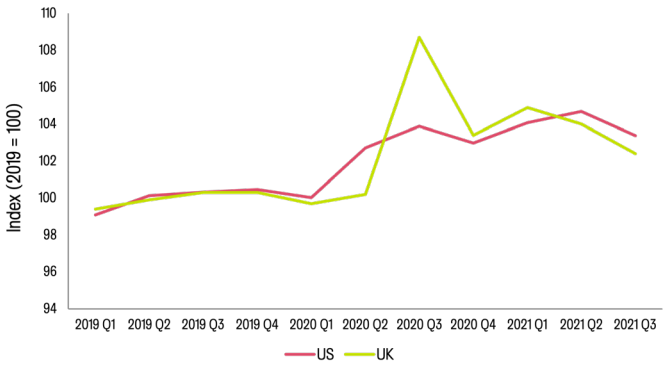
Generally speaking, the first group of studies is supported by databases with a significant level of detail and coverage, allowing the authors to employ methodologies that could be considered as more "objective" in the determination of labour productivity or TFP. To some extent, the same applies to

studies in the second group, where changes in the activity of workers in specific firms between the pre- and post-pandemic period are recorded directly from computer systems. Although the third group presents more "subjective" characteristics in the evaluation of productivity, it highlights a highly relevant element that is often neglected in quantitative productivity analysis, namely the workers' perception of their own work environment and performance.

How the pandemic impacted labour productivity

On a statistical level, the labour productivity indices of two of the world's leading economies, the US and the UK – determined in terms of output per hour worked – have, in the aggregate, been positive. Indeed, US labour productivity increased by 1.92 per cent in the second half of 2021, compared to the same period of the previous year, while UK labour productivity increased by 3.79 per cent considering the same comparison period.

FIGURE 1: LABOUR PRODUCTIVITY (OUTPUT PER HOUR WORKED) IN THE US (NONFARM BUSINESS SECTOR) AND THE UK (MARKET SECTOR), INDEX 2019 = 100, QUARTERLY

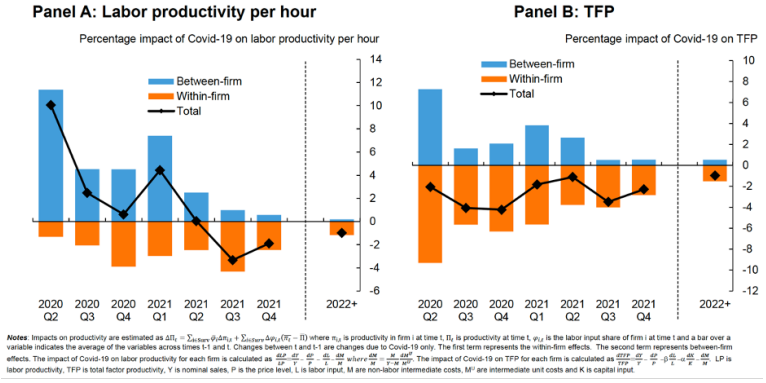


Source: Own elaboration based on data from US Bureau of Labour Statistics (US) and the Office for National Statistics (UK).

For Bloom et al. (2021a), such a statistical increase in productivity may reflect the fact that hours worked during the pandemic fell faster and recovered more slowly than value added per hour (p.3). Indeed, the results of Bloom et al. (2021a) show a negative effect of Covid-19 on productivity. According to the authors, the pandemic would have reduced TFP in the UK private sector by up to 4 per cent, estimating a 1 per cent reduction in the medium term. Furthermore, their study suggests that the increase in intermediate costs associated with the pandemic would be influencing the reduction in *"within-firm"* productivity, notwithstanding the aggregate compensation coming from the contraction of less productive sectors (and firms) in the *"between-firms"* effect (see Figure 2).

