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DISCUSSION PAPER SERIES

IZA DP No. 17694

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ABSTRACT

Estimating the Effect of Working from Home on Parent's Division of Childcare and Housework: A New Panel IV Approach

This study investigates whether (and how) working from home (WFH) affects the gender division of parental unpaid labor. I use the recent COVID-19 pandemic that brought an unanticipated yet lasting shift to WFH combined with a measure of occupational WFH feasibility (Alipour et al. 2023) as a quasi-experiment to employ an instrumental variable (IV) approach and estimate causal effects. I use unique longitudinal data from the "Growing up in Germany" (AID:A) panel study, which administered a prepandemic wave in 2019, and a post-pandemic wave in 2023. AID:A contains rich information on mothers' and fathers' time use for work, commuting, childcare, and housework. I find that the most robust effects emerge for paternal WFH intensity (at least weekly WFH) on parental division of housework: families in which fathers start weekly WFH in the period 2019 to 2023—due to their occupational WFH capacity in combination with the pandemic WFH-boost—experience a significant decrease in the maternal share of parental housework. Interestingly, this shift appears to be mainly driven by a reduction of maternal time use for housework (combined with an increase of her work hours) and less by an increase in paternal time use for housework suggesting crossparent effects of WFH.

JEL Classification: D13, I31, J13

Keywords: working from home, childcare, housework, time use, gender equality, COVID-19, AID:A panel survey

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1 Introduction

In the world of work, the digital transformation is taking place at an increasingly accelerated pace. New technologies have altered how, when, and where individuals can work. Moreover, since early 2020, the COVID-19 pandemic has boosted usage and further development of these technologies with working from home (WFH) becoming increasingly significant worldwide, while it was relatively uncommon prior. The ability to work flexibly in terms of time and place thanks to digital technology is particularly important for parents: the hope is that WFH might defuse conflicts between work and family life and could perhaps pave the way for more gender equality in paid labor and in unpaid family care work (Mas and Pallais 2017, 2020). While the acute period of the pandemic was often used as a testing ground for these hypotheses,[1] scant evidence has been brought to bear on the question of whether WFH effects extend beyond the immediate pandemic period. In this article, I use the pandemic as a quasi-experiment to provide new evidence on the more general impact of WFH on parent's time use and gender equality in parental couples. Results indicate cross-parent effects in that father's regular and frequent WFH affects mother's time use, resulting in a more equal division of housework (not childcare).

In the economic literature, the potential effects of WFH on parents' time use and the division of paid and unpaid labor are mainly discussed with a focus on mothers' labor supply. The essential idea is that WFH can reduce the time cost of working, for example commuting time (Aksoy *et al.* 2023; Belloc *et al.* 2024), and that especially women with children respond to such time-savings by increasing their labor force participation, which leads to more gender equality in paid labor. In fact, already pre-pandemic, Dettling (2016) provides evidence for WFH being a leading

[1] See e.g. Allmendinger 2020; Alon *et al*. 2020; Arntz *et al.* 2020; Berghammer 2022; Biroli *et al.* 2021; Champeaux and Marchetta 2021; Del Boca *et al.* 2020; Farré *et al.* 2022; Gaudecker *et al*. 2023; Hank and Steinbach 2021; Hupkau and Petrongolo 2020; Inoue *et al.* 2023; Kohlrausch and Zucco 2020; Müller *et al.* 2020; Mangiavacchi *et al*. 2021; Sevilla and Smith 2020; Zoch *et al.* 2020.

explanation for the positive labor supply response of married women (especially the college-educated with children) to Internet availability. Generally, an individual perspective dominates (rather than a family or collective household perspective), without cross-parent effects being considered.

I begin my analysis of parental WFH effects in the post-pandemic era by describing the changes in WFH in parental couples between pre-pandemic 2019 and post-pandemic 2023 based on unique longitudinal data from the "Growing up in Germany" (AID:A) family panel survey. I document a strong increase in WFH among employed mothers and fathers between 2019 and 2023, both at the extensive (ever WFH) and the intensive margin of (at least weekly WFH) and across all age groups of the youngest child. Second, I find strong associations between mothers' and fathers' WFH use and their occupational WFH feasibility (the instrument, based on Alipour *et al.* 2023). Third, I run IV regressions on within-changes of housework and childcare division in the parental couple to identify causal effects. The measure of unpaid labor division among parents is based on mothers' and fathers' individual reports on time use for housework and childcare, which is rarely available. I find that the most robust effects emerge for paternal WFH intensity (at least weekly WFH) on parental division of housework: families in which fathers start weekly WFH in the period 2019 to 2023—due to their occupational WFH capacity in combination with the pandemic WFH-boost—experience a significant decrease in the maternal share of parental housework. Interestingly, when analyzing mothers' and fathers' time use on housework separately, this shift appears to be mainly driven by a reduction of maternal time use for housework and less by an increase in paternal time use for housework. My results indicate substantial cross-parent effects of WFH opportunities and highlight the importance of taking a family rather than only an individual perspective in analyzing WFH effects.

