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Wiring the Labor Market Revisited: Working from Home in the Digital Age

In his seminal paper "Wiring the Labor Market," published in the *Journal of Economic Perspectives* in 2001, David Autor identifies three channels through which the Internet is likely to change the labor market fundamentally. First, the Internet will change how workers and firms search for one another. Second, the Internet will facilitate outsourcing business services. Third, workers will increasingly carry out their work via the Internet rather than at their physical workplace at the firm.

The first two predictions have already come true: job ads in daily newspapers have become rare and over the last two decades, business services have grown faster than the overall economy. However, measurement issues make it difficult to detect whether "working from home" (WfH) is in fact on the rise. Should the WfH capacity of a job or the actual realization (WfH usage) of this capacity be considered? The WfH capacity can be measured by surveying employees (or employers) or by having experts assess which tasks of a job can be done from home. WfH may also differ in terms of quality and quantity. Do employees only sometimes work from home, for example, when they have to care for their sick children, or do they work from home regularly or even always? Do workers receive full recognition for time worked from home?

The coronavirus pandemic has shone a spotlight on WfH, as it has allowed maintaining economic activity even in times of lockdown. Based on survey data from the Socio-Economic Panel (SOEP), Schröder et al. (2020), for example, estimate that of all employed persons in Germany, around 34% worked partly or completely from home in April 2020. Many policymakers are keen to maintain this awareness for WfH in the post-coronavirus era, for example, by proposing a legal right to work from home.

The aim of this essay is to document the extent of WfH and to draw conclusions about its future. We do this using the example of Germany, an industrialized country that is representative in that it is neither a forerunner nor a laggard in the age of digital transformation. We mainly use data from the 2018 BIBB/BAuA Employment Survey (ETB). This representative survey of more than 20,000 employees with a minimum of 10 working hours per week includes extensive information on workplace characteristics, occupational tasks, requirements, qualifications, employment history, personal characteristics and differentiated information on WfH. These data are complemented by time-series evidence from the European Labor Force Survey (LFS) and the German Socio-Economic Panel (SOEP). The richness of our data allows us to comprehensively describe and analyze WfH in Germany from different perspectives.

WFH TRENDS IN GERMANY

Figure 1 depicts WfH trends drawing on two longitudinal surveys in Germany that record employees' WfH practices: the SOEP and the *Mirkrozensus*, which feeds into the European Labor Force Survey (LFS). Due to missing data, the WFH shares derived from SOEP for the period after 2014 are extrapolated. The figure reveals a remarkable pattern: until the beginning of the 2000s, the two WfH trends appear very consistent, with each share of employees reporting some WfH ranging between 12% and 14%. However, parallel to the expansion of broadband Internet that facilitates WfH, the trends start to diverge considerably. Whereas the WfH share computed from the SOEP increases sharply, the trend calculated from the LFS data even tends to decline. A closer look into the SOEP data reveals that the first phase of the WfH boom is primarily driven by employees taking up WfH on an occasional basis, i.e., "only when necessary" or "every 2–4 weeks." Only after 2009 does the share of regular WfH homeworkers, i.e., "daily" or "several times a week," approach that of occasional homeworkers.

But why is David Autor's prediction reflected in the SOEP but not in the LFS? This could be due to different measurements and framing of the surveys. In the SOEP, for instance, respondents are asked whether "[it