This negative relationship between Covid-19 and productivity is also evidenced in the study by Ahumada et al. (2022), who estimate that the pandemic reduced labour productivity by 4.9 per cent in Latin America and by 3.5 per cent in the 24 countries of the sample analysed, considering direct and indirect sector-level effects on the economy. Thus, the first group of studies, which determine productivity on the basis of accounting information, show a negative impact of Covid-19 on productivity. However, this is not fully supported by the other two groups of studies.

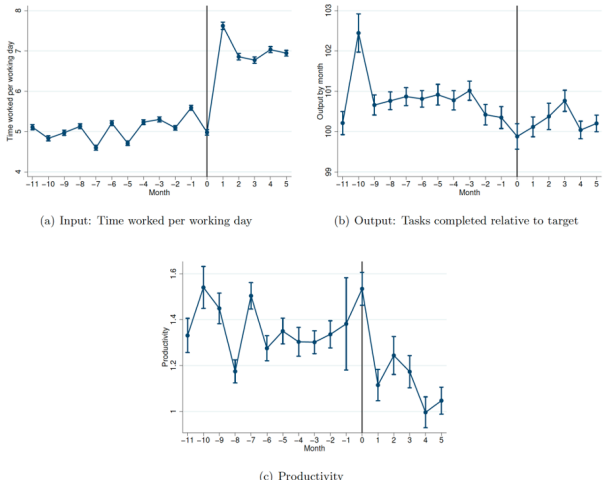
FIGURE 2: CONTRIBUTIONS TO IMPACT OF COVID-19 ON PRODUCTIVITY (IN BLOOM ET AL., 2021A)



Source: Bloom et al., 2021a, p.16.

In the use of employee activity tracking systems in IT service companies, Gibbs et al. (2021) also observe a reduction in labour productivity by 8-19 per cent due to the pandemic – employees worked longer but less productively, as output remained about the same (see Figure 3). However, the study by Bao et al. (2020) finds varied results depending on the different comparison metrics used. In this case, for example, the authors observe a negative impact of the pandemic on productivity associated with large projects, but a mostly positive impact on small projects, possibly due to the difficulties involved in adjusting the structure, schedule and communication associated with the former. However, the results of their study do not show that individual worker productivity has changed significantly between the office and WFH periods due to the pandemic. In other words, the authors find that WFH has positive and negative effects on overall project productivity depending on the metrics evaluated and the characteristics of each project – programming language used, project type, project age and project size.

FIGURE 3: AVERAGE OUTCOME BY MONTH, WITH THE VERTICAL LINE (MONTH 0) INDICATING THE SWITCH TO WORKING FROM HOME (IN GIBBS ET AL., 2021)



(a) Input: Time worked per working day

(b) Output: Tasks completed relative to target

(c) Productivity

Source: Gibbs et al., 2021, p.13.

The above divergences are also exposed in the results of the third group of studies. Indeed, Bucurean (2020), Farooq & Sultana (2021) and Kitagawa et al. (2021) obtain results that support the negative relationship between WFH due to the pandemic and labour productivity, particularly considering the possible influence of an unfamiliar way of working, a less supervised work environment, and poor WFH setups and communication difficulties, respectively. Similarly, Morikawa (2021) found that even adjusting for additional working hours from reduced commuting (approximately 3 per cent and 0.7 per cent of the total labour input of WFH workers and all workers, respectively), the conclusion of relatively low productivity at home remains essentially unchanged. In addition, Feng & Savani (2020) found that before the pandemic, there were no gender differences in self-rated work productivity and job satisfaction; however, during the lockdown, women reported lower work productivity and job satisfaction than men.