I believe Germany makes for an interesting case study. The care division among parents is persistently traditional in Germany despite substantial policy efforts in recent years (Samtleben *et al.* 2019). The COVID-19 pandemic has boosted WFH worldwide and also in Germany. Previously, many German employers did not offer WFH options and the use of WFH was—despite an increasing trend of at least occasional teleworking since the early 2000s—well below average in a European comparison (Alipour *et al.* 2020a). On the other hand, calculations of WFH capacities in Germany show that around 56 percent of employees can work from home at least some of the time (Alipour *et al.* 2023). Women, particularly mothers, have a significantly higher potential to work from home than men (Alipour *et al.* 2020b). In times of pandemic school and daycare closures, longitudinal evidence for Germany showed that although the paternal share of care work increased measurably, this increase was very small and short-lived (Boll *et al.* 2023, Jessen *et al.* 2022). Mothers remained primarily responsible for family care work. Studies further show that the paternal share of care work increased (temporarily) mainly in constellations in which fathers, but not mothers, were able to WFH (Boll *et al.* 2024 for Germany; Gaudecker *et al.* 2023 provide similar findings for the Netherlands). However, the emergency of the acute pandemic with school- and facility closures and quarantine measures does not necessarily further our understanding of more general WFH effects among parents. Post-pandemic evidence is needed to speak to the broader policy debate on the potential benefits of WFH. Boll *et al.* (2024) find a small but significant shift towards a more egalitarian childcare division by spring 2022 in couples where fathers unilaterally gain WFH possibilities. This descriptive evidence gives moderate support for optimism. I now attempt to provide causal evidence based on novel data and expand the analysis period to post-pandemic 2023.

The main scholarly contribution of this article is to provide an empirical analysis of how WFH effects parental time use and gender equality in parental couples after the COVID-19 pandemic, taking on a family rather than an individual perspective. I draw on unique longitudinal data from before (2019) and after (2023) the pandemic, propose an instrumental variable approach to estimate causal effects, and find most robust effects of father's regular and frequent WFH, which leads to both an increase in maternal work hours and a decrease in maternal time use for housework, resulting in a more equal division of housework.

The paper is structured as follows: Section 2 introduces the empirical setup, and Section 3 presents results. The final section concludes.

2 Empirical Setup

2.1 Data and Sample

The analysis is based on unique longitudinal data from the "Growing up in Germany" (AUFWACHSEN IN DEUTSCHLAND: ALLTAGSWELTEN [AID:A]; Kuger *et al.* 2023) survey study, which is a rare probability sampling panel survey with a pre-pandemic starting wave surveying children, adolescents, young adults and parents of minors in around 6000 households in Germany. I employ two main waves administered in 2019 and 2023.

The main analysis sample employed in the IV approach is based on information from 410/413 mothers and 575 fathers in couple-households with at least one biological child below the age of 14 who report to be in employment and provide information on their current WFH use, and where information is available on both parent's time use for domestic care work. Appendix Table A1 reports summary statistics.

Concerning the main variables employed in the analysis, the survey question on WFH use frequencies reads: *"How often do you work from home?"* (daily, several times a week, once or

twice a week, once or twice a month, less often, never). The division of unpaid labor in the parental couple is based on information provided by mothers and fathers on their individual use of time (recorded in hours/minutes per day on an average weekday) for *"housework, e.g. washing, cooking, cleaning, tidying up or shopping"* (housework) and *"spending time with the children, e.g. looking after, caring for or playing"* (childcare). A measure based on individual information on time use for unpaid labor by both mothers and fathers is considered superior to relative measures where only one parent is surveyed on how unpaid labor is divided between parents, potentially introducing gender-specific reporting bias.

2.2 Identification and Empirical Strategy

Estimating causal effects of parental WFH on the division of unpaid labor in the parental couple is not straightforward. Naïve OLS estimation would likely suffer from potentially severe omitted variable bias and inconsistent estimates arising from the fact that both WFH usage and engagement in unpaid care labor are individual decisions. To address endogeneities and obtain consistent estimates, I hence utilize exogenous variation that is correlated with the endogenous independent variable, but not with the error term. Specifically, I use the recent COVID-19 pandemic that brought an unanticipated yet lasting shift to WFH combined with a measure of occupational WFH feasibility (Alipour *et al.* 2023) as a quasi-experiment to employ an instrumental variable (IV) approach.

The basic framework of the analysis is a first-difference model that compares parents' domestic labor division in 2023 with their labor division in pre-pandemic 2019. The model is of the form:

$$(1) \qquad \Delta D_c = \alpha + \beta\, \Delta maternal(paternal) WFH_c + \varepsilon_c,$$

where c indexes parental couples. ΔD_c is the change of parental division of domestic care work from pre-pandemic 2019 to post-pandemic 2023. Note that this first-difference model is equivalent

to a standard fixed-effects model with two repeated observations per parental couple. Changes in parental WFH usage, $\Delta maternal(paternal)WFH_c$, are measured via a first-differenced binary variable indicating whether mothers (fathers) work either ever or weekly from home. The effect of maternal and paternal WFH is estimated in separate regressions. ε_c is an error term.

