Working from Home, Commuting, and Gender *

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Abstract

Work from home (WFH) arrangements may provide an opportunity to reduce gender gaps in labor market outcomes by reducing the gender differences in the willingness to commute. Using a stated-preference experiment among German employees, we estimate workers' valuation of working from home and its impact on willingness-to-pay to avoid commuting by gender after the end of the COVID pandemic. We show that workers are willing to give up 7.7% of their earnings for full WFH and 5.4% for two-day WFH on average. We find that female, young, highly educated, and high-earning individuals show a higher valuation of WFH options. The willingness-to-pay for WFH steeply increases with commuting distance, in line with WFH reducing the need for long commutes for many workers. Importantly, we find that WFH reduces, but does not close, the gender gap in willingness-to-pay to avoid commuting. This result is unaffected by accounting for underage children in the household. This suggests that hopes of technology closing the gender wage gap are premature.

Keywords: working from home, commuting, gender, working conditions
JEL-Classification: J31, J32, J33, J81, R12, R23, R41

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1 Introduction

A key advantage of the rise of work from home (WFH) arrangements is the time savings from less commuting (e.g., Barrero et al., 2021; Aksoy et al., 2023; Cowan, 2023). This may be particularly important for women, who seem more averse to long commutes and thus sort into worse jobs (e.g. Black et al., 2014; Le Barbanchon et al., 2021; Caldwell and Danieli, forthcoming; Hirsch et al., 2022; Meekes and Hassink, 2022; Farré et al., 2023; Casarico and Lattanzio, 2023). Recently, Le Barbanchon et al. (2021) estimated that around 10 percent of the gender wage gap is due to differences in commuting valuation between genders and that married women are particularly averse to commuting. Even at the extensive margin, women's labor force participation is strongly affected by commuting distance (Black et al., 2014; Farré et al., 2023).[1] It is therefore important to understand the extent to which the gender gap in commuting can be expected to shrink due to increased WFH options.

Estimating whether WFH indeed closes the gender commute gap is difficult, however. The reason is that this requires estimating worker preferences for shorter commutes depending on WFH arrangements. Estimating such valuations in observational data is hampered by well-known limitations, such as search frictions on labor markets, endogenous matching between workers and firms, and missing data on complete compensation packages including non-wage amenities (e.g., Brown, 1980; Bonhomme and Jolivet, 2009; Eriksson and Kristensen, 2014; Lavetti and Schmutte, 2016; Lavetti, 2020). Consequently, recent research has used stated-choice experiments to identify worker valuations of workplace amenities (Mas and Pallais, 2017; Maestas et al., 2023; Arntz et al., 2023). However, so far, there is only scarce evidence about how much workers value WFH as a non-wage job attribute depending on their commute and how this differs by gender. This is especially true for worker valuations of WFH after the COVID pandemic, which has fundamentally changed perceptions of WFH among firms and workers (Barrero et al., 2021; Draca et al., 2022).

In this paper, we report detailed evidence on workers' valuation of WFH and its connection to commuting by gender shortly after the COVID pandemic. Our data come from a stated-choice experiment among a sample of over 3,300 workers in Germany conducted in July 2022 that is representative of the German workforce in terms of age, gender, and education. In our data, the gender gap in hourly wages amounts

[1] At the same time, women might suffer more from increased WFH in terms of their wages for other reasons, including limited promotion at work and less learning (Kouki and Sauer, 2022; Emanuel et al., 2023; Kouki, 2023).

to roughly 20% and is close to the gender wage gap reported in official statistics (Destatis, 2022b). In addition, we observe a substantial gender gap in commuting behavior.[2] Our experimental setup follows Maestas et al. (2023): Workers made choices between hypothetical jobs that randomly varied in terms of earnings and along several non-wage dimensions, including WFH options. Using this data, we back out clean estimates of how much workers value WFH both generally and relative to and depending on commuting time, focusing on differential valuations by gender.

In our data and in line with the literature, workers on average have a sizable willingness-to-pay for WFH. On average, workers are willing to give up 5.4% (7.7%) of their earnings to obtain the option to work from home for up to 2 days (5 days) a week. These estimates are larger than survey-based estimates on workers' valuation of WFH for Germany (Aksoy et al., 2022) and close to experimental estimates in the US before the pandemic (Mas and Pallais, 2017; Maestas et al., 2023). To put these numbers into perspective, the average willingness-to-pay for maximum flexibility in terms of WFH (up to 5 days a week) amounts to about 58% of the willingness-to-pay for reducing a (one-way) commute of 45 to 15 minutes. We find that female, young, highly educated, and high-earning individuals show a higher valuation of WFH options. These heterogeneous valuations of WFH, together with the unequal distribution of WFH options across the wage distribution and across education groups, lead to WFH exacerbating existing labor market inequalities, in line with expectations (Bonacini et al., 2021). We also find evidence of worker sorting, a key prediction of models of compensating differentials (Rosen, 1986): Among workers who report having WFH as an amenity in their current job, the willingness-to-pay for WFH for up to 2 days (5 days) per week is around 10% (17%). This suggests that, in line with theory, workers tend to sort into jobs based on their preference for WFH options.

Importantly, we find that workers' valuation of WFH meaningfully interacts with commuting. In line with expectations, we find that workers' willingness-to-pay for WFH is higher the longer the commute. Correspondingly, the presence of a WFH option reduces the willingness-to-pay to avoid longer commutes. Additionally, the value of WFH is higher in the presence of a flexible work schedule, suggesting that employees view these amenities as complements. In contrast, workers' valuation of WFH is unaffected by the number of paid days off.

[2]For example, around 35% of men in our sample commute more than 30 minutes to work (one-way), as compared to 26% of women (see Table 1).

Our main finding adds to the debate on gender gaps in commuting (e.g., Black et al., 2014; Gutierrez, 2018; Le Barbanchon et al., 2021; Caldwell and Danieli, forthcoming; Farré et al., 2023). We experimentally confirm that, on average, women have a higher willingness-to-pay than men to avoid long commutes, with the gap increasing in commuting distance. Interestingly, WFH options reduce this gender gap, but do not close it. Among women in our experiment, the willingness-to-pay to reduce a commute of 60 minutes to 15 minutes *under maximum flexibility regarding WFH* (up to 5 days per week) is about the same as men's willingness-to-pay for the same reduction *in the absence of any WFH option*. We find qualitatively the same pattern when restricting the comparison to men and women without children, a key explanation why women tend to behave differently on the labor market (Bertrand, 2018). This suggests that WFH may help in reducing gender wage gaps, but that hopes of technology erasing the gender commute gap are not warranted (Le Barbanchon et al., 2021).

Our paper contributes to the current debate on the future of working from home (Dingel and Neiman, 2020; Alipour et al., 2021, 2022a,b; Adams-Prassl et al., 2022; Barrero et al., 2021; Teevan et al., 2021; Arntz et al., 2022; Dole et al., 2023). Importantly, one theme of the literature on WFH is that it is a job amenity that workers value (e.g., Maestas et al., 2023; Datta, 2019; Lewandowski et al., 2022; Aksoy et al., 2022).[3] A key reason is that WFH lowers the burden of commuting. For example, Aksoy et al. (2023) and Cowan (2023) show that WFH saves workers substantial time due to less commuting.

