The Impacts of Health Shocks on Household Labor Supply

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This paper investigates the impact of severe health shocks, measured by prolonged sick leaves, on labor supply decisions and domestic production within German households. We draw from the German Socio-Economic Panel (SOEP), focusing on individuals aged 25 to 50 at the time of their first observed health shock. We find a persistent loss in annual gross labor income of around 3,300 Euros. This effect results mostly from adjustments at the extensive margin, with labor market participation declining by about 13%. We observe a reduction in full-time employment, but no significant effects on part-time employment. At the household level, couples are able to compensate their income loss. We find evidence of an added worker effect, with female spouses increasing their labor income at the intensive margin. Finally, individuals experiencing a health shock, in particular women, increase their time spent on domestic production.

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I. Introduction

Severe health shocks during a person's prime working years not only pose a serious threat to their own financial well-being, but also have far-reaching implications for their household. Depending on the generosity of social security, public transfers can mitigate these adverse financial consequences. However, households may also act as a form of insurance against these shocks, for instance, through increased spousal labor supply. Understanding the intra-household dynamics of labor supply reactions to a health shock, is essential for policy in designing efficient social security programs.

In this paper, we adopt an event study approach to investigate the impact of health shocks on labor supply and domestic production. Our data come from the German Socio-Economic Panel (SOEP), a representative panel study of the German resident population. We use data on $2,311$ individuals between ages 25-50 at the time of their shock, and on their households from 1984 to 2020. Our analysis sample includes individuals in the labor force who take sick leaves of 6 weeks or more, which we use as a proxy for a health shock. Our treatment definition is highly correlated with a reduction in subjective health measures and the number of overnight hospital stays. In addition, we link treated individuals to their spouses to investigate their responses as well. Spouses do not experience

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a health shock, and any change in their observed outcomes is attributable to their partner's shock.

We depart from traditional event study designs by using the estimator provided by Callaway and Sant'Anna (2021), thus avoiding common pitfalls associated with two-way fixed effects regression. This approach diverges from the conventional difference-in-differences methodology. Our comparison group is composed of individuals who will undergo the health shock in subsequent cohorts. Hence, our results are calculated in reference to the period before the shock, and in comparison to the not-yet-treated control group. Essentially, we leverage the temporal variation in the timing of these shocks, which we presume to be random conditional on control variables. Our identifying assumption is that the not-yet-treated control group would have followed identical outcome trends had they not experienced the shock.

We find that a health shock leads to a persistent decline in pre-tax labor income of around $3,300$ Euros. The changes appear immediately upon the year of the treatment and worsen over time. The results are driven by changes at the extensive margin of labor supply, with almost 20% of our treatment group leaving the labor force 5 years after the shock. We find no evidence that there is reintegration into the labor market in the time window we analyze. This reduction is predominantly observed in full-time employment, with no significant changes detected in part-time employment. Our findings indicate that an economically significant fraction of individuals leaves the labor force following the health shock.

At the household level, we observe that households appear capable of mitigating the income loss via two forms of insurance against the health shock and subsequent income loss. First, we find that public transfers are able to almost completely close the difference between pre- and post-treatment financial resources available to the household. Public transfers mitigate the household's losses, but are not sufficient to fully compensate them. Second, spousal labor supply plays an important role in closing the remaining gap through moderate increases in full-time employment. Overall, taking into account equivalent household income, we reject the hypothesis that the financial well-being of households is significantly affected over the entire period of our analysis.

Recognizing that time spent on the labor market competes with time spent in domestic production, we investigate whether the shock also affected time use at home. Our results show that affected individuals increase their time spent in domestic production, in particular for general household duties and childcare. We find an overall increase in time spent for childcare of 22.9% and 13.9% for household chores. Spouses do not change their time use dramatically, though we do observe a downward trend in time spent on household chores.