The results of Mustajab et al. (2020), Etheridge et al. (2020), Ramos & Prasetyo (2020), Ipsen et al. (2020), Galani et al. (2021), Awada et al. (2021) and Russo et al. (2021) show both negative and positive incidences. Mustajab et al. (2020) found a negative impact of WFH on productivity when considering decreased work motivation, distraction and multi-tasking, but a positive impact when considering work-life balance, flexibility and timesaving. While Etheridge et al. (2020) found that workers WFH report being, on average, as productive as before the pandemic, they also noted that productivity varies substantially across socioeconomic groups, industries and occupations. Thus, for example, workers in sectors less suitable for WFH reported productivity declines, something that was also observed in low-income earners, the self-employed and women, particularly those with children. Likewise, Ramos & Prasetyo (2020) show that WFH factors, such as having a comfortable workplace at home, making one's own decision about how to schedule work, combining work with household chores or avoiding commuting can have a positive impact on

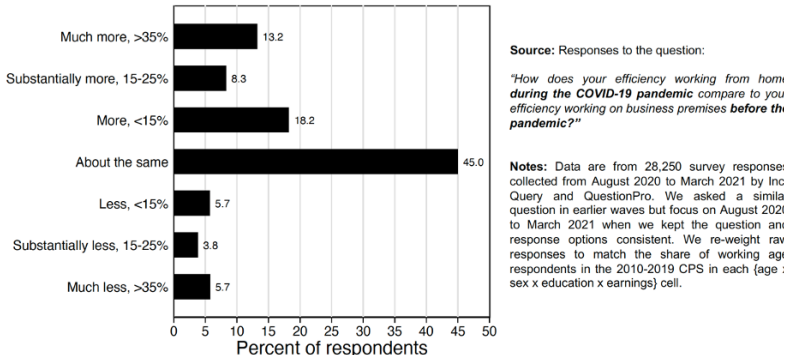
job satisfaction and a negative impact on job performance, with positive and negative effects on productivity, respectively.

Ipsen et al. (2020) found that most respondents (57 per cent) disagree or strongly disagree that they were getting less work done than usual during WFH although 38 per cent of the respondents agree or strongly agree that they work more hours than usual in the pandemic context (42 per cent disagree on that or strongly disagree). In the study by Galani et al. (2021), it is observed that difficulties in reconciling family and work and social isolation negatively affect work productivity, while autonomy is positively related to work productivity. Similarly, the study by Awada et al. (2021) found no significant changes in workers' perceptions of productivity before and during the pandemic, although they found a significant increase in the number of hours spent at the workstation. However, their study suggests that perceived productivity is higher in older, high-income and female workers, as well as in workers with a dedicated workplace at home, workers with better physical and mental health, and workers categorised as "scientists". For their part, Russo et al. (2021) concluded that WFH was per se not a significant challenge for software engineers, as the longitudinal analyses did not provide evidence that any predictor variable causal explained variance in well-being and productivity.

On the other hand, in the study by Guler et al. (2021) self-reported productivity was higher during the WFH, despite self-reported negative health impact, while in Rahman & Arif (2021) the results shown that most of the participants have felt that they have been getting more work done at home as compared to onsite locations. In Barrero et al. (2021), the authors estimate that the Covid-19 induced WFH will boost productivity in the post-pandemic economy by 0.8-1.0 per cent as conventionally measured, or by 3.6-4.6 per cent on a wider definition of productivity which includes reduced commuting time. In the data used by the latter large-scale survey, 45 per cent of the respondents answered that their efficiency WFH was about the same as working on company

premises, while 39.7 per cent answered that their efficiency WFH is higher (see Figure 4).

FIGURE 4: EFFICIENCY OF WFH VS WORKING ON BUSINESS PREMISES (IN BARRERO ET AL., 2021).



Source: Barrero et al., 2021, p.45.

In general terms, there is not necessarily a direct relationship between the methods used to measure productivity and changes in productivity due to the pandemic. While the results of the impact of Covid-19 on productivity appear to diverge depending on whether the methodology used is quantitative or qualitative, the main determinants are associated with the objectives of each study and the data available for them.

