Perceived Productivity when Working From Home and Gender Evidence From a Survey Experiment

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Abstract

This paper studies whether managers perceive working-from-home (WFH) productivity differently for female versus male employees. We embed a randomised wording experiment in the ZEW Business Survey of German firms (June–July 2025), covering firms from the ICT services and manufacturing sectors. More than 1,000 executives and decision-makers are randomly asked to assess either female or male employees' productivity when working from home relative to working on business premises, first on a five-point Likert scale and subsequently as a percentage difference. Managers perceive female employees as, on average, equally productive when working from home, whereas they hold substantially more pessimistic beliefs about male employees' WFH productivity. In the percentage measure, the implied belief gap amounts to roughly 7–8 percentage points and remains stable when controlling for firm size and industry as well as respondent characteristics. Heterogeneity analyses suggest that the perceived gender gap is more pronounced in smaller firms and among firms without WFH practices in place, and that male respondents are more pessimistic about WFH productivity overall. The results provide evidence of gendered managerial beliefs about remote-work performance, which may matter for WFH adoption and career-relevant decisions such as task allocation and promotions.

Keywords: working from home, manager perceptions, productivity, remote work, gender, survey experiment

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1 Introduction

Greater work flexibility has been described as the "last chapter" towards gender equality in the labour market (Goldin, 2014). Due to the COVID-19 pandemic, many firms were forced to experiment with more flexible working arrangements such as working from home (WFH). Studies have shown that men and women have different preferences and valuations regarding WFH. It has also been shown that WFH has different effects on men and women and that both genders might have different circumstances regarding the working environment at home. This raises the question whether the productivity when WFH also differs by gender. This paper uses a unique dataset of responses to a firm survey including more than 1,000 managers and decision-makers. We ask them about their perception of employees' productivity when they work from home, compared to their productivity at their office workplace on business premises. By randomising the respondents into one of two groups we can elicit the assessed productivity of female and male employees separately without risking dishonesty due to social desirability and discrimination concerns. Our findings show that employees' WFH productivity is assessed differently by gender. More precisely, male employees are estimated to be less productive when they work from home, compared to their female colleagues. Moreover, we detect different sizes of this finding depending on respondent gender, firm size and previous experience with WFH. This paper is structured as follows: Section 2 shortly summarises the literature background and shows where this paper contributes to. Section 3 explains the experimental setting, while Section 4 summarises the collected data and descriptive statistics. Section 5 shows our empirical findings, including an analysis of effect heterogeneity which are discussed in Section 6. In Section 7 we provide robustness checks, Section 8 concludes.

2 Background & Related Literature

This paper contributes to several strands of literature. First, this paper adds to the literature of survey experiments with firms. While there is an increasing body of literature using survey experiments to answer different economic questions (see overviews by Coibion and Gorodnichenko (2025), Fuster and Zafar (2022), Haaland et al. (2023), and Stantcheva (2023)), survey experiments with firms or managers are much less prevalent (e.g. Coibion et al. (2018, 2020), Lee et al. (2019), Savignac et al. (2024), and Weber et al. (2025)), as many large-scale firm surveys do not allow experimental settings (Coibion and

Gorodnichenko, 2025). By using a large-scale, representative survey of German firms of two sectors and embedding randomised variation in question wording, we exploit a rare opportunity to implement a survey experiment with firms.

Second, we augment the literature on the connection between WFH and gender. Previous studies found that women have a higher valuation of WFH than men (Bartik et al., 2025; Lewandowski et al., 2025; Mas and Pallais, 2017; Nagler et al., 2024), and benefit more from less commuting (Kroesen, 2022; Künn-Nelen, 2016; Tao et al., 2023). WFH increases un-paid domestic work as well as leisure, exercise and sleep among women (Alipour, 2025). Esposito et al. (2024) find the effect of WFH increasing job satisfaction exclusively among women. Moreover, female employees seem to face different WFH circumstances with more interruptions (Adams et al., 2025; Andrew et al., 2022) and increased work-family-conflicts (Oakman et al., 2020; Yucel and Chung, 2023) compared to male employees WFH. Further, the gap between employees' preferred share of WFH and the share allowed by the employer is bigger for women than it is for men (Buckman et al., 2025; Touzet, 2023).