While the first-difference model allows overcoming estimation biases that result from unobserved, time-invariant factors at the parental-couple level, there might still be unobserved time-variant factors that are correlated with both changes in parent's labor division and WFH usage. I hence instrument maternal WFH (and paternal WFH respectively) with occupational WFH feasibility ($maternal(paternal)WFHfeasibility_c$) employing an index developed in Alipour *et al.* (2023) based on pre-pandemic data. Alipour *et al.* (2023) validate this index by showing that it performs well in predicting actual WFH utilization during the pandemic, and the index is in fact widely employed in econometric studies (e.g. Gathmann *et al.* 2024, Meister *et al.* 2024, Müller 2024, Hamann *et al.* 2023, Alipour *et al*. 2021a, Alipour *et al.* 2021b, Felbermayr *et al.* 2021). I define WFH feasibility defined at the 3-digit KldB2010 level and cluster all standard errors at the 1-digit KldB2010 level. The first-stage equation is

$$\Delta maternal(paternal)WFH_c = \alpha + \gamma\, maternal(paternal)WFHfeasibility_c + \epsilon_c. \quad (2)$$

2.2 Documenting Parental WFH 2019 and 2023

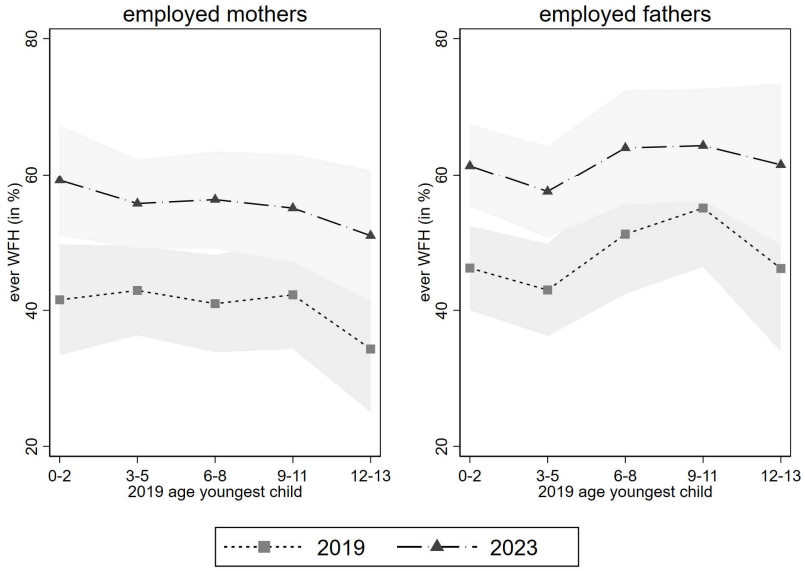
In the following, I document the changes in WFH in parental couples between pre-pandemic 2019 and post-pandemic 2023 based on the unique longitudinal AID:A survey data as well as the the association between parents' WFH utilization and their occupational WFH feasibility (the instrument). Figure 1 depicts changes in WFH among employed mothers and fathers in Germany over the AID:A waves 2019 and 2023 by age of the youngest child. Panel 1a shows the respective share of employed mothers/fathers that report to ever WFH. Panel 1b shows the respective share

of employed mothers/fathers that report to WFH at least weekly. The findings document a strong increase in WFH among employed mothers and fathers between 2019 and 2023, both at the extensive (ever WFH) and the intensive margin of (at least weekly WFH) and across all age groups of the youngest child. There are especially strong increases in weekly WFH for employed fathers. Figure 2 displays the strong associations between mothers' and fathers' WFH use in 2019 and 2023 and their occupational WFH capacity (the instrument).

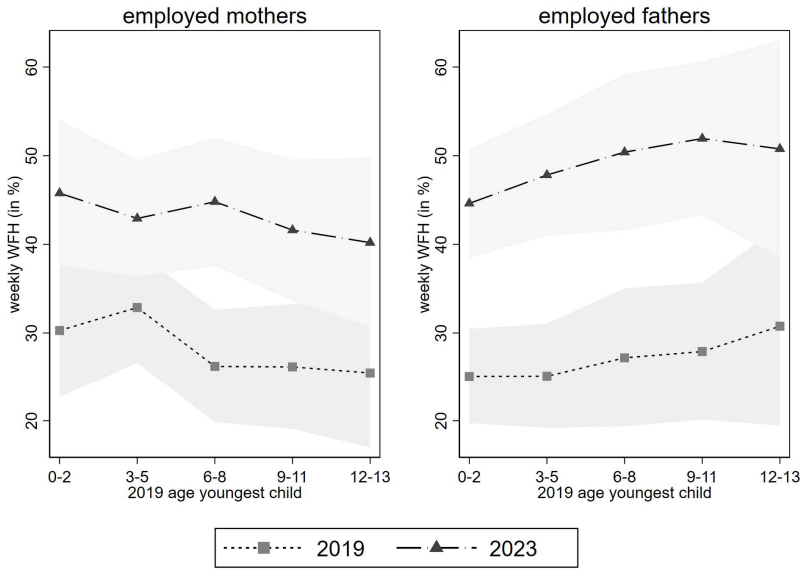
Figure 3 depicts changes in parental division of housework and respectively childcare over AID:A waves 2019 and 2023 by age of the youngest child. The maternal share of unpaid care work appears to have decreased, however, significantly so only for the youngest age group of 0-2 year olds. Yet, for no age group does the division approach an equal division, not even closely: maternal share of care work always remains well above 60 percent.

Figure 1. WFH among employed parents in Germany 2019 and 2023 by age of youngest child.