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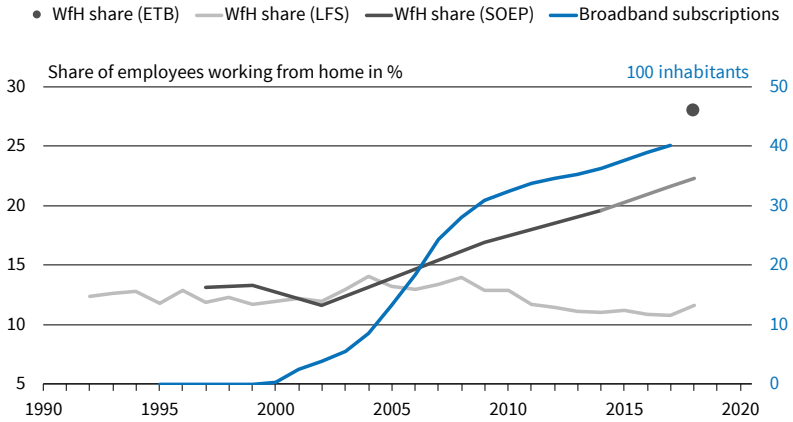
happens that] they work from home" (yes/no). In the LFS, however, respondents are asked whether they worked from home *in the last three months*, and can choose from the answers: "More than half of my working days," "Fewer than half of my working days" and "Never."[1] Thus, on the one hand, the LFS is more likely to miss sporadic WfH due to the temporal constraint. On the other hand, the question in the LFS understands WfH more as entire days rather than fractions of days worked from home. As we document below, even frequent homeworkers tend to spread their hours worked from home over several days. Consequently, the LFS probably records WfH practices for a very selected group, which might also explain why the LFS trend does not catch up after 2009, according to the SOEP survey, and frequent WfH becomes more prominent. David Autor's prediction is therefore not refuted. On the contrary, it seems to apply to a type of WfH that is more occasional (at least until 2009) and less institutionalized, i.e., not contractually organized.

In the following section, we shed light on two approaches to measure access to WfH, i.e., its capacity, and discuss different types of WfH practices in relation to workers' needs. We draw on the 2018 wave of the ETB, which is the most recent representative survey about WfH among the working population. The ETB determines the prevalence of WfH using a similar question found in the SOEP: "Do you work for your company – even if only occasionally – from home?" (yes/no). The emphasis on *occasional* WfH in the ETB might explain the gap between the WfH share from the ETB and the projected WfH share from the SOEP in 2018 (Figure 1).

Figure 1

Work from Home (WfH) Trends and Diffusion of Broadband Internet



Note: WfH-trend based on SOEP data extrapolated after 2014. Sample includes employees (i.e., no freelancers, assisting family members, self-employed or marginally employed) aged 15–64.
Source: SOEP; LFS; ETB International Communications Union; authors' calculations. © ifo Institute

MEASURING GERMANY'S WFH CAPACITY

To draw conclusions about the future development of WfH, one should consider an economy's WfH capacity – in addition to the mere actual use of WfH. The measure of an economy's WfH capacity provides a general upper limit for the extent of WfH and is informative about possible developments and limits of WfH in the near future. WfH capacity is especially relevant in a post-pandemic world in which many reservations of employees and employers regarding WfH have become obsolete. However. before the coronavirus crisis, the actual use of WfH did not even come close to the overall WfH capacity; the WfH surge during the crisis suggests that WfH usage will continue to converge toward WfH capacity.

Essentially two approaches for calculating an economy's WfH capacity have been proposed in the recent empirical literature. These approaches provide two distinct types of information: one approach relies on expert judgment as to which tasks of a job can be done from home (see e.g., Dingel and Neiman 2020). The other approach relies on survey evidence on how employees assess the feasibility of WfH in their specific jobs (see e.g., Alipour, Falck and Schüller 2020; Mergener 2020a). It is important to note that the "expert" approach by Dingel and Neiman (2020) provides an estimate of how many jobs can be performed *entirely* from home. That is, every job that contains *at least one commonly performed task*, which according to experts cannot be performed at home, is considered entirely incompatible with WfH. Other tasks of a job that could plausibly be performed from home are not taken into account. Yet, as pointed out above, it is occasional and partial WfH that has been on the rise since the beginning of the digital age. In contrast to the "expert" approach, the "employee" approach provides an estimate of how many jobs can be carried out from home *at least partly or temporarily*. That is, a job is only considered incompatible with WfH if *no essential part* of the job can be performed at home.