Third, we add to the literature investigating the effects of WFH on workers' productivity. Previous studies measured productivity effects of WFH with heterogeneous results. Some studies found positive effects on employees' performance when they worked from home, especially in settings where productivity could be measured objectively. For instance, Bloom et al. (2015) measured a 13% productivity increase among WFH workers of a travel agency, whereas a later study of Nicolas Bloom and his team only concludes that "hybrid WFH improves retention without damaging performance" (Bloom et al., 2024). Aksoy et al. (2025) measured the productivity of call centre employees and found a 10% increase in productivity for those employees who work from home. Similarly, Choudhury et al. (2021) found that remote work increased output by 4.4%. Angelici and Profeta (2024) found positive productivity effects for "smart-workers" which includes location independency using objective measuring as well as subjective perception. These positive findings are counter-balanced by two studies that found a productivity decrease by $\sim 8\%$ when WFH (Emanuel and Harrington, 2024; Gibbs et al., 2023). However, results of previous research are more ambiguous when WFH productivity is subjectively assessed rather than objectively measured. While some found higher assessments of productivity when WFH (Angelici and Profeta, 2024; Deole et al., 2023), others detected declines in self-assessed WFH productivity (Kitagawa et al., 2021; Morikawa, 2020). According to a large survey, firms in Germany see no reduction in productivity due

to WFH (Erdsiek, 2021). Kazekami (2020) concludes that WFH can increase labour productivity to a certain degree, but can harm productivity when teleworking hours are too long. It becomes apparent that there is no universal truth regarding the productivity effects of WFH but results are dependent on the chosen setting, the teleworkability of the respective tasks and how WFH is executed. Another potential source of heterogeneity is employee gender, which constitutes the last strand of literature we are adding to.

Some investigations of productivity effects of WFH arrangements also focussed on gender differences, yielding mixed results once again. Gibbs et al. (2023) found stronger productivity declines of WFH among women. According to the findings by Feng and Savani (2020) there was no productivity gap between male and female workers before the outbreak of the COVID-19 pandemic, but lower productivity among female employees during the pandemic. Moreover, Etheridge et al. (2020) found lower self-reported WFH productivity for women compared to men using a survey during the end of the first lockdown in the UK. A second block of studies focussing on gender heterogeneities of productivity effects of WFH settings found no significant differences (Bartik et al., 2023; Chen et al., 2023; Huls et al., 2022). Finally, there are studies finding higher WFH productivity for women. The aforementioned study by Angelici and Profeta (2024) proposes "that the improvement of objective productivity and a reduction of the number of days of leave is driven by women" and Hill and Hincapie (2025) found women to be more effective regarding virtual collaboration. Wattenberg et al. (2023) found effects of gender on productivity with women being more productive, however they use a relatively small sample of only 174 women and 63 men. Hence, the study by Toivonen et al. (2025) seems substantially more reliable by using data from more than 137,000 respondents from 88 different countries, concluding that women are significantly more satisfied with their WFH productivity compared to men. Further, Kitagawa et al. (2021) – despite finding negative productivity effects of WFH overall – found significantly higher productivity rates for female employees WFH compared to their male colleagues.

Additionally, there is previous research focussing on gender differences of WFH productivity that did not focus on the employee-firm-setting but can still provide fruitful insights. For instance, a study by Hipp and Konrad (2022) that found that the lockdown increased the number of contributions on GitHub, but this effect was less pronounced for female users. Finally, Oladipo et al. (2023) studied the returns-on-assets for self-employed, finding that being home-based reduces returns overall, however, the

performance gap between male and female business-owners is smaller among home-based businesses with female self-employed catching up and thus narrowing the performance gap when WFH.

Although the topics of WFH, productivity and gender have been of deep interest for researchers, especially since the outbreak of the COVID-19 pandemic that forced many firms and employees to experiment with WFH settings, there is no universal consensus on a) how WFH affects employees' productivity or b) how gender affects WFH productivity. In this paper, we will further address these research questions by using an experimental setting within a survey among German managers eliciting their assessment of female and male employees' WFH productivity.

3 Experimental Design

We use a large firm survey and create exogenous variation by implementing a survey experiment. Rather than asking employees about their self-assessed WFH productivity, we let managers and decision-makers of German firms assess the WFH productivity of female and male employees. Asking the same respondent for their assessment of both female and male employees in the same questionnaire might lead to dishonest responses. Due to social desirability respondents might rate female and male employees identically in order to avoid gender discrimination. To tackle this issue we randomise our sample into two groups, so that each respondent only assesses one of the two genders. The relevant research question of this paper is

RQ: "Do managers assess employees' productivity when working from home differently depending on whether they are asked about female or about male employees?"