Gender roles, in particular, might influence the response in labor supply and domestic production to a health shock. To explore this, we reanalyze our data, segregating it by gender and focusing on specific dependent variables. Treated women are significantly more likely to leave the labor market after a health shock, with an 18.8% reduction in labor force participation, as opposed to 7.8% for treated men. This difference is statistically significant at the 1% level, with distinct confidence bands. Most women who remain in the labor market after their health shock are likely engaged in part-time jobs. In contrast, men tend to remain in full-time positions. Concerning domestic production, treated women significantly increase their childcare hours, averaging nearly an extra hour per weekday – a 33% rise. Conversely, treated men report no significant change in childcare hours post-shock. In contrast, we do not find statistically significant gender differences with respect to changes in time spent for household chores.

For policymakers, understanding the effects of health shocks on household labor supply is critical for better policies. Our results suggest that while the German welfare system is a critical component in ensuring the stability of household financial well-being, it may inadvertently provide incentives for lock-in effects. In addition, our findings on the differential impact on treated women suggests that their labor supply reacts more strongly to health shocks than men's.

The rest of the paper is organized as follows. Section II discusses the related literature and our contribution. Section III outlines the institutional environment in Germany and our dataset. In Section IV, we present our empirical strategy for estimating the impacts of health shocks on labor supply. We present our main results in Section V followed by robustness checks in Section VI. Section

VII concludes.

II. Related literature and Contribution

Our paper contributes to a growing empirical literature on the consequences of serious health shocks for labor supply. Despite variations in methodologies for defining health shocks, there is a unanimous finding in the literature about their detrimental effects on labor supply (García-Gómez, 2011; Cai, Mavromaras and Oguzoglu, 2014; Trevisan and Zantomio, 2016). Several studies explicitly highlight their adverse effects on individual income (García Gómez and López Nicolás, 2006; García-Gómez et al., 2013; Lenhart, 2019; Jones, Rice and Zantomio, 2020; Simonetti et al., 2022).

Limited research on this subject from Germany is largely based on disability shocks or chronic conditions. Riphahn (1999) stands as an early investigation, using health satisfaction as a proxy for the health shocks. The author finds a marked decline in labor force participation, together with an increase in unemployment risk. Lechner and Vazquez-Alvarez (2011) investigate the impact of disability on labor market outcomes, finding a significant decrease in employment chances, but no reduction in available individual income thanks to public transfers. Poor health (Haan and Myck, 2009) and chronic pain (Piper, Blanchflower and Bryson, 2021) have also been shown to have a negative correlation with labor supply. Our study closely aligns with and expands on the recent working paper by Beckmannshagen and Koenig (2023). Using SOEP data, they use variation of sick days and hospitalizations in their definition of health shocks. We corroborate their causal estimates on the effects on individual labor supply and income. In contrast to their results, we find that spousal labor supply is critical in stabilizing household total income. Moreover, we complement their evidence by exploring the type of labor market exit (i.e. whether treated individuals go into retirement, or receive unemployment benefits), as well as the changes in domestic production for the treated and their spouse.

Our paper also contributes to the literature investigating the added worker effect (AWE), an increase in the spouse's labor supply as a response to their partners income shock. Economic theory suggests that individuals in households may insure each other in case of a sudden shock through changes in spousal labor supply (Stephens, 2002; Attanasio, Low and Sánchez-Marcos, 2005; Mankart and Oikonomou, 2017; García-Pérez and Rendon, 2020). So far, empirical studies have found mixed evidence, with AWE depending strongly on the institutional and cultural setting, as well as on gender and family composition. In the context of a health shock within a household, both a general presence of AWE (Coile, 2004; Jeon and Pohl, 2017; Acuna, Acuna and Carrasco, 2019; Macchioni Giaquinto et al., 2022), and a lack thereof (Fadlon and Nielsen, 2021) have been documented. With regard to Germany, Braakmann (2014) finds that healthy spouses do not significantly change their labor supply after a disability shock, neither at the intensive nor at the extensive margin.