TABLE 2: : IMPACT OF COVID-19 ON PRODUCTIVITY ACCORDING TO DIFFERENT EMPIRICAL STUDIES

Productivity methodology group[4]	Authors	Productivity type	Impact of Covid-19 on Productivity
First group	Bloom et al. (2021a) Ahumada et al. (2022)	Labour productivity / TFP Labour productivity	Negative Negative
Second group	Gibbs et al. (2021) Bao et al. (2021)	Labour productivity	Negative Negative/Positive
Third group	Galanti et al. (2021) Awada et al. (2021) Farooq & Sultana (2021) Guler et al. (2021) Ramos & Prasetyo (2020) Barrero et al. (2021)	Labour productivity	Negative/Positive Negative/Positive Negative Positive Negative/Positive Positive

Source: Own elaboration.

The impact of Covid-19 on productivity is generally negative in those studies that could be called more "objective", i.e. that use mostly accounting data in measuring the productivity of the corresponding economies, sectors or firms analysed. However, the monitoring of workers' activities and workers' perceptions of their performance yields diverse results that depend on contextual and characteristic factors associated not only with the work, but also with the workplace and the workers themselves.

In addition to the studies mentioned above, an interesting and very recent investigation of 1,612 engineers, marketing and finance employees at a large technology firm based in Shanghai used a randomised control trial (RCT) methodology in which half the group were arbitrarily assigned to being able to work from home two days per week while the other half worked full time in the office (Bloom et al. 2022). Amongst other findings, this study found no impact in the WFH group overall or in any individual sub-group in terms of performance reviews or promotions. Lines of code written by the WFH group, another measure of employee productivity for IT engineers, rose by 8 per cent (as measured over the whole working week) compared with the control group. Employees' self-assessed productivity impact of WFH was also positive, with an average post-experiment assessed impact of 1.8 per cent.

Conclusion

The Covid-19 pandemic is a unique crisis that has affected both the supply and demand for goods and services. On the supply side, adverse effects have been observed through labour depletion, tighter financial conditions, and disrupted supply chains. On the other hand, aggregate demand has been affected as consumer demand for goods and services has been depressed, business confidence and investment have eroded and financing costs have risen. In these conditions, incentives for product innovation and quality improvement are reduced, technological progress is held back and productivity is reduced (The World Bank, 2021, p.21).

Therefore, a proactive approach from both the public and private sectors is needed to boost productivity growth. Policymakers will need to facilitate investment in physical and human capital, and firms will need to revitalise their capabilities to drive technology adoption and innovation. Certainly, skills development and labour flexibility could help to share more equitably the gains from any Covid-19 induced technological improvements (p.xvii).

Economic shocks caused by the pandemic may lead to structural changes that can improve productivity in certain sectors. For instance, Barrero et al. (2021) suggest that the WFH option will increase after Covid-19 and may positively impact labour productivity due to the re-optimisation of labour arrangements. According to the authors, reasons for maintaining WFH after the pandemic include: (i) better than expected WFH experiences; (ii) decreased stigma associated with WFH; (iii) increased technological innovation supporting WFH driven by the pandemic; and (iv) new investments in physical and human capital conducive to WFH.

The resilience of the economic response has mitigated the impact of Covid-19 in several aspects. According to Eberly et al. (2021), the significant deployment of WFH together with so-called "potential capital", that is, equipment – home offices, computers, and internet connections – that can be combined with remote working to produce results, has roughly halved the decline in GDP during the pandemic in countries such as the US and the UK. Studies such as Bloom et al. (2021b) note that the proportion of new patent applications promoting WFH technologies doubled in the US between January and September 2020, reinforcing the shift towards WFH even after the initial waves of the pandemic. Thus, the investment and various measures taken by firms to deal with the productivity consequences of the pandemic have mitigated the decline in output and significantly changed the work dynamics. For Eberly et al. (2021), the future incidence of WFH will depend not only on costs and technologies, but also, and mainly, on the elasticity of substitution between labour at home and at work.