The empirical analysis is based on a survey experiment that was implemented in the ZEW Business Survey in the Information Economy. This quarterly business survey is conducted by the ZEW – Leibniz-Centre for European Economic Research and covers the German ICT sector, media services, and further knowledge-intensive service providers. Except for ICT hardware manufacturers that are also surveyed as part of the ICT sector, our sample only consists of service firms. Hence, the survey focusses on sectors where the majority of jobs and tasks are suitable for WFH (Alipour et al., 2023; Dingel and Neiman, 2020). In addition to the ICT services sector, firms of the manufacturing industry were also included in the sample for this survey wave. In each quarter, firms are asked about their current and expected business situation in the first part of the questionnaire. The topics addressed in the rest of

the questionnaire change in each wave but are generally focused on the diffusion of digital technologies, innovation activities, and work organisation. In any given wave, firms receive the questionnaire by mail with an accompanying invitation letter addressed directly at the CEO or another member of the executive board. After answering the paper questionnaire, firms have the option to send it back by mail, fax machine, or email. Moreover, respondents can answer the online version of the questionnaire using their personalised password provided within the invitation letter. The ordering and wording of questions is identical in the paper version and online version of the questionnaire. In June and July 2025, the survey's emphasis was on WFH practices. After some questions regarding the share of employees who are regularly WFH and general trends regarding the companies' WFH policies, the respondents were asked about their assessment regarding employees' productivity when they work from home compared to their productivity when they work on business premises. In order to create experimental variation and reduce bias due to fear of discrimination, the question of interest was different for different groups of respondents. Each respondent was randomly assigned to one of two groups. Group A received the following question:

A: Please give your personal assessment: Compared to their normal office workplace, female employees working from home are...

- ...significantly less productive
- ...somewhat less productive
- ...equally productive
- ...somewhat more productive
- ...significantly more productive,

whereas Group B received the corresponding question referring to male employees:

B: Please give your personal assessment: Compared to their normal office workplace, male employees working from home are...

with the same range of answer options.

Subsequently the respondents were asked to numerically estimate a percentage that corresponds to their assessment. Furthermore, we asked for the gender and age of the person who filled in the questionnaire, allowing us to not only differentiate the results according to firm characteristics, but also along personal characteristics.

4 Data & Descriptive Statistics

4.1 Sample Balance

After cleaning the data and removing responding firms with less than 5 employees, the final sample consists of 1,174 respondents. As we address our questionnaire directly at CEO's or top-level managers of the respective firms, we are confident to reach executives and decision-makers.[1] As mentioned before, our sample includes German firms with at least 5 employees from two industries. 649 firms in the final sample belong to the ICT services sector, whereas 525 firms of our sample are active in the manufacturing industry.

To make sure the randomisation between Group A and Group B worked well, that there is no self-selection into groups, nor any other bias or distortion among the groups, Table 4.1 provides a balance table of firm characteristics, personal information about the respondents as well as other variables.

Variable	Mean A	Mean B	Diff	t-stat	p-value
ICT services sector	0.52	0.59	0.07	-2.30	0.0213
Number of employees	130.93	137.89	6.96	-0.31	0.7547
5-19 employees	0.33	0.31	-0.01	0.48	0.6300
20-99 employees	0.39	0.37	-0.02	0.75	0.4547
>100 employees	0.28	0.31	0.03	-1.29	0.1971
Firms offering WFH	0.73	0.77	0.03	-1.37	0.1710
Female respondents	0.27	0.24	-0.03	1.00	0.3183
Respondents over 50	0.74	0.74	0.00	0.07	0.9411

Table 4.1: Balance between Group A (female employees) and B (male employees).

[1] In an earlier survey wave (2023) we explicitly asked our respondents for their hierarchical position within their firm: 73% were CEOs or members of the executive board, 17% department heads, 3% team or project leaders; only 7 % did not hold any management position. Due to the panel structure of the survey and the similar setting, we are confident that the used survey wave has a similar composition, i.e. the vast majority of our respondents are decision-makers in German firms.

As can be seen from Table 4.1, most respondent and firm characteristics are well balanced. The only firm characteristic that is statistically significantly different between Group A and B is the share of ICT services firms, which is 7 percentage points higher in Group B. Hence, it will be of high importance to include the industry dummy as a control variable for all model specifications.

4.2 Descriptive Results

This section provides descriptive analyses of the two main variables of interest. First, we analyse the response data to the question: *Please give your personal assessment: Compared to their normal office workplace, female / male employees working from home are...*, to which the respondents could reply on a five-point Likert scale ranging from *significantly less productive* to *significantly more productive*. Figure 4.1 shows the retrieved responses.



Figure 4.1: Managers' perceptions of employees' productivity when working from home, by employee and respondent gender.