To compare these two measures in the German context, we employ both approaches and calculate the two types of WfH capacity measures ("expert"[2]

[1] In some years, possible response options or the temporal constraint are slightly different.

[2] More precisely, we calculate expert-judgment-based WfH capacity in line with Dingel and Neiman (2020) by defining an individual's job as incompatible with WfH if at least one of the following conditions

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and "employee"[3]) based on data from the 2018 ETB. The data contains detailed information on occupational tasks as well as information on employees' self-reported feasibility of WfH in their respective job. We present the results at the 1-digit occupational level according to the German Classification of Occupations 2010 (KldB 2010). In the light of political discussions about a universal right to WfH, it is important to consider the heterogeneity of WfH capacity across occupational groups. Figure 2 depicts both WfH capacity measures at the time of the survey in 2018.

Both measures of WfH capacity are strongly correlated across all occupation groups. Considerable heterogeneity of WfH capacity across occupational groups is evident in both measures. However, the measure based on expert judgement is considerably lower than the measure based on employee reports for every occupation group. This is probably not only due to differences in the assessments of experts and employees, but rather indicates a strong discrepancy between the potential to work entirely from home and the potential to work at least partly or occasionally from home. In a nutshell, it appears that the capacity to work from home at least partly/temporarily is considerably larger than the capacity to work entirely from home.

It is interesting to note from Figure 2 that the share of employees in an occupational group that may potentially work entirely from home is relatively close, and sometimes even less than, the share of employees that actually use WfH. This could be a tentative indication of the relative importance of occasional vs. full modes of WfH in different occupational groups. For example, in the agriculture, construction, health and natural sciences professions, in which the actual use of WfH surpasses the capacities to entirely WfH, occasional rather than full use of WfH might play a dominant role. These professions are also the occupational groups in which differences between the capacity to partly and the capacity to entirely work from home are most pronounced. Given that these groups include occupations in which physical presence, e.g., on a field, on a construction site, in a hospital or laboratory, is often at least temporarily necessary, entirely working from home may not be feasible for many employees in these occupational groups. At the same time, however, these occupations entail tasks that can be carried out from home, such as documenting, email processing, preparing work processes or training, which still allow employees to work at least occasionally from home.

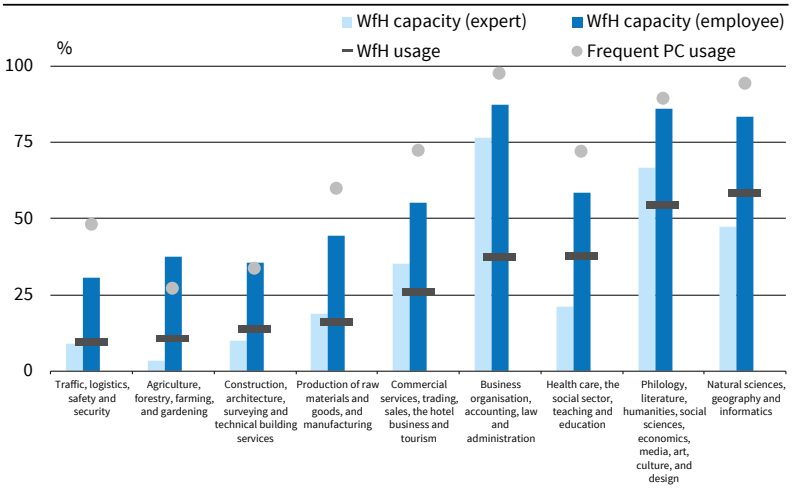
Another striking observation illustrated in Figure 2 is that the share of employees in an occupational group that may at least partly WfH is close to the share of frequent occupational PC users in that occupational group. In fact, the massive increase in professional PC use since the late 1990s, in combination with widely accessible broadband Internet infrastructure, might make it possible to perform more and more occupational tasks from home. However, it does not necessarily allow workplaces to be entirely moved into employees' homes.