Certainly, the shift to WFH seems to be a variable that has had an impact not only on labour productivity, but also on workers' wellbeing, especially in the context of work-life balance (see e.g. Felstead et al., 2006). Ramos & Prasetyo (2020) and Rahman & Arif (2021) found a positive relationship between WFH and self-reported job satisfaction and self-reported labour productivity during Covid-19, despite the incidence of stress and anxiety from working during a pandemic reported, respectively, in these studies. For their part, Kitagawa et al. (2021) found that the mental health of workers who WFH is significantly better than that of workers who are unable to WFH. On the other hand, studies such as Guler et al. (2021) observe that workers WFH due to the pandemic have reported lower stress, higher efficiency, and better quality in their work, although the same study also found self-reported weight gain and increases in lower back pain.

Prior to the pandemic, experiments such as the one conducted by Bloom et al. (2015) at the Chinese travel agency Ctrip, already suggested that WFH could increase productivity

and that WFH workers tend to report higher job satisfaction and lower quit rates (see also other experiments on WFH in Choudhury et al., 2021, and Emanuel & Harrington, 2021).

However, while some studies show that employees feel more productive WFH during the pandemic, they often do not take into account in their findings that the hours worked by employees have increased or that employees are working during the hours they used to commute to work. Moreover, workers' perception of WFH is still a subjective variable that depends on multiple factors (see e.g. Bailey & Kurland, 2002). These include the complexity of the work performed, the need for interaction (or not) with other colleagues to complete certain tasks, the awareness of being observed and evaluated (see e.g. the concept of the "Hawthorne effect" in Diaper, 1990; Wickström & Bendix, 2000), and, even more importantly, family and workspace conditions at home. Indeed, there is no consensus in the economic literature on the productivity effects of WFH, which can be very unequal across people and locations (Behrens et al., 2021; Barrero et al., 2021).

One policy conclusion from our review is that policymakers should be sceptical of general claims being made about the impact of WFH on productivity, either in a negative or positive direction, and hence should evaluate carefully the desirability or otherwise of employers and policymakers encouraging or mandating either a return to the office or the permanent adoption of distributed (hybrid or WFH) practices.

While the quantitative studies reviewed here mostly support the notion of a negative effect of the pandemic on labour productivity, urging a necessary return to the workplace to regain pre-pandemic economic performance, those studies of a more qualitative nature provide important insights that should be considered by relevant public and private decision-makers. In itself, more responsive management can lead to higher labour productivity (Bryson et al., 2006), so capturing workers' perceptions of their performance and wellbeing during the pandemic and integrating them into the decision-

making process is certainly a key element in understanding the consequences and opportunities of Covid-19 on work dynamics and the future of work.

References

Ahumada, H., Cavallo, E., & Espina-Mairal, S. (2022). Sectoral Productivity Growth, COVID-19 Shocks, and Infrastructure. *Economics of Disasters and Climate Change, Vol. 6*, 1-28.

Andrews, D., Charlton, A., & Moore, A. (2021). Covid-19, productivity and reallocation: Timely evidence from three OECD countries. *OECD Economics Department Working Papers No. 1676*.

Awada, M., Lucas, G., Becerik-Gerber, B., & Roll, S. (2021). Working from home during the Covid-19 pandemic: Impact on office worker productivity and work experience. *Work, Vol. 69, Issue 4*, 1171-1189.

Bailey, D., & Kurland, N. (2002). A review of telework research: findings, new directions, and lessons for the study of modern work. *Journal of Organizational Behavior, Vol. 23, Issue 4*, 383-400.

Bao, L., Li, T., Xia, X., Zhu, K., Li, H., & Yang, X. (2021). How does Working from Home Affect Developer Productivity? - A Case Study of Baidu During Covid-19 Pandemic. *Science China Information Sciences*.

Barrero, J. M., Bloom, N., & Davis, S. (2021). Why Working From Home Will Stick. *National Bureau of Economic Research (NBER), Working Paper Series No. 28731*.

Behrens, K., Kichko, S., & Thisse, J.-F. (2021). Working from Home: Too Much of a Good Thing? *CESifo Working Paper Series No. 8831*.