The key contribution of our paper relative to this literature is to provide detailed evidence that workers' valuations of WFH options meaningfully interact with commuting and that this differs by gender. In particular, to the best of our knowledge, this paper is the first to examine whether increased WFH options have the potential to close the gender gap in commuting - an important driver of gender differences in the labor market (Black et al., 2014; Le Barbanchon et al., 2021; Meekes and Hassink, 2022; Farré et al., 2023). Our results overall suggest that WFH acts as a substitute for a reduction in commuting time from the perspective of workers, similar to infrastructure

[3]Before the pandemic, Mas and Pallais (2017) and Maestas et al. (2023) used stated-choice experiments to elicit workers' willingness-to-pay for WFH in the United States. Datta (2019) followed their approach in the UK and found similar results. During the pandemic, Lewandowski et al. (2022) used a stated-choice experiment in Poland to estimate the willingness-to-pay for WFH. After the pandemic, Aksoy et al. (2022) used surveys to inform on workers' valuation of WFH around the world. There is also literature on the productivity effects of WFH and hybrid work (e.g., Angelici and Profeta, forthcoming; Bloom et al., 2015, 2022; Choudhury et al., 2021; Harrington and Emanuel, 2021; Shen, 2023). There is also evidence of directed technological change likely enabling more efficient working from home in the future (Bloom et al., 2021).

investments. Our paper thus also contributes to the literature on the determinants of commuting distance (for German-speaking countries, see recently, e.g., Heuermann and Schmieder, 2019; Paetzold, 2019; Dauth and Haller, 2020; Krebs and Pflüger, 2023).

In this literature, there is also some debate whether working from home affects men and women differentially. Bertrand (2018) reviews explanations for remaining gender gaps in the labor market and suggests that improving opportunities to work remotely may reduce these gaps. Recently, Bonacini et al. (Forthcoming) show that occupations more prone to WFH have higher gender wage gaps, however. This may have to do with different implications of WFH on time use across genders (Pabilonia and Vernon, 2022).[4] Women may also face greater career consequences of WFH because of differential manager perceptions, task assignment, or because of differential on-site learning and productivity (Leslie et al., 2012; Kouki, 2023; Emanuel et al., 2023; Gibbs et al., 2023). We add to this literature by providing evidence on workers' valuations of WFH after the end of the pandemic by gender and, more importantly, by using our experiment to assess whether WFH has the potential to close determinants of the gender wage gap, namely the gender commute gap. Our results caution that while WFH reduces the gender gap in willingness-to-pay to avoid commuting, it is unlikely to close the gap completely.

More generally, this paper provides the first experimental estimates of worker valuations of WFH after life turned (almost) normal again post-COVID. While WFH is an important amenity, workers are willing to give up much higher shares of their earnings to avoid long commutes relative to obtaining even maximum flexibility in terms of WFH, in line with large revealed preference estimates of workers' aversion to long commutes (e.g. Van Ommeren and Fosgerau, 2009; Hirsch et al., 2022). Finally, we are also the first to show post-COVID experimental estimates for a large European economy with substantial capacity to work from home (Dingel and Neiman, 2020; Alipour et al., 2023; Ben Yahmed et al., 2022). In comparison to the survey-based estimate of Aksoy et al. (2022) for Germany, we find higher willingness-to-pay for WFH, closer to estimates for workers in the US.[5]

Our results also contribute to the literature on worker valuations of job amenities and resulting inequality. Empirically, this literature suffers from well-known issues

[4]For productivity effects of WFH by gender in developing countries, see, e.g., Bose (2023).

[5]Instead of conducting an experiment, Aksoy et al. (2022) ask survey respondents this question: "How much of a pay raise [cut] (as a percent of your current pay) would you value as much as the option to work from home 2 or 3 days a week?"

such as the comparability of workers and jobs in observational data and frictions in the labor market (e.g., Brown, 1980; Bonhomme and Jolivet, 2009). While there are a handful of exceptions that provide clean (quasi-)experimental estimates of compensating differentials for job (dis-)amenities from observational data (e.g., Lavetti and Schmutte, 2016; Lavetti, 2020; Wissmann, 2022; He et al., 2021), one part of the literature has turned to stated-choice experiments to elicit workers' willingness-to-pay for job characteristics (Eriksson and Kristensen, 2014; Mas and Pallais, 2017; Wiswall and Zafar, 2018; Maestas et al., 2023; Felfe et al., 2021; Arntz et al., 2023). This avoids problems of hedonic wage regressions (that often produce "wrong-signed" estimates, including in our sample) when estimating worker valuations of amenities. We contribute to this literature by providing novel and clean estimates for workers' willingness-to-pay for WFH. In particular, we then use these to inform how WFH may affect workers' aversion to commuting and how this differs by gender. We also contribute to this literature by eliciting workers' willingness-to-pay for other job amenities in Europe in a way that is comparable to evidence in the United States. For instance, we show that German workers display a somewhat lower willingness-to-pay for schedule flexibility but a higher willingness-to-pay for paid days off than American workers, in line with expectations (Mas and Pallais, 2017; Maestas et al., 2023; Bick et al., 2019).

2 Setup

2.1 Experimental approach

We ran an online experiment on a sample of German private-sector employees in July 2022. At this time, there was no lockdown in Germany and, while COVID incidence rates remained relatively high, life was almost normal again. Thus, our experiment was not directly affected by the huge changes in labor demand induced by the pandemic (e.g., Forsythe et al., 2020; Hensvik et al., 2021; Ben Yahmed et al., 2022).

We restricted the sampling to subjects aged 20 to 60. For recruitment, we used the infrastructure of the data collection agency Norstat. The sample is broadly representative of the population of German workers in terms of age, gender and education.[6] Following the pre-registered experimental design, we recruited 3,307

[6]Table A1 in the Appendix reports additional checks of representativeness, including dimensions like work from home arrangements and commuting patterns. Comparing our sample to representative

subjects.[7] To each respondent, we administered ten stated-preference experiments, following Maestas et al. (2023).

In each of these experiments, we asked subjects to select between two jobs, each defined by a partially varying set of non-wage job attributes, hours, and wages. Before the experiments, each respondent answered a short survey about current job characteristics. Each survey item corresponds to one of the non-wage job attributes in the experiment. Based on the respondents' baseline job, we created two hypothetical jobs (labeled "A" and "B") by randomly selecting two non-wage attributes (including hours) to vary across the two jobs. Within each of the two randomly selected attributes, we chose corresponding attribute values at random sequentially for both jobs without replacement. This procedure made sure that Job A and Job B actually varied in the selected attributes.

The hypothetical jobs were described by the following attributes. One-way commuting time to the workplace varied between 15, 30, 45, and 60 minutes. Options to work from home in a given job varied between "none", "up to 2 days per week," and "up to 5 days per week." We complemented the job profiles by three further non-wage attributes: flexibility of schedule (yes or no), number of paid days off (25, 30, or 35 days), and weekly work hours (varying between 15 and 60 in 5-hour increments). Finally, we included measures of work pressure, which we report in a companion paper (Nagler et al., forthcoming). The first attribute related to the presence of deadlines, while the second related to multitasking. In both cases, the job attributes were defined by statements whether the respective characteristic (presence of deadlines and/or multitasking) would apply "frequently" or just "occasionally." These measures also speak to recent findings regarding potential (time) pressure and stress aversion of workers (Buser et al., 2022). To minimize the risk for differential perceptions regarding unspecified job characteristics, we followed Maestas et al. (2023) and instructed respondents to assume that attributes not mentioned were identical across jobs.