1a. Share ever WFH (in %)

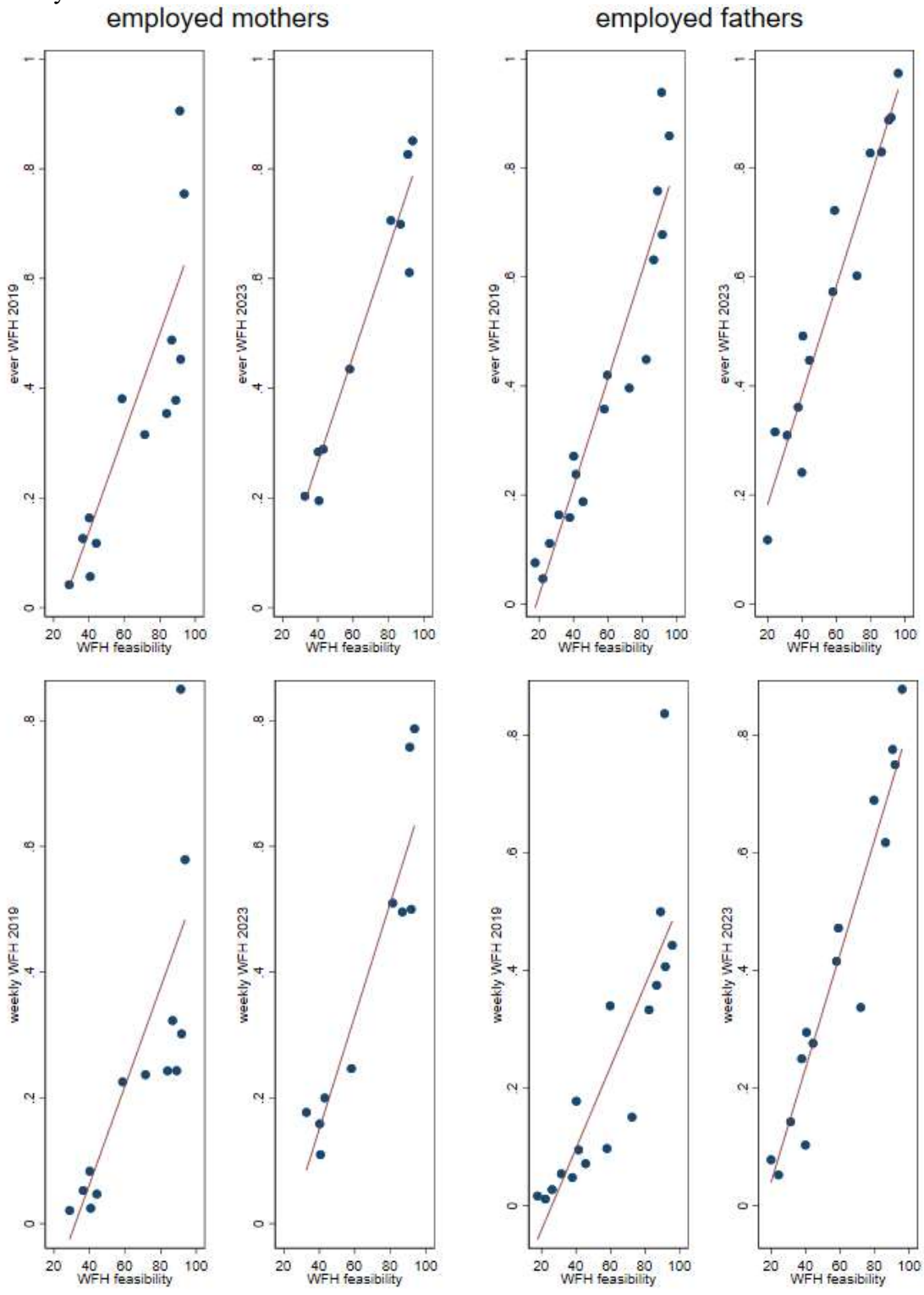


1b. Share at least weekly WFH (in %)



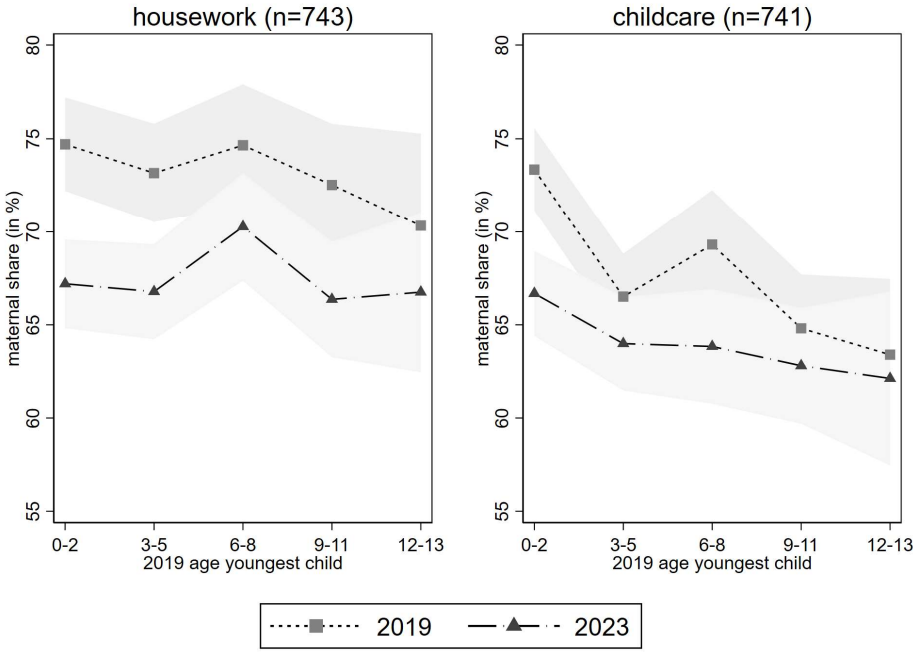
Notes: N = 795 employed mothers, N = 777 employed fathers. 95-percent confidence intervals in grey. Balanced panels, not weighted.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Figure 2. Mothers and fathers ever (weekly) WFH in 2019 and 2023 and occupational WFH feasibility.