is met: (a) never uses PC, Internet or email; (b) frequently carries loads of more than 10kg (women)/20kg (men); (c) frequent exposure to smoke, dust or gases; (d) frequent exposure to cold, heat, moisture, humidity or drafts; (e) frequently works with oil, grease, dirt; (f) frequent exposure to microorganisms; (g) works the majority of time outdoors; (h) frequently engages in nursing, caring or healing; (i) frequently engages in protecting, guarding, monitoring, regulating traffic; (j) frequently engages in cleaning, waste disposal, recycling; (k) frequently engages in monitoring, controlling machines or technical processes; (l) frequently works standing up; (m) frequently engages in transporting, storing, shipping.

[3] In calculating the employee-reported WfH capacity, we follow Alipour, Falck and Schüller (2020) as well as Mergener (2020a) and assume that a job cannot be performed at home, if the respondent does not work from home and indicates that WfH is "not possible" in his/her job even if the employer were to grant the option. The survey question reads "If your company allowed you to temporarily work at home, would you accept this offer?"– (*Yes; No; Is not possible with my work*).

Figure 2

Expert-judgement and Employee-survey Based Measures of WfH Capacity, Wfh Use, and Occupational PC Use by Occupational Group



Note: Weighted data; sample includes employees (i.e., no freelancers, assisting family members, self-employed or marginally employed) aged 18–65.
Source: ETB 2018; authors' calculations.

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DIFFERENCES IN THE EXTENT AND RECOGNITION OF WFH TIME

When estimating WfH capacity, we find indications for differences for occasional vs. full modes of WfH. This heterogeneity is reflected in the actual use of WfH.[4] Only about one-eighth of all employees who work from home do so entirely, the others do so frequently, sometimes or rarely (each with a share of about 30%). The proportion of weekly working time that employees work from home ranges on average from 7% (rarely), to 12% (sometimes) and to 29% (frequently). Employees who sometimes work from home spread their working hours over 2.2 working days; those working from home frequently distribute their working hours over 3.7 days. Almost 30% of all

[4] For details, see Mergener (2020b).

hours worked from home are not fully recognized as working time.

Mergener (2020a) shows that the capacity for WfH increases with the number of cognitive, mostly complex, tasks associated with a job, whereas manual tasks reduce this capacity. We find a comparable pattern for the actual use of WfH (Figure 3). It is more frequent in occupations with (highly) complex requirements. Working entirely from home is particularly common in jobs with highly complex tasks, while WfH frequently is also widespread among employees with complex tasks. However, WfH sometimes or rarely is of importance not only for jobs with (highly) complex tasks but also for those involving (un)skilled tasks.

In particular, employees with young children and commuters are in need of flexibility in choosing where they work. Parents of children under the age of 12 living in the same household more frequently work from home than employees without young children. Mothers in particular are slightly more likely to work entirely or at least frequently from home (see also Arntz et al. 2020). This WfH time consists primarily of contractually recognized hours worked from home (74% fully recognized, 16% not at all). Women without children more often work from home outside their recognized working hours (68% fully recognized, 23% not at all). Fathers use WfH arrangements more irregularly or on demand, i.e., sometimes or rarely. The proportion of unrecognized working time from home is higher for fathers (21% not at all recognized, 6% partially) than for mothers, but is not significantly different from men without children (22% not at all recognized, 7% partially).

WfH arrangements are often discussed as an instrument to reduce commuting, e.g., employees whose place of residence is located (very) far away from the employer's premises can especially benefit from such flexibility. We find that WfH increases with the distance between home and workplace at both the extensive and intensive margin. More than half of the employees with a commuting distance of 100 km or more state that they work from home (11% always and 21% frequently). In addition, long-distance commuters also work irregularly from home. However, the proportion of employees who sometimes or rarely work from home does not differ significantly between employees with longer and shorter commuting distances (it is about 10% in all distance groups). Regarding the contractual recognition of working time, it becomes obvious that long-distance commuters, who do a large part of their work from home, more often receive full recognition (82% fully recognized, 13% not at all). This proportion decreases with the commuting distance.