Besides the two randomly selected non-wage attributes, the wage always varied between Job A and Job B. We anchored the randomly determined wage using the

data from the German Statistical Office, we find that we oversampled workers with limited WFH arrangements. The share of workers with more extensive WFH arrangements is very similar to the general population. The same holds for commuting patterns. Reweighting our estimations to account for differences relative to population means does not affect our results qualitatively (results available on request). Our respondents also report slightly higher hours worked, slightly fewer paid days off, and slightly lower earnings than the population, but the differences are small.

[7] We pre-registered the design at the AEA RCT registry under AEARCTR-0009559.

respondent's actual hourly wage w. The anchoring was achieved by setting the wages of Job A and Job B as $\theta_A w$ and $\theta_B w$, respectively, where θ_A and θ_B follow a $N \sim (1, 0.01)$ distribution. We truncated both weights to lie between 0.75 and 1.25. In the choice experiments, the wage offer was converted back to the units in which the respondent originally reported their earnings (hourly, monthly, or yearly).[8] We also adapted the strategy used by Maestas et al. (2023) to limit the number of job pairs in which one of the jobs dominated the other on all varying dimensions. Figure A1 in the Appendix shows a screenshot of two hypothetical jobs between which participants had to choose.

In addition to the 10 choice experiments, we included two further questions that follow the "trick" questions in Maestas et al. (2023) and serve as attention checks.[9] Responses to the trick questions allow us to estimate the share of inattentive participants and test the robustness of our findings when excluding inattentive respondents.[10] Overall, 65.6% of respondents answered both questions correctly, somewhat above the share in Maestas et al. (2023).[11] For further details on the design, see Appendix Section A.2.

Our experimental approach to elicit workers' willingness-to-pay for job attributes has advantages over hedonic wage regressions since it avoids the well-known problems of observational data when estimating such worker valuations (Bonhomme and Jolivet, 2009; Mas and Pallais, 2017; Maestas et al., 2023; Lavetti, 2023). For example, when we use our survey data to estimate hedonic wage regressions, we find negative wage differentials for WFH (shown in Appendix Figure A4), in line with wrong-signed estimates for other job amenities in the literature (e.g., Brown, 1980; Mas and Pallais, 2017; Lavetti, 2023).[12] Such stated preference experiments have therefore become

[8]We asked the subjects in the survey if they are able to state their current (gross) income. If a given subject answered "no", we did not ask for the current income, but randomly chose w. For details, see Section A.2 in the Appendix.

[9]When facing these questions, which appeared randomly (and non-consecutively) between the third and the last experiment, respondents were instructed to respond in a specific way, irrespective of what they believed was the true answer.

[10]Figure A2 in the Appendix shows a screenshot of a trick question. When restricting the sample to subjects who passed both attention checks, the results are stronger than the baseline results (see Figure A3 in the Appendix).

[11]Another fact suggesting high levels of attention comes from the subset of choices where one of the jobs dominated the other in all dimensions (1,958 cases). In these choices, the subjects selected the dominant job in 94.7% of all cases.

[12]Note, however, that our approach elicits workers' willingness-to-pay for WFH, but not the compensating wage differential associated with this amenity, since this is a market outcome reflecting the *marginal* worker's willingness-to-pay for a job amenity. However, workers' willingness-to-pay is a key component of compensating differentials since without workers having a sizable valuation for an

state-of-the-art when eliciting worker valuations of job or place characteristics (e.g., Mas and Pallais, 2017; Wiswall and Zafar, 2018; Maestas et al., 2023; Felfe et al., 2021; Arntz et al., 2023).

Table 1 shows descriptive statistics on our participants. A majority of workers (68%) do not have work from home arrangements in their jobs. 18% of workers can work from home up to 2 days per week, and around 14% have a WFH option on up to 5 days per week. These numbers reflect an increase in WFH opportunities compared to pre-pandemic times (Alipour et al., 2022b; Destatis, 2022a). On average, men are slightly more likely to have WFH options. There is a strong association between workers' education and the availability of WFH in their current job. The table also shows the distribution of other job amenities in our sample. More educated and male workers in our sample are more likely to have longer commutes, are more likely to have a flexible schedule and, on average, have a slightly higher number of paid days off. The gender wage gap is close to the actual one in Germany (Destatis, 2022b).[13] Table A2 in the Appendix shows descriptive statistics by age groups and wage quintiles.

2.2 Estimation approach

2.2.1 Additive model

We estimate the willingness-to-pay (WTP) for job characteristics following Maestas et al. (2023). In the baseline estimates, we assume that the binary choices of participants reflect a linear indirect utility function in which job attributes, the log wage and work hours enter additively,

$$V_{ijt} = \alpha + X'_{ijt}\beta + H'_{ijt}\theta + \delta \ln w_{ijt} + \epsilon_{ijt}, \tag{1}$$

where V_{ijt} represents individual i's indirect utility from job j in choice pair t. X_{ijt} represents the vector of non-wage job attributes, H_{ijt} is a function of hours, and w_{ijt} is the wage rate. Taking the difference in indirect utilities between two hypothetical jobs, j and k, we can use a logistic specification to estimate the probability to select job j

amenity, we would not expect it to lead to compensating differentials in the first place (Lavetti, 2023). In addition, we can bound the compensating differential for the job amenity. The reason is that the marginal worker's willingness-to-pay should lie between the willingness-to-pay of workers who sorted into jobs without (weakly lower willingness-to-pay than marginal workers) and workers who sorted into jobs with the respective amenity (weakly higher willingness-to-pay than marginal workers).

[13] Note that the wage information is missing for 12.2% of all subjects. For details, see Appendix A.2.

Table 1: Sample descriptives

	All	Females	Males	Education		
				Low	Medium	High
Working from home						
No WFH	0.68	0.71	0.65	0.82	0.73	0.33
WFH up to 2 days	0.18	0.16	0.20	0.10	0.16	0.38
WFH up to 5 days	0.14	0.12	0.15	0.08	0.11	0.29
Flexible schedule	0.36	0.31	0.40	0.27	0.32	0.61
Paid days off	28.65	28.31	28.94	28.52	28.59	29.02
Commuting time						
0-15 minutes	0.32	0.36	0.29	0.37	0.32	0.24
16-30 minutes	0.37	0.37	0.37	0.37	0.39	0.33
31-45 minutes	0.19	0.16	0.21	0.17	0.18	0.25
46-60 minutes	0.08	0.07	0.09	0.07	0.08	0.11
>60 minutes	0.04	0.03	0.05	0.03	0.03	0.07
Weekly work hours	36.92	33.61	39.77	36.54	36.47	38.72
Gross hourly wage	19.52	17.10	21.53	17.24	18.27	26.17

Note: This table shows descriptives on the subjects' current job. We use these job characteristics to construct a subject-specific baseline job profile for the experiment. The number of participants is 3,307. High-educated workers are those with a college degree. Medium-educated workers are those with a high-school degree or a vocational degree. The share of females is 46.3%. The share of subjects with low (medium, high) education is 31.0% (50.2%, 18.8%). In the last row, we exclude subjects who did not report a wage for their current job (12.2% of respondents).

over job k as a function of differences in job attributes, differences in log wages, and differences in work hours between both jobs,

$$P(V_{ijt} > V_{ikt}) = \frac{\exp[(X'_{ijt} - X'_{ikt})\beta + (H'_{ijt} - H'_{ikt})\theta + \delta(\ln w_{ijt} - \ln w_{ikt})]}{1 + \exp[(X'_{ijt} - X'_{ikt})\beta + (H'_{ijt} - H'_{ikt})\theta + \delta(\ln w_{ijt} - \ln w_{ikt})]}. \quad (2)$$