The upper section of Figure 4.1 displays the responses from all respondents, irrespective of their own gender. It becomes apparent that the productivity when WFH is assessed more negatively for male employees compared to their female colleagues. Whereas around 18 percent of (Group A) respondents stated that female employees are significantly or slightly less productive when they work from home compared to their productivity on business premises, this number is close to 35 percent when asked for the WFH productivity of male employees (Group B). Moreover, almost one in five respondents (19.2%) perceived female employees as being more productive when they work from home compared to working in the office. For male employees, this assessment was only shared by one in eleven respondents (8.6%).

It should also be noted that the clear majority of respondents do not perceive a productivity difference between working in the office and working from home, irrespective of the employees' gender.

The lower section of Figure 4.1 differentiates the respondents according to their own gender.[2] The general trend that the productivity of male employees WFH is assessed lower compared to their female counterparts can also be seen for both, only female respondents and only male respondents. However, male respondents seem to be more pessimistic in general. Whereas 13.9 % (25.4%) of female respondents assess female (male) employees to be significantly or slightly less productive when WFH, these shares rise to 19.8% (37.7%) when only male respondents are considered. Accordingly, a positive perception of WFH productivity is more prevalent among female respondents. 26.2% of them see female employees as more productive when they work from home, 9.1% perceive male employees as more productive when WFH. Among male respondents these values are considerably different: While a similar share of 8.7% perceive male employees more productive when WFH compared to working on business premises, the share of male respondents that assess female employees as more productive in the home office is around 9 percentage points lower and lies at 17.3%.

The second variable of interest is the estimated percentage of this perceived difference in productivity between the two different working environments. On average, the managers of our sample estimated the difference for female employees to be $\bar{x}_A = -0.72\%$, i.e. they expect female employees to be 0.72 percent less productive when they work from home. For male employees this estimation amounts to $\bar{x}_B = -7.66\%$, i.e. the WFH performance of male employees is assessed to be 7.66% lower compared to their performance in the office. Figure 4.2 shows the difference including confidence intervals.

When we differentiate between female and male respondents, there is an interesting finding: Whereas both respondent groups are similar in their assessment of male employees ($\bar{x}_B^{\text{female resp.}} = -7.45\%$ vs. $\bar{x}_B^{\text{male resp.}} = -7.87\%$), they differ when it comes to the assessment of female employees. The near-zero overall average ($\bar{x}_A = -0.72\%$) masks substantial heterogeneity: female respondents assume a positive effect of WFH on productivity, while male respondents assume a negative productivity effect: $\bar{x}_A^{\text{female resp.}} = +2.85\%$ vs. $\bar{x}_A^{\text{male resp.}} = -2.00\%$.

[2] Our sample of CEOs and managers of German firms is not well-balanced in terms of gender. This data consists of 281 female and 825 male respondents.



Figure 4.2: Managers' perceptions of employees' productivity when working from home, by employee gender; mean ±95% confidence intervals

5 Empirical Results

5.1 Baseline Results

In order to answer the research question of this paper (**Do managers assess employees' productivity when working from home differently depending on whether they are asked about female or about male employees?**), we will use the estimated percentage of productivity difference between working on business premises and working from home as our main variable of interest. As we use experimental data and randomisation worked well, we will use the following OLS specification[3]:

$$Y_i = \beta_0 + \beta_1 G_i + \beta_2 \mathbf{R}_i + \beta_3 \mathbf{X}_i + \varepsilon_i \tag{1}$$

As shown in Equation 1, we regress the estimated difference in productivity on G_i which represents whether a respondent i was part of Group A or B, i.e. whether this estimation applies on female or male employees, on a vector of respondent characteristics R_i including age and gender, as well as a vector of control variables X_i, which includes industry and firm size.

Figure 4.2 already showed graphically, that there is a statistically significant difference between the productivity assessment for female and for male employees. Table 5.1 displays the coefficients of the corresponding OLS model with and without control variables.

[3]All our models use heteroskedasticity-robust standard errors (HC3)

	(1)	(2)	(3)
Treatment (A vs B)	−6.944***	−7.733***	−7.818***
	(1.218)	(1.257)	(1.301)
Female respondent			3.177+
			(1.723)
Respondent over 50			−0.774
			(1.405)
R2	0.031	0.053	0.059
Industry FE	No	Yes	Yes
Firm size FE	No	Yes	Yes
Observations	1016	1016	973

Table 5.1: Main regression results for perceived productivity difference between female and male employees. Significance levels: + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

Column (1) of Table 5.1 shows the baseline effect without any control variables, i.e. the statistical difference of the estimated productivity effect when WFH between female and male employees. The difference is close to 7 percentage points and is statistically significant on all conventional levels. In column (2) firm characteristics are included as control variables, which increases the estimated coefficient slightly to 7.7 percentage points. When respondent characteristics (i.e. binary variables for the respondents' age and gender) are included (see column (3)), the coefficient remains at a similar level and highly significant. Age does not seem to have an effect on the productivity assessment[4], whereas the aforementioned effect of gender is only significant on the 10 percent level.