Notes: Employed mothers/fathers = employed parents of minor children. N = 1,831 mothers, N = 1,771 fathers (2019); N = 1,450 mothers, N = 1,184 fathers (2023), not balanced, not weighted. The binned scatterplot groups occupational WFH feasibility into 20 equal-sized bins and plots them against the share of employed mothers/fathers in each bin that reported to weekly/ever WFH in 2019/2023. Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Figure 3. Changes in division of parental housework and childcare in Germany 2019 and 2023 by age of youngest child.



Notes: N = 741(childcare)-743(housework) parental couples. Balanced panels, not weighted.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

3 Results

Table 1 reports the main analysis results of the effects of parental WFH on the division of unpaid labor in the parental couple. For each outcome variable (parental division of housework and childcare), the table reports first-difference instrumental variable (IV), reduced form (RV), and OLS regression results. OLS results in Columns (3) and (6) suggest a statistically significant and negative association between employed fathers 'ever' WFH and the maternal share in time spent on housework, while associations between paternal WFH and childcare are not statistically significant, neither are associations between maternal WFH on either outcome or between paternal WFH intensity (weekly WFH) and housework division. However, the observed association is merely suggestive. It is consistent with a causal relationship between fathers WFH leading to a more equal division of unpaid labor. Yet, it is also consistent with a selection story where fathers with more modern attitudes both select into "new work" behaviors and are more prone to follow trends of "new father" norms by increasing involvement in domestic care work irrespective of WFH. Hence, a simple comparison between fathers by their WFH utilization is not sufficient to establish a causal link between WFH and care division.

The instrumental variable (IV) results instead intend to identify the causal effect of parental WFH on the division of unpaid care work in the parental couple, using occupational WFH feasibility as an instrument. Columns (1) and (4) of Table 1 present the second- and first-stage estimates with the respective F-statistics. We first note that similar to the correlative evidence of our OLS results, it is paternal WFH rather than maternal WFH that appears relevant for the care division among parents. All second stage estimates pertaining to maternal WFH, both at the extensive ('ever WFH') and the intensive ('weekly WFH') margin are insignificant. We note a

strong first-stage relationship between maternal occupational WFH feasibility and actual usage of WFH throughout; however, the instrument appears to be somewhat weak indicated by F-statistics that are just below the typical rules-of-thumb values for strong instruments. With respect to paternal WFH effects on the division of housework, the second-stage estimates concerning WFH intensity ('weekly' WFH) are statistically significant with highly significant first-stage results and an F-statistic of 23.22, that is, well above the typical rules-of-thumb values. When it comes to the effects on the division of childcare, the first-stage results are equally strong, but second-stage estimates are insignificant. Concerning the effect of fathers 'ever WFH,' first and second-stage results are insignificant throughout. That is, the previously observed negative correlation between fathers 'ever' WFH and the maternal share in time spent on housework cannot be substantiated when estimating causal effects utilizing the instrument of occupational WFH feasibility, which, however, proves to be rather weak in this specific context. Considering the reduced form effects that represent the intention-to-treat effects, that is the causal effect of maternal/paternal occupational WFH capacity on the division of unpaid care work—Columns (2) and (5) of Table 1—, significant effects are observed only for paternal WFH capacity on the division of housework. With respect to maternal WFH capacity and with respect to the division of childcare, effects are instead insignificant. In contrast to the intention-to-treat (ITT) effects, the IV estimates represent treatment-on-the-treated (TOT) effects, that is, on individuals that actually react to the pandemic WFH boost in combination with their occupational WFH feasibility by taking up WFH or by intensifying their WFH utilization. Given the results displayed in Table 1, and specifically first-stage results, it appears that in particular fathers react, and that they react by intensifying WFH or taking up regular (at least weekly) WFH. However, only with respect to housework (and not with respect to childcare), this reaction affects the division of unpaid labor among parents.

Overall, I find that the most robust effects emerge for paternal WFH intensity (at least weekly WFH) on parental division of housework. It appears that families in which fathers start weekly WFH in the period 2019 to 2023—due to their occupational WFH capacity in combination with the pandemic WFH boost—experience a significant 21 percentage-point decrease in the maternal share of parental housework, With respect to the sample mean of 75.2 percent maternal share in housework (see Appendix Table A1), this almost corresponds to approaching an equal division.