To compute the willingness-to-pay for a specific job attribute r, we use the coefficients from the logistic regression and set up the following indifference condition between a job not having attribute r at wage w and one that has attribute r and pays $w - WTP^r$ as

$$\delta \ln w = \beta^r + \delta \ln(w - WTP^r), \tag{3}$$

where β^r and δ are the corresponding coefficients from the logistic regression. The willingness-to-pay WTP^r for attributes that enter the indirect utility negatively would be negative. WTP^r is thus given by

$$WTP^r = w \left[1 - e^{\left(-\frac{\beta^r}{\delta}\right)}\right]. \tag{4}$$

Following Maestas et al. (2023), we display all results in percent of w. This means that gaining a job attribute corresponds to a $100 \left[1 - e^{\left(-\frac{\beta^r}{\delta}\right)}\right]$ % wage increase. We compute standard errors, allowing for clustering within respondent, using the delta method.

2.2.2 Multiplicative model

To test for the existence of interaction effects between WFH and commuting (or other job attributes) in workers' valuation of job alternatives, we additionally consider an indirect utility function where job attributes enter in a multiplicative fashion. Analogously to equation 3, we set up the respective indifference conditions to solve for the willingness-to-pay to work from home, once for the case in which both job alternatives offer a specific commuting distance and once for the case in which they do not.

For example, to test for interaction effects between WFH and commuting, we assume the indirect utility function

$$\begin{aligned} V_{ijt} = \alpha + \gamma_1 W_2 + \gamma_2 W_5 + \psi_D \sum_D C_D + \xi_1 W_2 \sum_D C_D + \xi_2 W_5 \sum_D C_D \\ + X'_{ijt}\beta + H'_{ijt}\theta + \delta \ln w_{ijt} + \epsilon_{ijt}, \end{aligned} \tag{5}$$

where W_2 and W_5 are indicators for WFH 2 days and 5 days, respectively, and C_D (with D $\in$ 30, 45, 60) are indicators for commuting times of 30, 45, and 60 minutes, where 15 minutes is the reference group. X'_{ijt} now includes all job attributes other than WFH and commuting time.

3 Workers' willingness-to-pay to work from home

Baseline results. Figure 1 shows the baseline results from our experiment, along with 95% confidence intervals.[14] The first two rows show estimates of the average willingness-to-pay to work from home for up to 2 days and up to 5 days per week, respectively. On average, workers are willing to give up 5.4% of their earnings to have a WFH option for up to 2 days per week. This willingness-to-pay is substantially larger than a comparable recent survey-based estimate of 3.7% by Aksoy et al. (2022) for Germany. To obtain a WFH option for up to 5 days per week, workers in our sample are willing to give up around 7.7% of their earnings. This valuation is similar to the experimental estimate of the willingness-to-pay for WFH among call-center applicants in Mas and Pallais (2017) and somewhat higher than the pre-pandemic estimate from Maestas et al. (2023) for the United States whose experimental design we follow. Both the valuation for up to 2 and up to 5 days of WFH are precisely estimated. Table A4 in the Appendix shows the underlying logit estimates for the main regressions and provides details on the calculation of the WTP numbers.

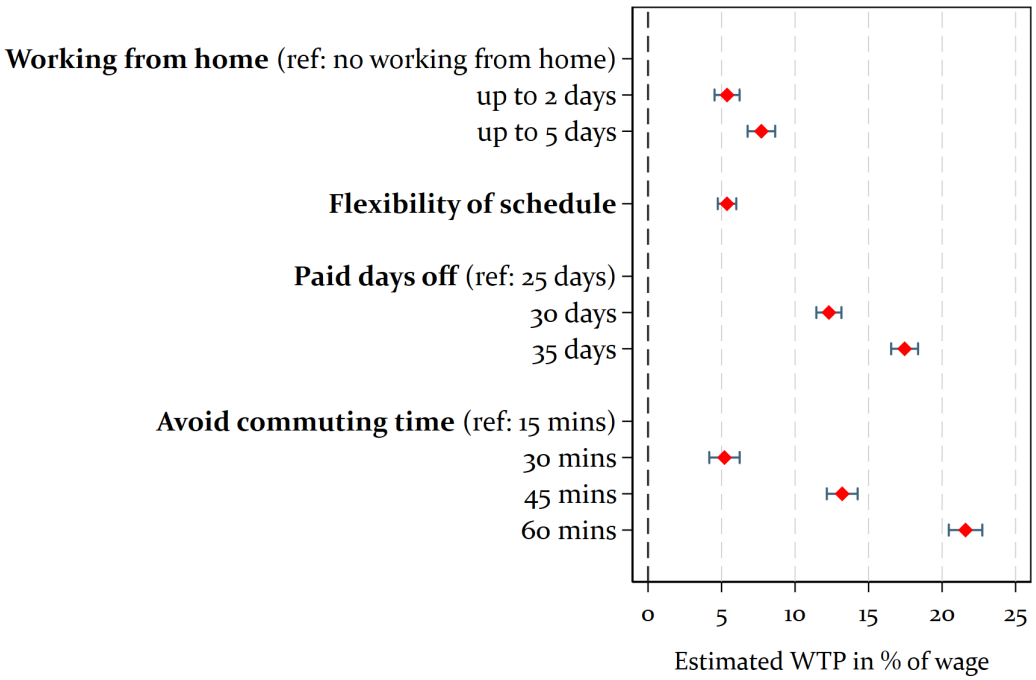
Having established that workers in our sample has a sizable willingness-to-pay for WFH, we benchmark workers' valuation for WFH against other job amenities. We focus on amenities for which the literature provides reference estimates of worker valuations, or that we believe are highly relevant in the German labor market. Below the estimates for WFH, Figure 1 shows how much workers in our sample value schedule flexibility, the number of paid days off, and avoiding longer commuting times. Regarding schedule flexibility, we estimate an average willingness-to-pay of 5.4% of earnings from a job with no flexibility. This estimate lies in between the results by Maestas et al. (2023) and the results by Mas and Pallais (2017). Hence, the average worker values a flexible work schedule about the same as the option to work from home up to 2 days per week.

Next, we turn to paid days off as a job amenity. The legal minimum in Germany is 20 paid days off for full-time workers. However, there is a strong norm towards 30 paid days off. For example, Bick et al. (2019) find that German workers have around 30 days of annual leave in their sample on average, while US workers have around 10 days.[15] We therefore used 25 paid days off as a reference category and present

[14] Table A3 shows descriptive statistics on the job attributes offered in the choice experiment.

[15] In our sample, 48% of workers report having 30 paid days off and only around 20% report having 25 or less paid days off. For workers with a high level of education, the numbers are 58% and 14%, respectively. See Appendix Figure A5 for the sample distribution of paid days off.