Bernard, A., & Jones, C. (1996). Productivity Across Industries and Countries: Time Series Theory and Evidence. *The Review of Economics and Statistics, Vol. 78, No. 1*, 135-146.

Bloom, N., Liang, J., Roberts, J., & Ying, Z. J. (2015). Does Working from Home Work? Evidence from a Chinese Experiment. *The Quarterly Journal of Economics, Vol. 130, Issue 1*, 165-218.

Bloom, N., Bunn, P., Mizen, P., Smietanka, P., & Thwaites, G. (2021a). The Impact of Covid-19 on Productivity. *National Bureau of Economic Research (NBER), Working Paper Series No. 28233*.

Bloom, N., Davis, S., & Zhestkova, Y. (2021b). Covid-19 Shifted Patent Applications toward Technologies That Support Working from Home. *American Economic Associatation, Papers and Proceedings, Vol. 111*, 263-266.

Bloom, N., Han, R., & Liang, J. (2022). How Hybrid Working From Home Works Out. *National Bureau of Economic Research (NBER), Working Paper Series No. 30292*.

Bryson, A., Charlwood, A., & Forth, J. (2006). Worker voice, managerial response and labour productivity: an empirical investigation. *Industrial Relations Journal, Vol. 37, Issue 5*, 438-455.

Bucurean, M. (2020). The impact of working from home on productivity: a study on the pandemic period. *The Annals of the University of Oradea, Economic Sciences, Vol. XXIX, Issue 2*, 267-275.

Carmody, D., Mazzarello, M., Santi, P., Harris, T., Lehmann, S., Abbiasov, T., . . . Ratti, C. (2022). The effect of co-location on human communication networks.

Nature Computational Science, Vol. 2, 494-503.
Caselli, F. (2004). Accounting for Cross-Country Income Differences. *National Bureau of Economic Research, Working Paper Series No. 10828*.
Choudhury, P., Foroughi, C., & Larson, B. (2021). Work-From-Anywhere: The Productivity Effects of Geographic Flexibility. *Strategic Management Journal, Vol. 42, No. 4*, 655-683.
Diaper, G. (1990). The Hawthorne Effect: a fresh examination. *Educational Studies, Vol. 16, No. 3*, 261-267.
Eberly, J., Haskel, J., & Mizen, P. (2021). "Potential Capital", Working from Home, and Economic Resilience. *National Bureau of Economic Research (NBER), Working Paper Series No. 29431*.
Emanuel, N., & Harrington, E. (2021). 'Working' Remotely? Selection, Treatment, and Market Provision of Remote Work (JMP). *Working Paper*.
Etheridge, B., Wang, Y., & Li, T. (2020). Worker productivity during lockdown and working from home: Evidence from self-reports. *Institute for Social and Economic Research (ISER), Working Paper Series No. 2020-12*.
Farooq, R., & Sultana, A. (2021). The potential impact of the Covid-19 pandemic on work from home and employee productivity. *Measuring Business Excellence*.
Felstead, A., Jewson, N., Phizacklea, A., & Walters, S. (2006). Opportunities to work at home in the context of work-life balance. *Human Resource Management Journal, Vol. 12, Issue 1*, 54-76.
Feng, Z., & Savani, K. (2020). Covid-19 created a gender gap in perceived work productivity and job satisfaction: implications for dual-career parents working from home. *Gender in Management: An International Journal, Vol. 35, No. 7/8*, 719-736.
Freeman, R., & Shaw, K. (2009). *International Differences in the Business Practices and Productivity of Firms.* Chicago: University of Chicago Press.
Galanti, G., Guidetti, G., Mazzei, E., Zappala, S., & Toscano, F. (2021). Work From Home During the Covid-19 Outbreak: The Impact on Employees' Remote Work Productivity, Engagement, and Stress. *Journal of Occupational and Environmental Medicine, Vol. 63, No. 7*.
Gentilini, U., Almenfi, M., Orton, I., & Dale, P. (2020). *Social Protection and Jobs Responses to Covid-19: A Real-Time Review of Country Measures.* Washington: World Bank.
Gibbs, M., Mengel, F., & Siemroth, C. (2021). Work from Home & Productivity: Evidence from Personnel & Analytics Data on IT Professionals. *Becker Friedman Institute, Working Paper No. 56*.
Guler, M. A., Guler, K., Guneser Gulec, M., & Ozdoglar, E. (2021). Working From Home During a Pandemic: Investigation of the Impact of Covid-19 on Employee Health and Productivity. *Journal of Occupational and Environmental Medicine, Vol. 63, Issue 9*, 731-741.
Hsieh, C.-T., & Klenow, P. (2010). Development Accounting. *American Economic Journal: Macroeconomics, Vol. 2, No. 1*, 207-223.
Ipsen, C., Kirchner, K., & Hansen, J. P. (2020). Experiences of working from home in times of covid-19 International survey conducted the first months of the national lockdowns March-May, 2020. *DTU Orbit*.
Kitagawa, R., Kuroda, S., Okudaira, H., & Owan, H. (2021). Working from home: its effects on productivity and mental health. *The Research Institute of Economy,*