5.2 Effect Heterogeneity

In this section, we explore whether the measured gender differences in perceived WFH productivity are heterogeneous across respondent and firm characteristics. Figure 5.1 shows the estimated coefficients that refer to the Group variable of the respective model, i.e. the difference regarding the WFH productivity assessments between female and male employees. Each estimate stems from a separate OLS model including robust standard errors, control variables and fixed effects as specified in Equation 1.

The first section of Figure 5.1 shows the mean perceived productivity gap among all respondents, which corresponds to the coefficient shown before in column (3) of Table 5.1. The next panel of Figure 5.1 displays the heterogeneity across the respondent's gender. Although the assessments of male respondents

[4]this finding does not change whether the age variable is used as a categorial variable or as a binary variable with different cut-off points

were more pessimistic (see Figure 4.1), the perceived gap between female and male employees is larger among female respondents. However, the smaller share of female respondents in our manager sample yields much larger confidence intervals. The section below shows that there are only minor differences between responses from the ICT services sector and from the manufacturing industry, with a slightly larger assessed productivity gap among firms of the latter. The fourth panel of the figure yields insights on firm size effects. The estimated difference between female and male employees WFH is larger for smaller firms (5–19 employees), smaller for medium-sized firms (20–99 employees) and smallest for large companies (more than 100 employees). The last section of Figure 5.1 shows the different assessments between firms that have WFH experience and those that do not offer WFH to their employees. Firms that do not have WFH schemes in place assess the gap between men and women WFH to be higher, compared to the firms that offer WFH to (at least some of) their employees. This does not mean that they see WFH practices in general as more negative, it just shows that the perceived difference between female and male employees is more pronounced among them. All of the perceived productivity gaps between female and male employees are negative and significant, even for those subsamples of relatively small sizes and correspondingly larger confidence intervals. Even though there are small, yet interesting differences along certain characteristics, the findings are robust across all analysed subgroups.