Figure 1: Willingness-to-pay for working from home and other job amenities



Note: This figure shows workers' average willingness-to-pay (WTP) for specific job attributes in percent of earnings. The first two rows show workers' willingness-to-pay to work from home for up to two days and up to five days per week, respectively. The reference category is no option to work from home. The third row shows workers' willingness-to-pay to have schedule flexibility. The fourth and fifth rows show estimates of workers' willingness-to-pay for 30 and 35 paid days off, respectively, relative to 25 days. The final three rows show workers' willingness-to-pay to avoid a commute of 30 minutes, 45 minutes, and 60 minutes, respectively. The reference category is a 15-minutes commute. The (red) diamonds indicate point estimates, the bars reflect 95% confidence intervals where standard errors allow for clustering at the respondent level. Each of the 3,307 respondents did participate in 10 stated-preference experiments. Number of observations: 33,070.

estimates of workers' willingness to pay for 30 and 35 days, respectively. We estimate that workers are willing to give up 12.3% of their earnings to switch from a job with 25 paid days off to an otherwise identical job that features 30 paid days off. In light of the strong norm towards 30 paid days off, the size of this estimate might reflect a strong aversion to having fewer paid days off than in the current job.[16] Interestingly, workers seem to have substantial valuations for additional paid days off beyond a baseline of 30 days. The valuations of 30 and 35 paid days off (relative to 25) are similar to worker valuations of 10 and 20 paid days off in the United States (relative to no paid days off, see Maestas et al., 2023). This higher valuation in Germany is consistent with large

[16]In line with this explanation, workers who have 25 paid days off or fewer in their current job show a lower WTP of around 7% for 30 paid days off, relative to 25 paid days off (not shown).

differences on average in workers' actual number of paid days off between the United States and Germany (Bick et al., 2019).

At the bottom of Figure 1, we report workers' willingness-to-pay to avoid commutes. The average worker in our sample is willing to give up 13.2% of earnings to reduce a one-way commute of 45 minutes to 15 minutes. This large willingness-to-pay to avoid commutes is well in line with revealed preferences estimates of worker valuations of commuting (e.g., Van Ommeren and Fosgerau, 2009; Hirsch et al., 2022).

Overall, Figure 1 shows that workers in Germany have a sizable willingness-to-pay for WFH, but they value other non-wage job attributes even more. The average willingness-to-pay for maximum flexibility in terms of WFH (up to 5 days a week) amounts to only about 58% of the willingness-to-pay for reducing a commute of 45 to 15 minutes, for example. We conclude that WFH is an important amenity for workers, but our data do not support the notion that COVID has led workers' valuations of work arrangements to be dominated by the availability of WFH options.

Sorting. We can also test whether our data are consistent with sorting, a key prediction from theories of compensating differentials (Rosen, 1986). According to a framework of compensating differentials, workers choose between jobs by evaluating the magnitude of the market-level compensating wage differential for a disamenity and comparing this to their compensating variation, i.e., the amount of consumption that would make them indifferent between a job with the amenity and with the compensating variation and a job without the disamenity. Under worker heterogeneity, we would then expect workers to choose jobs according to their distaste for the disamenity, generating rents. Thus, workers that face the disamenity in their current jobs would be expected to have lower valuations to avoid the disamenity than workers who do not face the disamenity. For amenities, the reverse is true.

In Appendix Figure A6, we show that workers who can work from home in their current job indeed show substantially higher willingness-to-pay to work from home for 2 days (10.3%) and 5 days (16.4%) than workers who do not (3.1% and 3.7%, respectively). Taking Rosen (1986) seriously, these estimates also bound the compensating wage differential for WFH. The reason is that the willingness-to-pay of workers who sorted into jobs with WFH should be above the willingness-to-pay of marginal workers, while the willingness-to-pay of workers who did not should be below.[17]

[17] See also Rosen (1986), Figure 12.2, p. 649.

Finally, in Appendix Figure A7, we show that workers who report a commuting time of more than 30 minutes in their current job show lower willingness-to-pay to avoid such long commutes. This is again consistent with worker sorting on this amenity.

Heterogeneities. Next, we study to what extent the willingness-to-pay for WFH is heterogeneous across worker types. Figure 2 reports our results. In Panel (a), we show workers' willingness-to-pay to work from home for up to 2 days per week. Workers' willingness-to-pay is slightly higher for female (6.1%) than for male (4.8%) workers. This is in line with the hypothesis that WFH arrangements are more important for women. The largest valuation for WFH is among young individuals (6.6%), with workers above age 50 valuing WFH least (2.9%). WFH is most popular among highly educated workers (7.9%) and least valued among low-educated workers (3.7%). Finally, the willingness-to-pay for WFH is highest among high-earning individuals (7.5%) and lowest in the bottom quintile of the wage distribution (3.9%).[18]

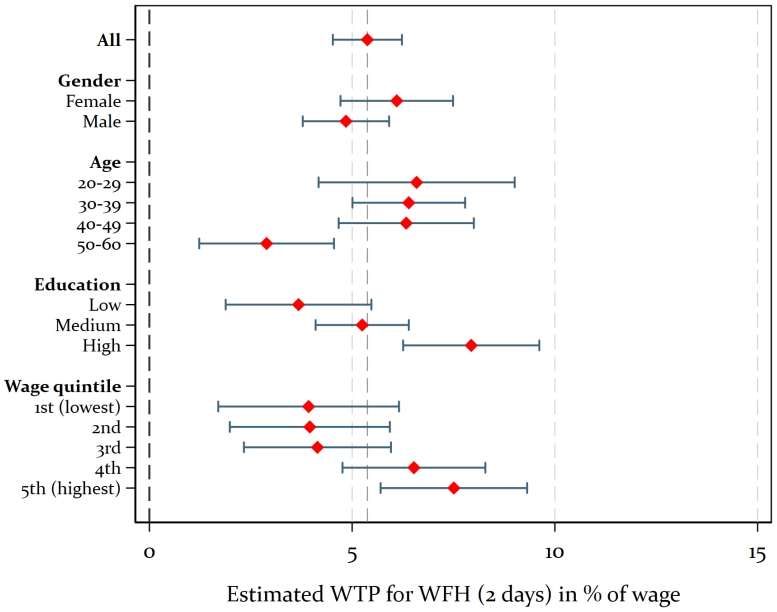
Panel (b) repeats this analysis for willingness-to-pay to work from home up to 5 days per week. Workers' valuation of WFH is higher, at 7.7% on average. The heterogeneity of effects is even more pronounced, especially regarding age and education. For instance, workers aged 20-29 now value WFH at 10.6% of their earnings, while workers aged 50-60 value it at 4.5% of their earnings. Similarly, while highly educated workers display a willingness-to-pay of 12.2%, low-educated workers show a valuation of 5.7%.

The gender differences in the valuation of WFH are of particular interest in light of the question whether WFH has the potential to reduce the gender wage gap. The higher valuation among females compared to males suggests that females benefit more from increased WFH options than males. On the one hand, if females in turn are willing to accept lower wages than males for jobs offering WFH, this might actually increase the gender wage gap. On the other hand, WFH may allow female workers to accept jobs at higher distance without having to commute. This could eliminate an important source of gender differences in labor supply (Le Barbanchon et al., 2021). We investigate the relationship between WFH options and commuting by gender in Section 5 below.