Several studies have found evidence that temporary unemployment, such as during the Great Recession or the COVID-19 pandemic, increases household production (Burda and Hamermesh, 2010; Gough and Killewald, 2011; Aguiar, Hurst and Karabarbounis, 2013; Van der Lippe, Treas and Norbutas, 2018; Voßemer and Heyne, 2019; Hupkau and Petrongolo, 2020; Zamberlan, Gioachin and Gritti, 2021). There seems to be an asymmetry in the responses, with women increasing their time in domestic production more than men (Gough and Killewald, 2011; Van der Lippe, Treas and Norbutas, 2018; Hupkau and Petrongolo, 2020; Zamberlan, Gioachin and Gritti, 2021). However, for Germany, Voßemer and Heyne (2019) find some evidence for a more gender-neutral perspective. Also, as Gough and Killewald (2011), they find a redistribution of total housework, with employed spouses decreasing their shares.

We are not aware of other study investigating changes in domestic production following a health shock. The closest paper in this context is Macchioni Giaquinto et al. (2022), who focus on the trade-off between working hours in the labor market and time spent on informal care provision for the affected partner. We expand on their work by directly testing multiple dimensions of domestic production.

III. Institutional Setting and Data

A. Institutional Setting

The German social security system is known for its comprehensive coverage, and focuses primarily on income replacement in times of labor income shocks (Blum and Kuhlmann, 2016; Larres, Moroff and Wittlinger, 2022). In the event of illness or injury, the system provides for sick leaves, during which employees continue to receive their full income by their employer for up to 6 weeks ("Continued Payment of Remuneration Act", or *Entgeltfortzahlungsgesetz* in German). The right to continued remuneration is independent of the workload and covers marginal and short-term employment. This entitlement is subject to the condition that the employee is not at fault for their illness or injury, has a medical certificate, and has been employed for more than four weeks at the time of their sick leave. The length of the sick leave is determined solely by a doctor and is based on the results of a medical examination.

The accumulation of sick leaves under the German Social Code (SGB V, 1988) is flexible. Individuals may make use of these 6 weeks in a single stretch or across multiple periods of the same illness or injury.[1] If the employee is absent from work due to two or more independent health conditions, the employer must consider as many 6-week periods.

After the initial 6-week period, the employer's obligation ends, and the employee

[1] The provisions of the German Social Code are more comprehensive but not relevant for our research question.

transitions to the statutory sickness benefits (*Krankengeld* in German), funded by the mandatory health insurance scheme. This benefit provides a substantial portion of the employee's salary: 70% of the person's regular gross salary, but no more than 90% of their net salary.[2] Individuals continue to pay income tax, and deductions for health and pension insurance, on this income. Individuals may receive sickness benefits until they are deemed fit to return to work, or for a maximum of 72 additional weeks within 3 years. While the German system generally protects employees from unfair dismissal, there is no specific protection for employees on sick leave. An employee can be dismissed at any time during the 78 weeks of continued remuneration or statutory sickness benefit. In fact, the illness itself may be the reason for the dismissal if the employee can be expected to experience similar health shocks in the future. Employees exhausting the full 78 weeks, are generally entitled to unemployment benefits or may apply for a reduced earning capacity pension, if a full recovery is not expected.[3]

Overall, the labor income of German workers is partially insured at the individual level against serious health shocks. The average net replacement rate over time (1984-2019) for the entire 78 weeks of German employees is about 74% for a model household with one income earner, a spouse, two children (Scruggs, Jahn and Kuitto, 2017). This is comparable to the Swedish case, which has a net re-

[2]Statutory sickness benefits were reduced from 80% to 70% of gross income in 1997.

[3]The requirements for obtaining the reduced changed earning capacity pension changed in 2001. We briefly explore the consequences of this reform in Section VI.B. If the requirements are met, an individual can receive a disability pension until the statutory retirement age, at which point it is replaced by the old-age pension.

placement rate of 85% for the same family type, and significantly higher than for British families (29%) (Scruggs, Jahn and Kuitto, 2017).[4]