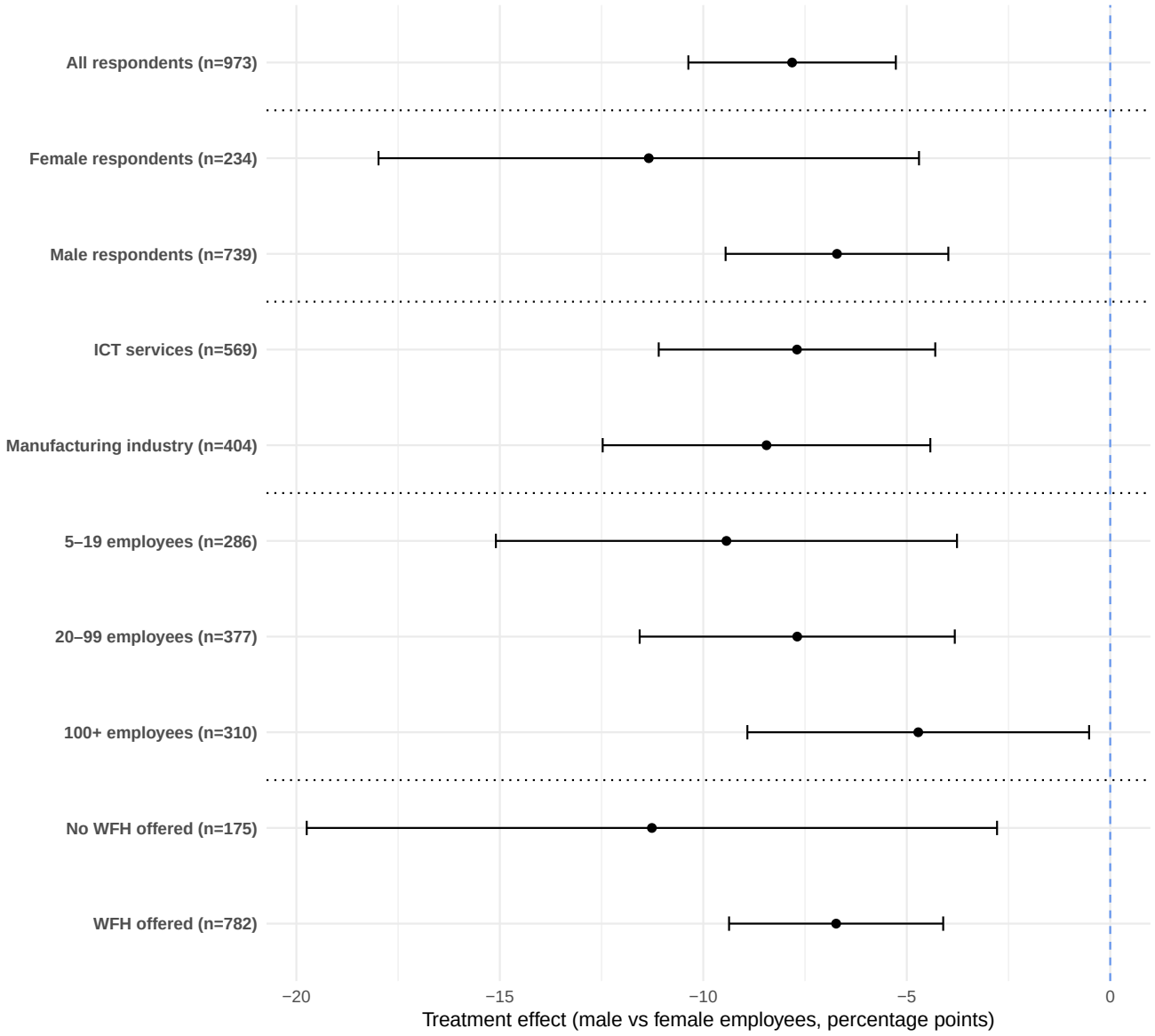


Figure 5.1: Estimated gaps in perceived WFH productivity between male and female employees across respondent and firm characteristics. Points show the estimated difference in percentage points (male vs female employees); horizontal lines indicate 95% confidence intervals based on HC3-robust standard errors. Each estimate comes from a separate OLS regression that includes industry and firm-size fixed effects and respondent characteristics, except that the characteristic used to define a given subgroup (respondent gender, industry, or firm size) is not included again as a separate control in that subgroup's specification.

6 Discussion

Our results show a clear and statistically significant difference between managers' beliefs regarding WFH productivity between female and male employees. Once again it should be underlined that our experiment did not measure productivity, but only managerial beliefs in this regard. These are of utmost importance as decision-makers within the firms are usually responsible for the firms' WFH adoption, but also they have impact on the employees' individual career paths by assigning tasks, projects and promotions and are thus steering career advancements. Having distorted or imbalanced beliefs about the productivity of certain employee groups might therefore lead to biased decisions or even discrimination. Understanding managerial beliefs about employees' (WFH) productivity is therefore insightful and relevant. Our experimental setting allowed us to implement an between-subject wording experiment. By avoiding to let managers assess female and male employees in the same questionnaire we lower the risk of potentially dishonest answers induced by social desirability and fear of discriminating one gender. The results show that managers see female employees – on average – as equally productive, whether they work from home or on business premises. The average of $\bar{x}_A = -0.72\%$ shows a minor perceived productivity decrease for female employees when WFH. However, this estimate is not significantly different from 0. Regarding male employees, however, managers hold more pessimistic beliefs. On average, male employees are estimated to be $\bar{x}_B = -7.66\%$ less productive when WFH. Hence, there is a large gap by employee gender. Moreover, we could show heterogeneity by respondent gender with men being more pessimistic than female respondents, regardless of whether they are asked about male or female employees. The finding that male employees are perceived to be on average less productive when WFH compared to their female counterparts was present and statistically significant in every analysed subsample of the data. However, the gender gap regarding perceived WFH productivity seems to be more pronounced among smaller firms and those firms that do not have WFH experience. Further, the mean gap in WFH productivity perception is larger among female respondents, even though they are less pessimistic overall regarding employees' WFH productivity.

This naturally arises the question about possible mechanisms that could explain the gap we measured. It is likely, that this is not plain discrimination against male employees. Our data does not provide clear explanations, but several mechanisms could be involved. First, it could be true that women are more productive when they work from home compared to their male colleagues. In this case, the measured