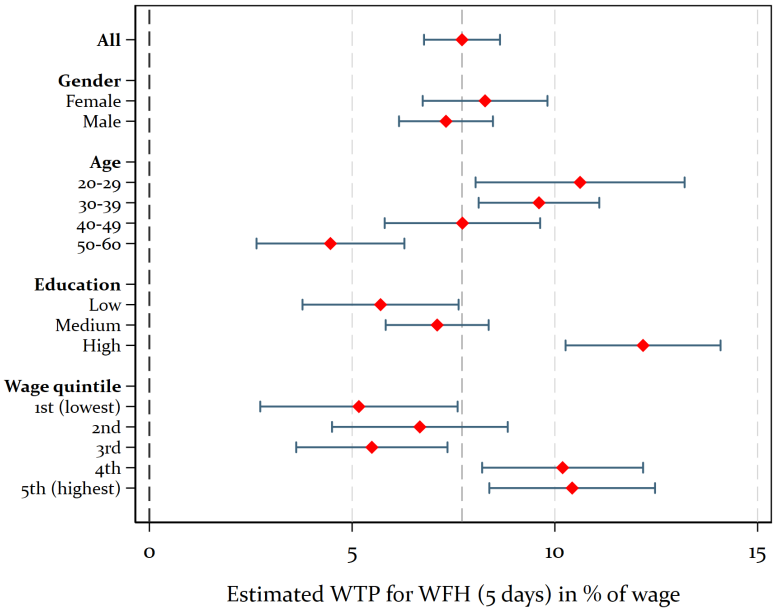
[18]In Appendix Figure A8, we use a random forest approach to impute missing wage information for respondents. The heterogeneity analyses regarding the respondent's position in the wage distribution remain qualitatively identical.

Figure 2: Heterogeneity of estimates of willingness-to-pay to work from home

(a) Up to 2 days per week



(b) Up to 5 days per week



Note: Panels (a) and (b) show the workers' willingness-to-pay for working from home for up to two days per week and up to five days per week in percent of earnings, respectively. In each panel, the first row shows the average willingness-to-pay for all respondents in the sample. The following rows provide estimates for specific subgroups. When computing wage quintiles, we drop observations with missing information on the worker's wage in her current job (12.2% of respondents). The (red) diamonds indicate point estimates, the bars reflect 95% confidence intervals where standard errors allow for clustering at the respondent level. Number of observations: 33,070 (29,050 for wage quintiles).

WFH and inequality. Finally, given the unequal distribution of WFH in current jobs across groups (see Tables 1 and A2) and the heterogeneities reported in the prior paragraphs, a natural follow-up question is whether WFH contributes to inequality meaningfully. To do so, we compare workers' total compensation by group taking respondents' average valuations of WFH to compute a counterfactual wage including the amenity value of WFH.

To this end, we again follow Maestas et al. (2023). Building on Equation (4), we compute the log compensation (i.e., wage plus amenity value of WFH) for each worker as $ln\left[w + w\left[1 - e^{\left(-\frac{A^2\beta^2 + A^5\beta^5}{\delta}\right)}\right]\right]$, where A^2 and A^5 are indicators for being able to WFH up to 2 or up to 5 days, respectively, and β^2 and β^5 are the corresponding estimated marginal utilities which we allow to differ between worker groups. To obtain standard errors, we perform a block (by respondent) bootstrap with 200 replications.

In Appendix Figure A9 we show that compensation inequality is indeed larger than wage inequality, e.g., for the inequality between high- and low-educated workers. This wage gap amounts to 40 log points in our sample. Taking into account the amenity value of WFH, inequality increases to 45.5 log points, an increase by almost 14%. As a comparison, taking into account the amenity value of *all* job characteristics simultaneously, inequality increases to 47.8 log points. We find similar results for the inequality between the 80th and the 20th wage percentile in our sample. The only difference is that the relative importance of other job amenities seems to be higher in this case. This confirms evidence from the Covid pandemic (Bonacini et al., 2021).

4 The interaction between WFH and commuting

One of the main benefits of WFH options for workers is arguably the reduction in commuting time (e.g., Barrero et al., 2021). Given that over 30% of our respondents commute more than 30 minutes to their work (one-way), the potential benefits from WFH in terms of saved commuting time and less commuting-related stress are sizable. This is why the next step of our analysis is to investigate the interaction between WFH and commuting. To this end, we depart from the additive model and include interaction effects, as described in Section 2.2.2.

Panel (a) of Figure 3 shows that workers' valuation of WFH steeply rises with the commuting distance of hypothetical jobs. As shown in the lower part of Panel (a), this pattern is particularly pronounced for the option to work from home up to 5 days a

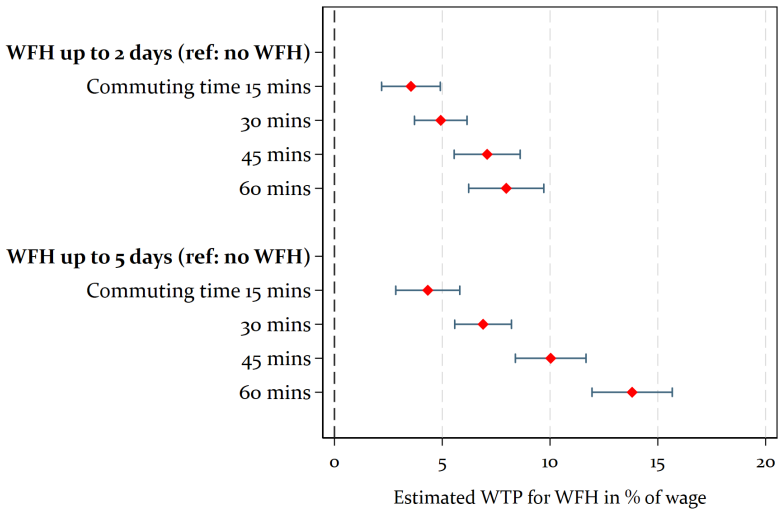
week. The willingness-to-pay to WFH up to 5 days a week increases from below 5% for a (one-way) commuting time of 15 minutes to around 14% for a commuting time of 60 minutes. The estimates are statistically different from another (except for the WTP to WFH up to 2 days for 45 minutes and 60 minutes). These estimates strongly confirm the notion that saved commuting time is an integral part of the value of WFH for workers.

Panel (b) of Figure 3 shows the willingness-to-pay to avoid specific commuting times holding the jobs' WFH arrangement constant. In each block of estimates, for example, the first row shows workers' willingness-to-pay to avoid a commute (relative to a 15 minutes commute) of 30 minutes, 45 minutes, and 60 minutes, respectively, when both jobs have no option to work from home. The panel shows that workers' willingness to pay to avoid commutes declines with better WFH options. At the most extreme, workers' willingness-to-pay to avoid a commute of 60 minutes is cut in half under the option to work from home up to 5 days, relative to no WFH option.