Interestingly, further investigations presented in Table 2 indicate that this effect appears to be driven by a reduction of maternal time use for housework rather than an increase in paternal time spent on housework. Specifically, Table 2 displays second- and first-stage IV results concerning paternal weekly WFH utilization on levels of mothers' and fathers' time use on housework (Columns 1 and 2), as well as on mothers' and fathers' time use on commuting (Columns 3 and 4) and mothers' and fathers' weekly work hours (Columns 5 and 6). An interesting pattern emerges, which suggests that paternal weekly WFH does affect the division of housework not mainly through an increase in fathers' own time spent on housework (the effect is statistically insignificant), but rather through the cross-parent effect of decreasing mothers time spent on housework: regular paternal WFH appears to decrease daily housework of mothers by almost two hours. However, when employing an alternative specification where standard errors are not clustered (see Appendix Table A2 Column 2), also the effect on fathers' daily housework time is statistically significant at the 5-percent level, yet with a 66-minute increase considerably smaller than the maternal reduction. Effects of paternal weekly WFH on commuting time of both mothers and fathers are not statistically significant. The effects on weekly work hours somewhat mirror the effects on housework time: weekly paternal WFH does not affect fathers own work hours, we rather observe a (marginally) significant cross-parent effect of increased maternal work hours:

fathers weekly WFH increases mothers' weekly work time by roughly 10 hours. Appendix Table A3 reports the additional evidence that fathers' weekly WFH does not affect mothers' probability of being employed. We can hence conclude that fathers' weekly WFH increases work hours of already employed mothers.

To probe the robustness of the main results, I consider a number of specifications samples and an alternative sample. Table 3 contains alternative effects of father's weekly WFH on housework division when applying the instrument of occupational WFH feasibility as a binary instead of a continuous variable (Column 1), when imposing a more narrow sample of employed fathers that report tenure with the current employer at least since 2018 (Column 2), when refraining from clustering standard errors at the 1-digit KldB2010 level (Column 3), and when employing sampling weights (Column 4). Table 3 shows the respective alternative first and second-stage IV effect estimates with baseline effects reported in Column 1 in Panel B2 of Table 1 as the point of reference. I find that alternative effects of fathers weekly WFH hardly change compared to the baseline when employing a binary instrument and when restricting the sample to fathers without employer changes. Without clustering standard errors, point estimates are not expected to change, but we observe a slight loss of precision with estimates still being statistically significant at the 5-percent level. Employing survey weights also decreases precision, however with effects still being (marginally) significant at the 10-percent level, and additionally boosts the first-stage correlation with a decrease in second-stage effect size by one-third.

Table 1. First-Difference Instrumental Variable (IV), Reduced Form (RV) and OLS Regressions. Parental WFH and Division of Housework and Childcare.

	Δ 2019-2023 division housework (maternal share)			Δ 2019-2023 division childcare (maternal share)		
	IV	RF	OLS	IV	RF	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1: Employed mothers						
Δ 2019-2023 ever WFH	-0.0187		0.0115	0.0598		-0.00838
	(0.050)		(0.0268)	(0.088)		(0.0235)
WFH feasibility		-0.00882			0.0291	
		(0.0266)			(0.0429)	
First stage: WFH feasibility	0.472***			0.486***		
	(0.154)			(0.164)		
Kleibergen-Paap F-Statistic	9.38			8.84		
Observations	413	413	413	410	410	410
Panel A2: Employed mothers						
Δ 2019-2023 weekly WFH	-0.0280		0.0186	0.0885		-0.0244
	(0.076)		(0.0400)	(0.135)		(0.0143)
WFH feasibility		-0.00882			0.0291	
		(0.0266)			(0.0429)	
First stage: WFH feasibility	0.315***			0.328***		
	(0.103)			(0.112)		
Kleibergen-Paap F-Statistic	9.29			8.68		
Observations	413	413	413	410	410	410
Panel B1: Employed fathers						
Δ 2019-2023 ever WFH	-0.558		-0.0264**	-0.152		0.0161
	(0.339)		(0.0112)	(0.181)		(0.0240)
WFH feasibility		-0.0768**			-0.0216	
		(0.0262)			(0.0151)	
First stage: WFH feasibility	0.138			0.142		
	(0.096)			(0.094)		
Kleibergen-Paap F-Statistic	2.07			2.25		
Observations	575	575	575	575	575	575
Panel B2: Employed fathers						
Δ 2019-2023 weekly WFH	-0.213***		-0.0123	-0.0588		-0.00877
	(0.061)		(0.0142)	(0.041)		(0.0141)
WFH feasibility		-0.0768**			-0.0216	
		(0.0262)			(0.0151)	
First stage: WFH feasibility	0.361***			0.367***		
	(0.075)			(0.069)		
Kleibergen-Paap F-Statistic	23.22			27.97		
Observations	575	575	575	575	575	575

Notes: Division of housework/childcare is defined as the time spent on housework/childcare reported by the mother divided by the sum of time spent on these activities among both parents. Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level. Standard errors clustered at the 1-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Table 2. First-Difference Instrumental Variable (IV) Regressions. Father's Weekly WFH and Parental Time Use.