gap would not capture distorted beliefs or potential discrimination, but merely a correct estimation by managers about employees' WFH productivity. As shown in Section 2, there are previous studies that might support this, however, the literature on WFH productivity is inconclusive and did not universally find women to be the higher performing home workers. Second, the gap in perceived WFH productivity between male and female employees could arise from different tasks. In many firms, men and women are not randomly assigned to their tasks, i.e. female and male employees might differ in their job roles, tasks and daily activities. As not all tasks are equally suitable for WFH settings, the gender-associated difference in tasks could translate in a gender-associated difference in teleworkability and therefore ultimately in a gender-associated difference in perceived WFH productivity. If this mechanism was responsible for (at least a large portion of) the measured gap, it would be more prevalent among firms with a higher degree of gender-specific job role or task assignments and higher degrees of gender segregation according to the specific occupation within the firm. Unfortunately, our data does not provide any insights on this. Third, the perceived gender gap in WFH productivity could stem from distorted beliefs due to lack of experience. This mechanism seems plausible, especially because the measured gap was smaller among those firms that use WFH compared to those firms with no WFH schemes in place (see Fig. 5.1). Yet, the majority of firms in our sample ($\sim$ 82%) offers WFH to at least some of their employees, i.e. most firms have WFH experience. The extent of this experiment remains yet unclear. Some firms might have a longer history using WFH, while others might have started recently or offer WFH only to a small share of employees. Further, we do not observe how closely connected the responding manager is to their employees who work from home. Being a decision-maker within a firm that uses WFH can therefore not rule out a lack of (personal) experience that might hence narrow the perception gap between female and male WFH productivity. Fourth, the underlying mechanism could be associated with social desirability once again. Our experimental design with a between-subject setting intended lowering the risk of socially desired responses that might potentially not reflect the true beliefs of managers. Even though we are confident that our setting decreased the social desirability bias substantially, we can not rule out the possibility that – even in a single-gendered question framing – managers are overly cautious when it comes to gender-specific ratings. As managers are expected and trained to refrain from any kind of gender discrimination, they might ascribe higher ratings to female employees just to be (overly) safe to not discriminate against them. Our data provides valuable insights into managerial beliefs about WFH

productivity and differences between the perceived productivity of male and female employees. However, it does not allow us to explain the exact underlying mechanism that leads to the observed gaps. Whereas some possible mechanisms could be tested by future research, others will remain unobserved and hard to measure.

As it is highly unlikely that managers intentionally discriminate against their male employees and at the same time it remains unclear whether female employees are actually performing better when WFH than their male colleagues, it can be assumed that managerial beliefs might be distorted or at least unsupported by real data. As their assessment of employee productivity is pivotal for career advancements, it should ideally based on clear criteria and objective productivity measurement rather than subjective and potentially biased beliefs. Many job roles that are particularly suitable for WFH do not allow clear output measures. Still, it is advisable to rate employees' (WFH) productivity based on pre-specified criteria in order to ensure a fair assessment. Thus, firms should advise and train their employees who have any kind of leading role or personnel responsibility and are therefore responsible for rating subordinated employees. These trainings should not only raise awareness for potential discrimination, but also advise against important decisions that are purely based on personal beliefs and gut feeling. Subjective perception is always prone to potential bias which could lead to unfair decisions, potentially harming employees dependent on those decisions. If applicable, firms could further lower this risk by implementing structured rating procedures that involve blind ratings or assessments by more than just one manager. It is important to underline that gender-distorted beliefs could arise from various reasons, even without deliberate discrimination or otherwise malicious intentions.

7 Robustness checks

When we checked the data for plausibility there were minor inconsistencies. Some respondents stated that they perceive employees as equally productive when they work from home, however, they still inserted a (non-zero) number in the following question regarding the productivity change in percent. As all percentages were indicated in absolute terms, i.e. without algebraic signs, we could not infer whether this stated percentage was meant as an increase or decrease in productivity. In order to still make their answers plausible and consistent, we set the percentage change of those respondents (n=76) equal to 0. This adapted setting was used in all previous analyses. Table 7.1 shows that the findings are robust

to these changes. The estimated treatment effect, i.e. the gap between perceived WFH productivity between female and male employees is even slightly larger when the percentage variable is not altered or if inconsistent observations are dropped from the sample. Hence, the results are not driven by our adaptations. The differences in sample sizes result from different numbers of missing values. Out of the 973 observations used in the previously discussed model specifications, 82 did not have any number entered for the percentage estimate, hence, they are not used in the model of column (2). Further 72 observations had numerical estimates even though they checked the box for equal productivity and were removed for the model in column (3). The difference between the aforementioned 76 observations where numbers were forced to zeros and this number of 72 dropped observations is explained by four observations with inconsistent responses that were not part of the model in column (1) due to missing values for other variables.