B. Data

We use the German Socio-Economic Panel (SOEP), which provides annual, representative data for the German population from 1984 to 2020 (see Wagner, Frick and Schupp, 2007; Goebel et al., 2019). Its longitudinal design follows participating households and individuals over time. These features allow us to identify the timing of the health shock, changes in labor supply, financial outcomes, and time use around the shock for the affected person and their spouse. Our treatment variable is based on the following question from the survey: *Were you on sick leave from work for more than 6 weeks at one time last year?*. In our sample, we only keep individuals answering positively to this question. Note, that this question explicitly asks about uninterrupted sick leaves with a duration of 6 weeks or longer. By relying on this survey question, we identify individuals with serious health conditions that qualify them for sick pay and statutory sickness benefits. We match this information with the self-reported amount of days a person was on sick leave, and reconstruct continuous health shocks that extend into the next year.

Panel A in Figure 1 shows the distribution of sick days for individuals in our

[4]This includes family or children benefits. These estimated rates should be interpreted with some caution, as they vary somewhat between 1971 and 2011, but are generally in the range of 85% to 96%. See (Scruggs, Jahn and Kuitto, 2017) for methodology.

sample in the year they report a sick leave of 6 weeks or longer. Most sick leaves end by day 180, suggesting that, while we are observing more severe health shocks, these do not necessarily appear to be permanent impairments. While sick leave is self-reported and may be subject to recall bias, we also observe that overnight hospital stays suddenly increase from 0.86 nights in the year before the shock to an average of 9.65 nights in the year of the shock. This confirms the precision of our treatment variable in identifying severe health shocks leading to prolonged sick leaves. In appendix A.A1, we show that our treatment definition correlates with other health related outcomes.

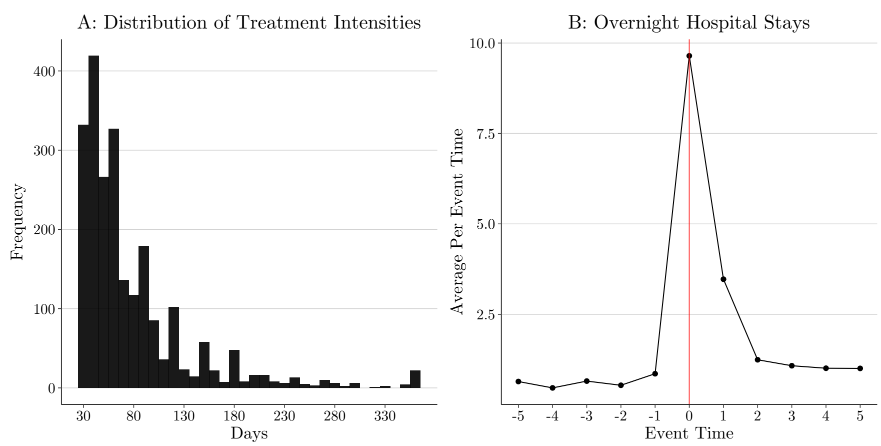

FIGURE 1. TREATMENT INTENSITIES

Note: Data are from the SOEP (1984-2020). Panel A is a frequency plot of sick days for all treated individuals in our sample. Panel B shows the mean of overnight hospital stays per event time period for the same group of people.

Our initial sample includes all individuals drawn from the SOEP who were between 25 and 50 years old at the time of their first observed health shock. The upper age limit prevents individuals in our sample from going into early retirement. Moreover, we retain only individuals who report having a stable partnership in the year prior to the shock, as we are also interested in household-wide outcomes and the adjustment dynamics that may occur within a household. We exclude individuals who are in education, military service, or do not clearly answer whether they are in regular employment or not. We also exclude the self-employed, as there are special provisions in the German Social Code for them. Further, we omit individuals with multiple shocks, unless we can identify this as the same shock crossing into the next calendar year. The exclusion of this group does not significantly affect our results. While we do not explicitly condition on employment status, the fact that individuals report a sick-leave implies that they were working around the time of the shock. Our approach leaves us with $2,311$ treated individuals or $34,995$ individual-year observations between 1984 and 2020.