Trade and Industry (RIETI) Discussion Paper Series 21-E-024.

Morikawa, M. (2021). Productivity of Working from Home during the Covid-19 Pandemic: Panel Data Anaylsis. *The Research Institute of Economy, Trade and Industry (RIETI) Discussion Paper Series 21-E-078*.

Mustajab, D., Bauw, A., Rasyd, A., Irawan, A., Akbar, M. A., & Hamid, M. A. (2020). Workinf from Home Phenomenon as an Effort to Prevent Covid-19 Attacks and Its Impacts on Work Productivity. *The International Journal of Applied Business, Vol. 4, No. 1*, 13-21.

OECD. (2001). *Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth.* Paris.

Oulton, N. (1998). Competition and the Dispersion of Labour Productivity Amongst UK Companies. *Oxford Economic Papers, Vol. 50, No. 1*, 23-38.

Rahman, K. T., & Arif, Z. U. (2021). Working from Home during the Covid-19 Pandemic: Satisfaction, Challenges, and Productivity of Employees. *International Journal of Trade and Commerce (IIARTC), Vol. 9, No. 2*, 282-294.

Ramos, J. P., & Prasetyo, Y. T. (2020). The Impact of Work-Home Arrangement on the Productivity of Employees during Covid-19 Pandemic in the Philippines: A Structural Equation Modelling Approach. *ICIBE 2020: 2020 The 6th International Conference on Industrial and Business Engineerin*, 135-140.

Russo, D., Hanel, P., Altnichel, S., & van Berkel, N. (2021). Predictor of well-being and productivity among software professionals during the Covid-19 pandemic – a longitudinal study. Empirical Software Engineering, Vol. 26, No. 62.

Sargent, T., & Rodriguez, E. (2000). Labour or Total Factor Productivity: Do We Need to Choose? *International Productivity Monitor, Centre for the Study of Living Standards, Vol. 1*, 41-44.

Schreyer, P., & Pilat, D. (2001). Measuring Productivity. *Organisation for Economic Co-operation and Development (OECD), Economic Studies No. 33*.

Solow, R. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, Vol. 39, No. 3*, 312-320.

Syverson, C. (2010). What Determines Productivity? *National Bureau of Economic Research (NBER), Working Paper Series No. 15712*.

The World Bank. (2021). *Global Productivity: Trends, Drivers, and Policies.* Washington: World Bank Publications.

Wickstrӧm, G., & Bendix, T. (2000). The "Hawthorne effect" — what did the original Hawthorne studies actually show? *Scandinavian Journal of Work, Environment & Health, Vol. 26, No. 4*, 363-367.

Yang, L., Holtz, D., Jaffe, S., Suri, S., Sinha, S., Weston, J., . . . Teevan, J. (2022). The effects of remote work on collaboration among information workers. *Nature Human Behaviour, Vol. 6*, 43-54.

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