WHAT DOES THE FUTURE OF WFH LOOK LIKE?

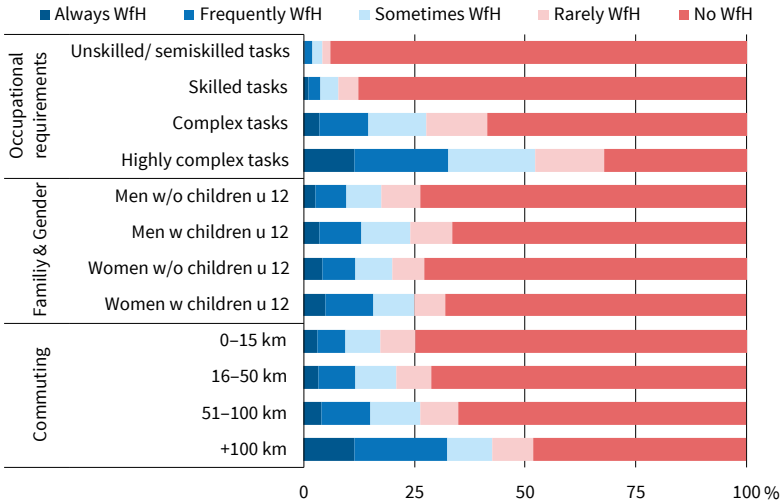
The evidence in this paper suggests that the increasing prevalence of WfH in the last two decades has been primarily driven by occasional homeworkers who spend only fractions of days rather than entire days working from home. Moreover, we show that the needs of employers and employees vary considerably, and that WfH is hardly feasible (at least completely) for some professions. Given this heterogeneity, a legal right to work from home is controversial. Nevertheless, it is likely that WfH will continue to gain importance even after the coronavirus crisis, so that parts of the unexploited potential from the pre-coronavirus era will be used. During the course of the pandemic, reservations and stigmas concerning WfH have dissolved. Necessary adjustments, such as digitizing work processes or introducing suitable communication tools, were implemented swiftly and many employees have developed or improved their digital skills.

The immediate benefits of such a shift are evident: companies can cut down on expensive office space; employees no longer lose time in traffic jams or crowded subways. A reduction in traffic would ultimately benefit the environment as well. The fact that people would no longer have to live near their place of work may also have a positive effect on the precarious situation in today's urban housing market. This, in turn, may benefit employees who cannot work from home, for example, healthcare workers. In addition, eliminating physical distance as a limiting factor could improve matching jobs between job seekers and employers, and ultimately boost overall economic productivity.

However, there are also arguments against a radical shift to WfH. Many employees experience permanent work from home as a burden rather than a relief. Employees who work from home often lack social exchange and report loneliness (Bloom et al. 2015). In fact, there is a large body of empirical ev-

Figure 3

Extent of WfH in Terms of Occupational Requirements, Family & Gender, and Commuting Distances



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Source: ETB 2018; authors' calculations.

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idence suggesting that it is precisely the personal exchange of ideas, knowledge, etc. that drives agglomeration and explains higher productivity in metropolitan areas.

If this type of exchange cannot be shifted to the digital realm, innovation and productivity-enhancing capacity could be lost. It is thus more probable that companies and employees will prefer a hybrid form of work. This would reconcile the flexibility and autonomy of working from home with the possibility of engaging in personal exchange at the office. In this case, office space would serve less as a mere place of work but as a communicative meeting place for employees. Future research should investigate how these changes in work organization will affect job performance and satisfaction for both employers and employees.

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