Using the household structure of the SOEP, we link these individuals to their spouses, where possible. In order to be included in our spousal sample, both the affected person and their partner must live together and agree on their relationship status, in the year prior to the shock. Moreover, a spouse is kept in the sample only as long as we observe the couple remaining stable. This leaves us with a second sample of $1,738$ spouses. We keep only those spouses between 25 and 50 at the moment of their spouse's shock. Spouses for whom we also observe a health shock after their partner's shock are not included in our sample.

Column 1 of Table 1 presents summary statistics for the full sample, in the year before an individual falls sick with the health shock. Notice that individuals are asked retrospectively whether they were in the labor force or received any benefits in the previous year. However, these aspects are not necessarily mutually exclusive, as they happen in the same year, but not at the same time. Thus, in the year before the shock, 97% of treated individuals are in the labor force, defined as reporting at least 52 working hours in a year. With respect to the type of employment, 70% work in full-time positions, and 27% in part-time positions. A few treated individuals receive disability benefits (1%), or are unemployed, either with (6%) or without (2%) unemployment benefits.

Columns 2 and 3 show that the main difference between treated men and women is a substantial earnings gap, driven by a lower labor force participation of women and higher share of part-time labor. 46% of women work in part-time jobs, compared to only 9% of men. Compared to men, treated women spend more time on childcare (3 hours per weekday, vs. 1.30 for men) and on household chores (2.43 hours per weekday, vs. 0.69 for men).

Column 4 of Table 1 presents descriptive statistics for the group of spouses. We observe a higher proportion of women in the spouse sample compared to the treated sample (63% against 48% in the treated group), along with lower labor force participation, higher share of part-time labor and lower labor earnings. In the treated sample, the employment rate is high as individuals can report sick leave only if they are regularly employed. On the contrary, we do not condition

Table 1— Descriptive statistics for SOEP data

	Treated			Spouses			
	(1) Full sample	(2) Women	(3) Men	(4) Full sample	(5) Women	(6) Men	(7) SOEP
Socioeconomic characteristics							
Age	38.92	38.25	39.56	38.35	38.00	38.94	37.45
Women	0.48			0.63			0.49
Days of sick leave	8.83	8.34	9.29	3.69	2.98	4.87	8.97
East	0.24	0.25	0.22	0.21	0.18	0.25	0.18
Nr. of children	1.28	1.09	1.46	1.34	1.42	1.19	1.18
Income and labor supply							
Gross labor income	24248.72	18616.08	29569.77	18183.37	11003.82	30446.10	28225.78
In labor force	0.97	0.96	0.98	0.78	0.70	0.92	0.93
Full-time employment	0.70	0.50	0.88	0.43	0.21	0.79	0.63
Part-time employment	0.27	0.46	0.09	0.35	0.49	0.12	0.29
Weekly working hrs	36.64	30.91	42.00	25.66	17.73	38.99	34.40
Unemployment benefits	0.06	0.06	0.06	0.08	0.08	0.09	0.06
Unemployment w/o benefits	0.02	0.02	0.01	0.17	0.25	0.04	0.06
Disability pension	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Household income							
Household pre-government income	47202.92	50836.46	43820.38	48393.90	45442.39	53365.11	53304.17
Household post-government income	36673.20	38522.08	34942.74	37707.19	36159.23	40310.57	38888.16
Domestic production							
Childcare (hrs/day)	2.13	3.00	1.30	3.26	4.44	1.30	2.20
Household chores (hrs/day)	1.55	2.43	0.69	2.49	3.39	0.94	1.51
Informal care (hrs/day)	0.11	0.16	0.05	0.12	0.18	0.04	0.10
Leisure activities (hrs/day)	1.31	1.31	1.31	1.37	1.34	1.42	1.38
Unique observations	2311	1117	1194	1738	1090	648	27547

Note: Data refer to year before treatment. Monetary values in 2020 euro. For variables related to domestic production, days refer to business days, excluding weekends. Disability pensions include both disability pensions and reduced working capacity pension.

on spousal employment, and the low employment share of female spouses broadly reflects the German setting, with a gendered division of labor.