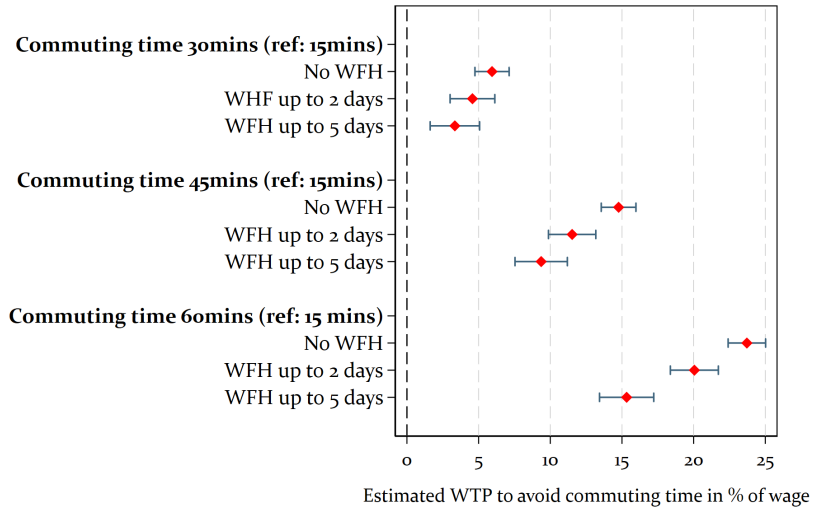
Overall, these results suggest that WFH acts as a substitute for a reduction in commuting time from the perspective of workers, similar to infrastructure investments (Heuermann and Schmieder, 2019). A potential implication is that firms may be able to attract workers from further away at the same wage rate if they offer WFH or, correspondingly, attract workers with a given commuting distance at a substantially lower wage rate under WFH. In addition, through the lens of job search models, these results suggest that an expansion of WFH opportunities might change the matching between workers and firms, with potentially important welfare and distributional implications (e.g., Dauth et al., 2022). Most importantly, however, this result suggests that WFH offers the possibility of reducing the so-called gender commute gap, an important source for unequal labor market outcomes between men and women (e.g., Le Barbanchon et al., 2021; Meekes and Hassink, 2022; Farré et al., 2023). This is what we investigate next.

Figure 3: Worker valuations of WFH and commuting, by the other job amenity

(a) Willingness-to-pay for WFH by commuting time



(b) WTP to avoid commute by WFH



Note: Panel (a) of this figure shows how the estimated willingness-to-pay (WTP) for WFH depends on commuting times. Panel (b) of this figure shows the estimated WTP to avoid commuting, conditional on different WFH options. The (red) diamonds indicate point estimates, the bars reflect 95% confidence intervals where standard errors allow for clustering at the respondent level. See section 2.2.2 for the estimation approach. Number of observations: 33,070.

5 Does WFH close the gender gap in commuting?

In this section, we leverage our experiment to inform the debate around the gender gap in commuting. The motivation for this analysis stems from research showing a sizable gender gap in the willingness to commute that translates into marked gender gaps in important labor market outcomes (Black et al., 2014; Gutierrez, 2018; Le Barbanchon et al., 2021; Caldwell and Danieli, forthcoming; Hirsch et al., 2022; Meekes and Hassink, 2022; Farré et al., 2023). Regarding the focus of our paper, an interesting question is whether the option to work from home closes this gender gap in the willingness-to-pay to avoid commuting. This could for instance work through reducing family-work conflicts for mothers or through more equal child rearing across partners under WFH (Sherman, 2020; Farré et al., 2023; Borghorst et al., 2021; von Gaudecker et al., 2023).

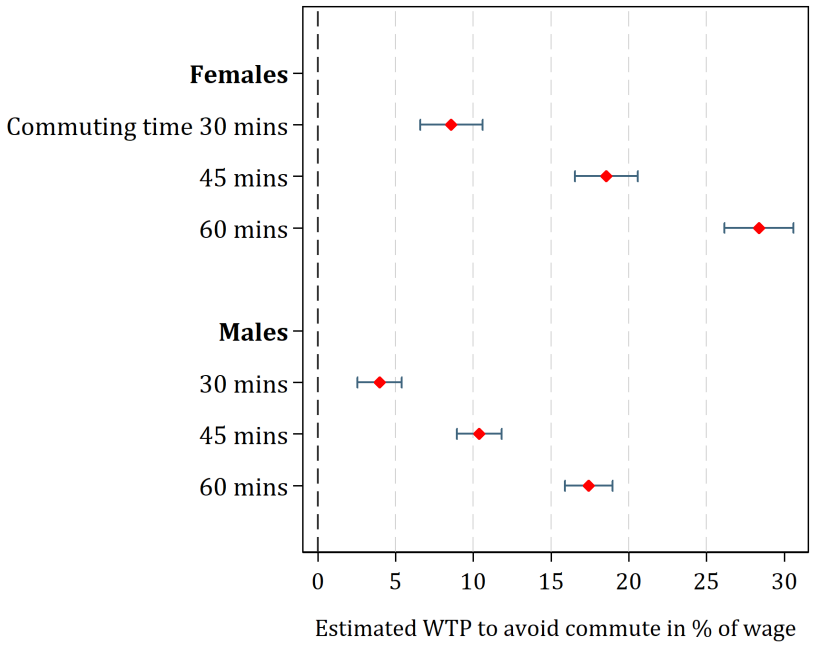
First, Panel (a) of Figure 4 experimentally replicates the gender gap in WTP to avoid commuting. As expected, the figure shows that females have a substantially higher disutility from longer commuting times than males. For each level of commuting time, the willingness-to-pay to avoid commuting is larger among females than among males. The WTP to avoid a one-way commuting time of 45 minutes for females is roughly the same as the WTP to avoid a commuting time of 60 minutes for males. The gender differences are statistically significant.

To understand whether these persistent gaps are driven by childcare duties, we use background characteristics on our subjects provided by Norstat regarding participants' underage children living with them. In this exploratory analysis, we find that the gender gaps are qualitatively identical when restricting the female sample to women without children and even when restricting the sample to childless participants above age 40.[19] These results suggest that the pronounced gender gap in the disutility from commuting is not driven by differences in childcare duties.

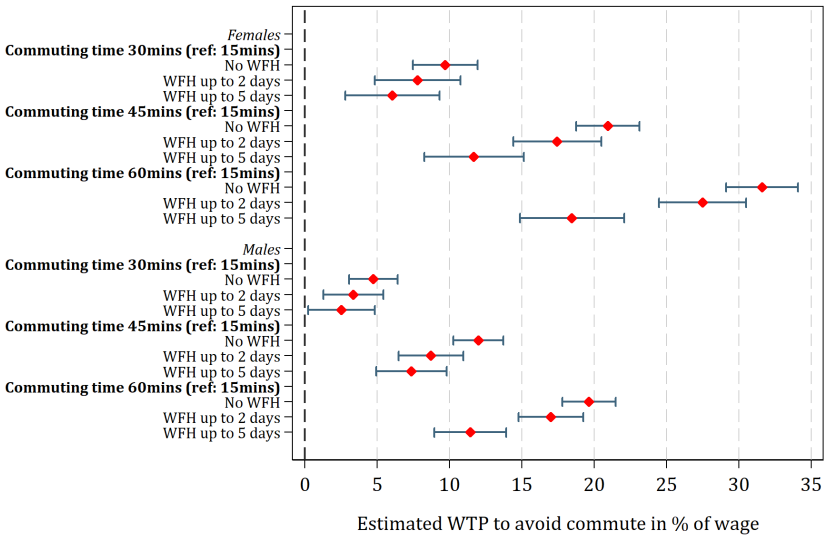
[19]However, we do see slightly higher commuting aversion among women who are married and have children, relative to childless women, in line with Le Barbanchon et al. (2021) and Farré et al. (2023). Results are available on request.

Figure 4: WTP to avoid commute by WFH options and gender

(a) WTP to avoid commute by gender



(b) WTP to avoid commute by gender and option to work from home



Note: This figure shows the relationship between WFH and commuting. Panel (a) depicts the WTP to avoid a certain commuting time, separately by gender. The reference category is a commute of 15 minutes. Panel (b) shows the WTP to avoid commuting, separately by gender, holding the hypothetical jobs' WFH option constant. The (red) diamonds indicate point estimates, the bars reflect 95% confidence intervals where standard errors allow for clustering at the respondent level. Number of observations: 15,320 females and 17,750 males.