	(1) Forced zeros (baseline)	(2) Raw percentages	(3) Drop inconsistent obs.
Treatment (A vs B)	−7.818***	−7.957***	−9.431***
	(1.301)	(1.547)	(1.520)
Female respondent	3.177+	2.177	3.507+
	(1.723)	(2.020)	(2.061)
Respondent over 50	−0.774	−1.299	−0.982
	(1.405)	(1.706)	(1.636)
Num.Obs.	973	891	819
R2	0.059	0.045	0.072
Industry FE	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes
Observations	973	891	819

Table 7.1: Model used in Table 5.1, column (3), as it was used before vs without aligning the percentage variable vs without observations that had inconsistent percentages. Significance levels: + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

Next, we winsorise the data in order to analyse whether our findings are driven by extreme values of the numerical estimation of the perceived productivity difference between WFH and working on business premises. Table 7.2 shows the main model in column (1). For column (2) we trim the top and bottom 1% of the distribution, in column (3) we trim the top and bottom 5%. The estimated gap in perceived WFH productivity remains large and statistically significant in all three specifications. The point estimate for the gap is reduced from -7.8 in the baseline to -7.3 using the 1% winsorisation and to -5.6 percentage points when we winsorise 5%. This shows that extreme responses contributed to the magnitude of the

measured effect. However, the perceived gap remains large and highly significant even with ambitious winsorisation, making our core result robust to extreme responses.

	(1) Baseline	(2) Winsor 1%	(3) Winsor 5%
Treatment (A vs B)	−7.818***	−7.278***	−5.623***
	(1.301)	(1.164)	(0.764)
Female respondent	3.177+	2.668+	2.479**
	(1.723)	(1.473)	(0.909)
Respondent over 50	−0.774	−0.603	−0.113
	(1.405)	(1.299)	(0.906)
Num.Obs.	973	973	973
R2	0.059	0.059	0.080
Industry FE	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes
Observations	973	973	973

Table 7.2: Model used in Table 5.1, column (3), compared to the outcomes if winsorised data is used. Significance levels: + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

Finally, we use the categorial variable of the assessment about the male/female employees' WFH productivity instead of the numerical estimate in percent. To make use of the five-point Likert scale response as the dependent variable we apply an ordered probit model including the same independent variables and controls as before. The results are displayed in Table 7.3. As the dependent variable is no longer the estimated productivity difference in percent, we cannot compare the magnitude of the coefficient to the results of the previously discussed models. However, the treatment effect, i.e. the gender gap, remains negative and significant on the 1% level. In the probit setting this means that male employees have a higher probability to be assessed with a lower productivity (category). Hence, the ordered probit model using the data of the five-point Likert scale question confirms our findings of a statistically significant difference between managers' perception of male vs female WFH productivity.

	(1) Ordered probit
Treatment (A vs B)	−0.549***
	(0.074)
Female respondent	0.276**
	(0.086)
Respondent over 50	−0.059
	(0.081)
Num.Obs.	990

Table 7.3: Ordered probit model using the five-point Likert scale question as dependent variable, independent variables and control variables as before. Significance levels: + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

8 Conclusion

Managerial beliefs are prone to potential biases. While the exact mechanisms cannot be reconstructed by our data, we have shown large gaps in productivity perception. Our unique experimental setting within a large-scale firm survey among German firms of the ICT sector as well as firms belonging to the manufacturing industry allowed us to elicit managers' assessments of female and of male employees separately using a between-subject variation of question framing. Whereas the majority of managers reported that employees are equally productive whether they work from home or on business premises (regardless of employee gender), there are interesting differences when it comes to those managers who see productivity differences between both working environments. Whereas female employees were assessed to be on average 0.72 percent less productive when WFH (a number that is not statistically significantly different from zero), male employees were on average estimated to be 7.66 percent less productive when WFH compared to their performance in the office environment on business premises. This gap between managers' perception of male employees WFH and female employees WFH remains stable when controlling for respondent (age and gender) and firm (industry and size) characteristics. When differentiating between respondent gender we found male managers to be overall more pessimistic about employees' productivity when they work from home. Moreover, we found different effect sizes according to firm or respondent characteristics. Even though female managers have a more positive belief regarding WFH productivity than their male counterparts, their assessed gap between the average male and the average female productivity when WFH is slightly larger than it is among male managers. We further found this gap in WFH productivity

perception to be larger in smaller firms as well as among those firms with no WFH practices in place. Even without any malevolent intentions or gender discrimination, subjective managerial beliefs might be vulnerable to bias, unobserved factors and potentially wrong gut feelings. It is therefore advisable that managers rely on ex-ante outlined criteria, objective measurements or structured procedures involving additional reviewers to assess their employees' performance. Otherwise, subordinated employees might suffer detrimental task assignments or slower career advancements for the wrong reasons.

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