To assess how representative our sample is, we compare it with the broader population, by selecting all untreated individuals in the same age range who were in the labor force at least one year, and report at least one sick day in any available year (column 7). This population shows similar figures to our treated sample, with respect to the majority of characteristics, with some differences. Compared to the treated sample, the labor force participation of the broader population is marginally lower (93% vs. 97% for the treated population), though the gross labor income is higher (28,225.78 Euros vs. 24,248.72 Euros). This may reflect the fact that severe health shocks, e.g. work-related accidents, are experienced more often by lower-paid employees. Nonetheless, the number of sick days is remarkably similar in each group (8.83 for the treated, 8.97 for the comparison sample). Overall, we believe that our sample is broadly representative of the German working population.

IV. Empirical Strategy

The objective of our empirical strategy is to identify the causal impact of health shocks measured by prolonged sick leaves on the financial well-being and labor supply decisions of affected households. Identifying these causal parameters is not straightforward, as health shocks may not be exogenous. In an experimental scenario, one could assign health shocks randomly and compare the evolution in incomes and labor supply decisions of affected individuals against those not affected. To mimic this experiment, we target all individuals in our sample that have ever experienced an extended sick leave and compare them against individuals who receive the same shock but in a future period. In doing so, we deviate from a traditional difference-in-differences setup, as we do not use the untreated or never-treated population in our analysis. Our comparison group consists of individuals receiving the health show but belonging to a future cohort. Therefore, we do not estimate the causal effect of health shocks on the general population, but on the working-age population receiving a health shock at some point in their working life. In essence, we estimate event study specifications, exploiting the temporal variation in the timing of the shock, which is assumed to be random conditional on control variables. Our identifying assumption is that individuals used as control units would have experienced the same trends in the outcomes, had they not received the shock, conditional on a set of control variables.

Traditional difference-in-differences, implemented through two-way fixed effects (hereafter TWFE), may introduce a significant bias in our application, as our treatments are rolled out in a staggered fashion and treatment effect heterogeneity is expected (Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021; De Chaisemartin and d'Haultfoeuille, 2020).[5] We address this challenge by using a dynamic difference-in-differences estimator provided by Callaway and Sant'Anna (2021):

$$\widehat{ATT}_{(g,t)} = \mathbb{E}_n\left[\left(\frac{G_g}{\mathbb{E}_n\left[G_g\right]} - \frac{\frac{\widehat{p}_{g,t}(X)(1-D_t)(1-G_g)}{1-\widehat{p}_{g,t}(X)}}{\mathbb{E}_n\left[\frac{\widehat{p}_{g,t}(X)(1-D_t)(1-G_g)}{1-\widehat{p}_{g,t}(X)}\right]}\right)(Y_t - Y_{g-1})\right] \tag{1}$$

where $\widehat{ATT}(g,t)$ are the cohort-specific average treatment effects at calendar year t for cohort g. Cohort membership is defined based on the year in which an individual first experienced the shock. G_g is an indicator variable equal to 1 if an individual is treated in that time period. D_t is a binary variable equal to 1 if the unit is in extended sick leave in period t, 0 otherwise. X denotes a vector of control variables, $\widehat{p}_{g,t}(X)$ are estimated, generalized propensity scores

[5]In appendix A.A2 we compare the performance of the estimators by Callaway and Sant'Anna (2021) and De Chaisemartin and d'Haultfoeuille (2022) with a conventional TWFE approach.

measuring the likelihood of treatment in period g, conditional on controls in X. Specifically, we control for age, age squared and gender. Y_t and Y_{g-1} are the outcomes of interest (e.g., gross labor income) at period t and $g-1$, the last pre-treatment period for a given unit. We bootstrap simultaneous confidence bands, that cover the entire path of $\widehat{ATT}_{(g,t)}$. This has two advantages. First, we can quantify *overall* estimation uncertainty than more widespread point-wise confidence intervals. Second, the bootstrapping algorithm provided by Callaway and Sant'Anna (2021) accounts for multiple-testing.[6]