In Panel (b) of Figure 4, we ask whether this gap closes with WFH. It shows the willingness-to-pay to avoid different commutes conditional on WFH options by gender. The figure reveals that both for men and women, the WTP to avoid commutes decreases substantially with WFH, especially for long commutes. Importantly, however, while the differences between men and women in their willingness-to-pay to avoid commutes decrease under WFH, the gap does not disappear. For women, the WTP to reduce a commute of 60 minutes to 15 minutes *under maximum flexibility regarding WFH* (up to 5 days per week) is about the same as men's willingness-to-pay for the same reduction *in the absence of any WFH option*.

As before, we use background data regarding participants' underage children living with them to study whether the gaps in the WTP to avoid commuting are related to childcare duties. In exploratory analyses shown in Figure 5, we find that even when comparing the valuations of men to those of childless women, the gender commute gap persists under full WFH options (Panel (a)). This is even true when restricting to men and women above age 40, when only few individuals become first-time parents (Panel (b)). That being said, women with children seem to have slightly higher valuations to avoid commuting than women without, conditional on WFH options. We also find larger WTP to avoid commuting under WFH for women with younger children (below age 10) than for women with older children. Moreover, WFH may decrease the WTP to avoid long commutes substantially more for women with older children (see Appendix Figure A10).

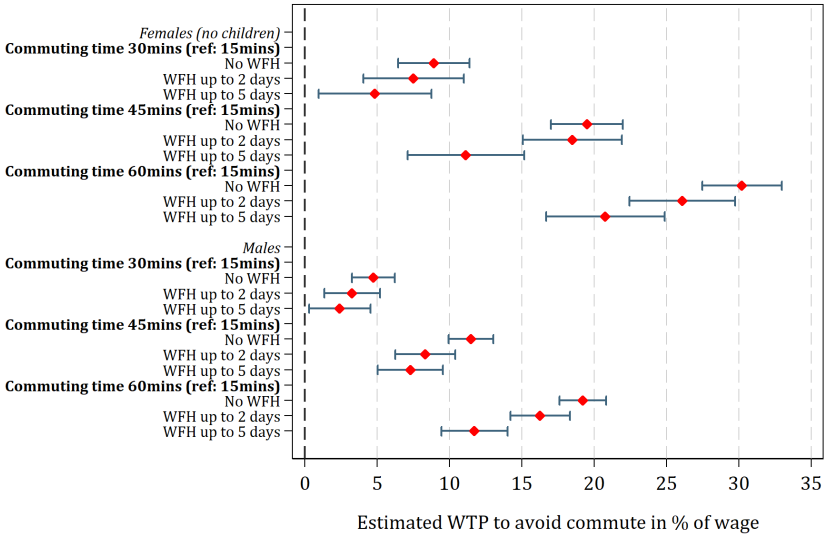
An important insight from our study is therefore that even a strong increase in the availability of WFH options to workers is unlikely to close the gender commute gap entirely. One reason for this result may be that even though workers value WFH, they still benefit from going to the office sometimes (Barrero et al., 2021). In particular, workers might expect worse chances of being promoted (Kouki, 2023) and fewer opportunities to learn from their co-workers (Emanuel et al., 2023) when being completely absent from the office.

What explains these persistent gender differences, then? While we can only speculate on the remaining channels, recent research by Emanuel et al. (2023) also shows that proximity to coworkers increases women's learning much more than men's in the long run in a setting of software engineers in a Fortune 500 firm. In addition, Gibbs et al. (2023) find that in an Indian technology company, WFH harmed women's productivity more than men's, even in the absence of children. Finally, Kouki (2023) finds that women are assigned less promotable job tasks when working from home.

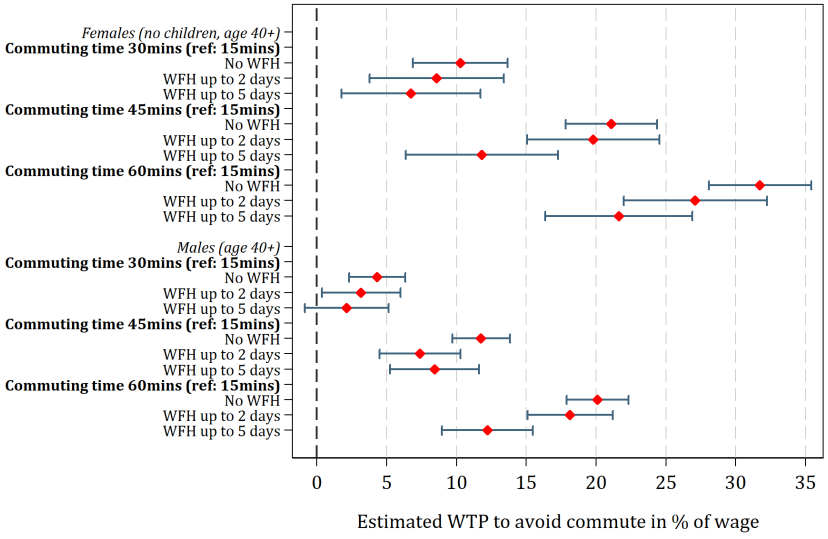
Thus, on-site work may be more important for women's careers regarding (long-run) productivity or promotions even when workers have the option to work from home.

Figure 5: WTP to avoid commute by WFH options, gender, and underage children in household

(a) WTP to avoid commute by gender and option to work from home: Men vs. childless women



(b) WTP to avoid commute by gender and option to work from home: Men vs. childless women, age 40+



Note: This figure shows the relationship between working from home and commuting. Panel (a) shows the WTP to avoid commuting, separately by gender, using only childless women in the sample, and holding the hypothetical jobs' WFH option constant. The reference category is a commute of 15 minutes. Panel (b) shows the same estimates, but among men and childless women aged above 40. The (red) diamonds indicate point estimates, the bars reflect 95% confidence intervals where standard errors allow for clustering at the respondent level. Number of observations: 9,770 childless women, 6,110 childless women over 40, 10,270 males over 40.

6 Conclusion

How much do workers actually value working from home? How do these valuations differ by commuting distance? And is WFH likely to close the gender commute gap? Addressing these questions, this paper reports evidence from a stated-choice experiment conducted after the COVID pandemic among a sample of German employees representative of the German workforce in key dimensions.

Our data suggest that workers are willing to give up 5.4% of their earnings for WFH up to 2 days and 7.7% of earnings for WFH up to 5 days a week, on average. The valuation of WFH is larger for female, young, high-educated, and high-earning workers. While these estimates are sizable, our estimates for example reveal that our participants have an average willingness-to-pay to avoid long commutes that significantly exceeds the willingness-to-pay for any WFH option. We also observe sorting on workers' willingness-to-pay into WFH and find that WFH contributes to inequality across education levels and across wage percentiles.

Importantly, we demonstrate that worker valuations of WFH options meaningfully interact with a job's required commuting distance, in line with arguments that avoiding commutes is a key advantage of WFH. Our key result is that WFH reduces the gender gap in willingness-to-pay to avoid commuting, but that WFH does not close the gap completely.

More broadly, our results on the interaction between WFH and commuting suggest that WFH may improve labor market matching since firms offering WFH might be able to attract talented workers who might otherwise live too far away to be willing to accept a job offer at the given wage. This is of particular interest in light of expected decreases in labor supply, for example due to demographic change.

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