	Δ 2019-2023 time use housework (min/d)		Δ 2019-2023 time use commute (min/d)		Δ 2019-2023 weekly work hours	
	mother	father	mother	father	mother	father
	(1)	(2)	(3)	(4)	(5)	(6)
Employed fathers:						
Δ 2019-2023 weekly WFH	-107.8***	66.44	-5.666	-37.19	10.40*	-0.120
	(38.815)	(41.621)	(27.964)	(29.331)	(5.897)	(1.723)
First stage:						
Fathers: WFH feasibility	0.357***	0.321***	0.350***	0.328***	0.348***	0.327***
	(0.073)	(0.070)	(0.081)	(0.071)	(0.084)	(0.068)
Kleibergen-Paap F-Statistic	23.71	21.19	18.51	21.08	17.28	23.02
Observations	581	705	401	696	399	702

Notes: Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level. Standard errors clustered at the 1-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Table 3. Robustness. First-Difference Instrumental Variable (IV) Regressions. Father's Weekly WFH and Division of Housework (Maternal Share)

	(1) WFH feasibility (binary)	(2) Father: Same Employer since 2018	(3) No clustering	(4) Weighted
Employed fathers:				
Δ 2019-2023 weekly WFH	-0.210***	-0.258***	-0.213**	-0.147*
	(0.069)	(0.100)	(0.091)	(0.080)
First stage:				
Fathers: WFH feasibility	0.178***	0.316***	0.361***	0.447***
	(0.040)	(0.092)	(0.077)	(0.104)
Kleibergen-Paap F-Statistic	19.84	11.79	21.74	18.47
Observations	575	432	575	575

Notes: (1) binary WFH feasibility defined at the 0.5 cut-off. (2) same employer since 2019 if father stated 2018 or earlier on the 2023-wave question on occupational tenure. (3) no clustering at the 1-digit KldB2010 level. (4) regressions are weighted utilizing the survey weight calHH.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

In a simple complier analysis following Angrist (2004) and Akerman et al. (2015), I attempt to examine in what type of families fathers start utilizing weekly WFH post-pandemic when occupationally feasible (compliers). The results displayed in Table 4 suggest that complier fathers are overrepresented among families that live in relatively less rural areas (with more than 20,000 inhabitants), among parents without a university degree, and in families with relatively older children (i.e., the youngest child is older than 4). While the age of the father and tenure with the current employer do not seem to play a very significant role, complier fathers are overrepresented in the group of fathers that report below-median individual net income, below-median weekly work hours, or below-median career ambitions in 2019. Compliers are instead underrepresented in the group of fathers born outside Germany. Interestingly, compliers are overrepresented in the group of fathers that report below-median (30 minutes) time use on housework and below median (i.e. never) WFH in 2019. These rough complier characterizations suggest that compliers are relatively low-educated, low-income fathers, with relatively low engagement in care activities, relatively weak career orientation, and an under-usage of their pre-pandemic occupational WFH potential. This is consistent with the view that this group may have been particularly limited in their WFH options before the pandemic despite occupational WFH feasibility.

Table 4. Complier Characterization

	Median	Sample share > median	Proportion of compliers:	
			≤ median	> median
	(1)	(2)	(3)	(4)
Population size of residence municipality (7 categories)	3 "5,000–20,000 inh."	0.48	0.31	0.65
At least one parent holds university degree (0/1)	0	0.38	0.62	0.26
Age of youngest child (as of 2019)	4	0.49	0.33	0.65
Age of father (as of 2019)	41	0.49	0.48	0.52
Individual net income father 2019	14 "2,900–3,200 €"	0.48	0.67	0.27
Weekly work hours father 2019	41	0.49	0.90	0.15
Importance of advancing professionally father 2019 (1 "not at all"–6 "very much")	4	0.43	0.64	0.36
Tenure with current employer father 2023	2012	0.49	0.49	0.52
Born outside Germany father (0/1)	0	0.11	0.75	0.28
Time use housework father 2019 (min/d)	30	0.44	0.62	0.38
WFH frequency father 2019 (1 "never"–6 "daily")	1	0.48	0.82	0.46

Notes: We partition the analysis sample sequentially above and below median of each characteristic. Column (1) displays the median value of each characteristic. Column (2) reports the proportion of the sample that falls above the respective median value. Columns (3) and (4) show the distribution of compliers across the two subgroups (below or equal to the median and above median) for each characteristic. The proportion of compliers of a given type is calculated as the ratio of the first-stage estimate $\hat{\delta}$ for that subgroup to the $\hat{\delta}$ in the overall sample, multiplied by the proportion of the sample in the respective subgroup (see also Angrist 2004, p.C69).
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

4 Concluding Remarks

The results of this study reveal that frequent and regular WFH among fathers may impact the division of housework among parents. This effect is not found concerning parental division of childcare and appears to be mainly driven by mothers reacting to regular and frequent (at least weekly) paternal WFH with a decreased time investment in housework (and less so by fathers reacting with an increase in time use for housework) accompanied by an increase in maternal work hours. The finding of such cross-parent WFH effects highlights the importance of family-level analysis based on family surveys rather than analyzing individual data only.

Overall, these findings contribute to the empirical literature on whether and how WFH can impact gender equality in the parental division of unpaid labor by proposing a novel quasi-experimental approach to estimate causal effects. In particular, causal effects are identified leveraging the clearly exogenous and unanticipated pandemic shock, which led to a lasting boom of WFH options (where occupationally feasible) in combination with a valid measure of occupational WFH feasibility serving as an instrument.

Identifying causal effects of WFH on parents is particularly relevant today: with persistent gender-inequalities in both labor and care responsibilities, the main legislative measures put forward to achieve gender equality among parents (e.g. by the European Commission: Directive (EU) 2019/1158[2]) are family-related leaves and flexible working arrangements. However, more research is needed to robustly evaluate and quantify to what extend such measures can address inequalities in paid and unpaid labor among parents.