In order to interpret the potential effects of health shocks on our outcomes of interest, we aggregate the $\widehat{ATT}_{(g,t)}$'s into event study coefficients following the schemes provided in Callaway and Sant'Anna (2021):

(2) $$\widehat{\delta}_{es} = \sum_{g \in \mathcal{G}} w^{es}(g,e)\widehat{ATT}(g, g+e)$$

Where $\widehat{\delta}_{es}$ is the average treatment effect across all g cohorts, observed $e = t - g$ periods after the shock. Note, that e does not refer to the calendar year, but to the event time centered around the year in which the shock occurs. This aggregation scheme is weighting cohort-specific $\widehat{ATT}_{(g,t)}$, by the size of the respective cohorts.[7] For a more straightforward interpretation, we also provide estimates of the overall

[6]Notice that this technique provides a slightly different critical value for significance for each regression, due to slightly different sample sizes. Therefore, we report these values in our coefficient tables.

[7]$w^{es}(g,e) = \mathbf{1}\{g + e \leq \mathcal{T}\}\mathrm{P}(G = g \mid G + e \leq \mathcal{T})$

impact of the treatment, $\widehat{\delta}_{es}^{O}$, which is the average of $\widehat{\delta}_{es}$ across event times.

V. Results

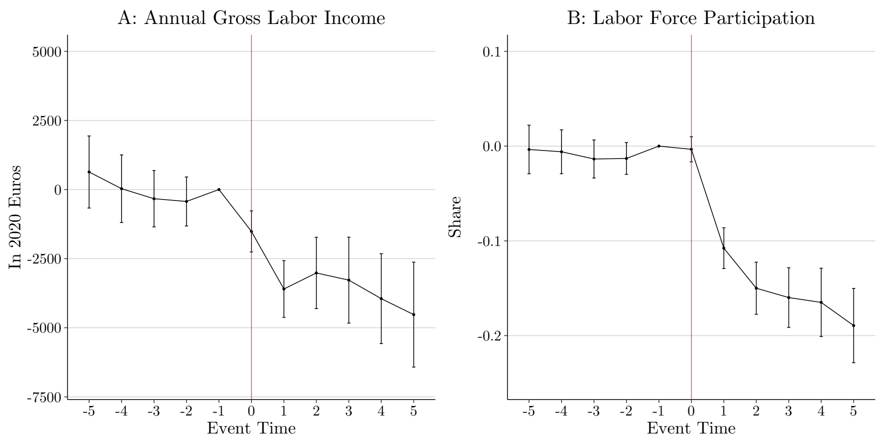

Figure 2. Evolution of Annual Gross Labor income

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for annual gross labor income (panel A) and labor force participation (panel B), based on estimating equation 1. For panel A, the dependent variable is in 2020 Euros, and we trim the top and bottom 1% of it. For panel B, the dependent variable is of binary type. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

A. Labor Supply and Income at the Individual Level

In this section, we estimate the effects of the health shock on the income and labor supply of the treated individuals. The results are shown in Table 2. The overall treatment effect for annual labor income across all post-treatment periods, is statistically significant at the 5% level. The coefficient predicts an average decrease of $-3,313.74$ Euros, compared to the not-yet-treated control group, and relative to the period before the shock. We observe an average decline in labor force participation of 13 percentage points (from 97% before the shock to 84%, a

13.4% decline). This effect is statistically significant at the 1% level.