[2] http://data.europa.eu/eli/dir/2019/1158/oj

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Appendix

Table A1. Summary Statistics

Sample:	Employed Mothers			Employed Fathers		
	mean	sd	count	mean	sd	count
2019 division housework (maternal share)	0.693	0.194	413	0.752	0.177	575
2023 division housework (maternal share)	0.638	0.176	413	0.683	0.174	575
Δ 2019-2023 division housework (maternal share)	-0.055	0.182	413	-0.069	0.182	575
2019 division childcare (maternal share)	0.652	0.167	413	0.700	0.162	574
2023 division childcare (maternal share)	0.618	0.181	407	0.645	0.173	572
Δ 2019-2023 division childcare (maternal share)	-0.034	0.208	407	-0.053	0.197	571
2019 mother time use housework (min/d)	130	75	413	167	110	575
2023 mother time use housework (min/d)	134	76	413	164	107	575
Δ 2019-2023 mother time use housework (min/d)	4	76	413	-3	108	575
2019 father time use housework (min/d)	56	55	413	48	47	575
2023 father time use housework (min/d)	76	53	413	69	48	575
Δ 2019-2023 father time use housework (min/d)	19	60	413	20	59	575
2019 mother time use childcare (min/d)	236	172	413	327	265	575
2023 mother time use childcare (min/d)	174	142	410	219	194	574
Δ 2019-2023 mother time use childcare (min/d)	-62	178	410	-108	248	574
2019 father time use childcare (min/d)	120	104	413	113	75	575
2023 father time use childcare (min/d)	100	79	410	104	80	573
Δ 2019-2023 father time use childcare (min/d)	-20	111	410	-9	84	573
Age youngest child (2019)						
0-2	0.199	0.399	413	0.322	0.468	575
3-5	0.300	0.459	413	0.266	0.442	575
6-8	0.191	0.394	413	0.157	0.364	575
9-11	0.194	0.396	413	0.169	0.375	575
12-13	0.116	0.321	413	0.087	0.282	575
2019 mother employed	1.000	0.000	413	0.675	0.469	575
2023 mother employed	1.000	0.000	413	0.837	0.370	575
Δ 2019-2023 mother employed	0.000	0.000	413	0.162	0.446	575
2019 mother ever WFH	0.426	0.495	413	0.405	0.492	363
2023 mother ever WFH	0.571	0.495	413	0.548	0.498	480
Δ 2019-2023 mother ever WFH	0.145	0.501	413	0.127	0.495	346
2019 mother weekly WFH	0.293	0.456	413	0.275	0.447	363
2023 mother weekly WFH	0.436	0.496	413	0.431	0.496	480
Δ 2019-2023 mother weekly WFH	0.143	0.479	413	0.136	0.459	346
2019 mother WFH feasibility	0.697	0.228	413	0.665	0.234	530
2019 father employed	0.954	0.210	413	1.000	0.000	575
2023 father employed	0.959	0.199	413	1.000	0.000	575
Δ 2019-2023 father employed	0.005	0.241	413	0.000	0.000	575
2019 father ever WFH	0.490	0.501	359	0.483	0.500	575
2023 father ever WFH	0.641	0.480	396	0.614	0.487	575
Δ 2019-2023 father ever WFH	0.154	0.440	351	0.130	0.440	575
2019 father weekly WFH	0.292	0.456	359	0.264	0.441	575
2023 father weekly WFH	0.482	0.500	396	0.478	0.500	575
Δ 2019-2023 father weekly WFH	0.199	0.490	351	0.214	0.495	575
2019 father WFH feasibility	0.665	0.263	372	0.657	0.262	575

Notes: Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Table A2. Robustness: No Clustering of Standard Errors. First-Difference Instrumental Variable (IV) Regressions. Father's Weekly WFH and Parental Time Use.

	Δ 2019-2023 time use housework (min/d)		Δ 2019-2023 time use commute (min/d)		Δ 2019-2023 weekly work hours	
	mother	father	mother	father	mother	father
	(1)	(2)	(3)	(4)	(5)	(6)
Employed fathers:						
Δ 2019-2023 weekly WFH	-107.8**	66.44**	-5.666	-37.19	10.40*	-0.120
	(52.454)	(29.271)	(39.811)	(26.088)	(5.542)	(3.425)
First stage:						
Fathers: WFH feasibility	0.357***	0.321***	0.350***	0.328***	0.348***	0.327***
	(0.077)	(0.069)	(0.093)	(0.069)	(0.094)	(0.069)
Kleibergen-Paap F-Statistic	21.47	21.85	14.02	22.77	13.87	22.36
Observations	581	705	401	696	399	702

Notes: Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.

Table A3. First-Difference Instrumental Variable (IV) Regressions. Father's Weekly WFH and Maternal Employment.

	Δ 2019-2023 maternal employment (0/1)
Employed fathers:	
Δ 2019-2023 weekly WFH	0.0429
	(0.183)
First stage:	
Fathers: WFH feasibility	0.356***
	(0.073)
Kleibergen-Paap F-Statistic	23.88
Observations	584

Notes: Occupational WFH feasibility based on Alipour *et al.* (2023) defined at 3-digit KldB2010 level. Standard errors clustered at the 1-digit KldB2010 level.
Sources: AID:A 2019 (10.17621/aida2019), AID:A 2023 (10.17621/aida2023); own calculations.