Table 2— Event study coefficients: Treated individuals

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
Income and labor supply								
Gross labor income	-3313.74	-1515.24	-3599.16	-3017.51	-3277.17	-3948.03	-4525.34	
	(404.21)	(-3313.74)	(-3313.74)	(-3313.74)	(-3313.74)	(-3313.74)	(-3313.74)	2.78
In labor force	-0.1292	-0.0034	-0.1077	-0.15	-0.1598	-0.1649	-0.1894	
	(0.0086)	(-0.1292)	(-0.1292)	(-0.1292)	(-0.1292)	(-0.1292)	(-0.1292)	2.64
Full-time employment	-0.1607	-0.1078	-0.1585	-0.1458	-0.157	-0.1853	-0.2095	
	(0.0136)	(-0.1607)	(-0.1607)	(-0.1607)	(-0.1607)	(-0.1607)	(-0.1607)	2.73
Part-time employment	0.02	0.104	0.0376	-0.0199	-0.0147	0.0067	0.0061	
	(0.0126)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	2.64
Weekly working hours	-6.42	-2.47	-6.73	-6.54	-6.79	-7.49	-8.49	
	(0.4709)	(-6.42)	(-6.42)	(-6.42)	(-6.42)	(-6.42)	(-6.42)	2.77
Unemployment with benefits	0.0494	0.0169	0.0591	0.0554	0.0603	0.058	0.0466	
	(0.0086)	(0.0494)	(0.0494)	(0.0494)	(0.0494)	(0.0494)	(0.0494)	2.75
Unemployment w/o benefits	0.0757	0.0087	0.0718	0.0848	0.0817	0.0972	0.11	
	(0.0064)	(0.0757)	(0.0757)	(0.0757)	(0.0757)	(0.0757)	(0.0757)	2.73
Disability pension	0.0209	-0.0013	0.0118	0.0246	0.0262	0.0289	0.0351	
	(0.0035)	(0.0209)	(0.0209)	(0.0209)	(0.0209)	(0.0209)	(0.0209)	2.59
Household income								
HH pre-govt income	-2245.57	-1568.3	-3406.2	-1855.4	-2553.21	-2220.13	-1870.2	
	(615.53)	(-2245.57)	(-2245.57)	(-2245.57)	(-2245.57)	(-2245.57)	(-2245.57)	2.66
HH post-govt income	-1010.37	-1086.28	-1279.9	-690.19	-1021.77	-931.15	-1052.96	
	(356.53)	(-1010.37)	(-1010.37)	(-1010.37)	(-1010.37)	(-1010.37)	(-1010.37)	2.84
HH pre-govt income equivalent	-411.76	-469.38	-1377.82	-545.41	-390.81	-209.99	522.86	
	(317.86)	(-411.76)	(-411.76)	(-411.76)	(-411.76)	(-411.76)	(-411.76)	2.76
HH post-govt income equivalent	117.77	-220.38	-373.32	72.01	169.75	241.31	817.26	
	(169.79)	(117.77)	(117.77)	(117.77)	(117.77)	(117.77)	(117.77)	2.68
Domestic production								
Childcare (hrs/day)	0.4868	-0.092	0.6187	0.714	0.6449	0.5479	0.4876	
	(0.0968)	(0.4868)	(0.4868)	(0.4868)	(0.4868)	(0.4868)	(0.4868)	2.66
Household chores (hrs/day)	0.2149	0.0094	0.174	0.2306	0.2775	0.2655	0.3324	
	(0.0418)	(0.2149)	(0.2149)	(0.2149)	(0.2149)	(0.2149)	(0.2149)	2.89

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of the treated individuals. The column "Overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

Figure 2 plots the evolution for both outcome variables over time. In panel A, gross labor income decreases instantaneously, already in the year of the shock. The effect size for the decline in event time 0 is around half of the overall treatment effect. This contained reduction is plausible for two reasons. First, the closer the health shock to the end of the year, the smaller the impact on annual income. Second, continued remuneration and sick pay replace a large part of the foregone income in the 78 weeks following the shock. The reductions in gross annual labor earnings are amplified from the second year of the shock onward, reaching $-4,525.34$ Euros 5 years after the shock. In panel B, we also observe a delayed response in labor force participation at event time 0. Due to the definition of the variable, individuals are not considered to be out of the labor force unless they work less than 52 working hours per year. In the following years, the decline in participation is more pronounced. The 5-year coefficient shows a reduction of 19 percentage points (about -20%) in the share of the population in the labor force, relative to the period just before individuals experience a health shock.

The reduction of labor income may be a combination of intensive and extensive margins. We cannot definitively infer whether it this is driven by changes in the number of individuals in the labor force, changes in earnings, or both. It is difficult to distinguish between these competing hypotheses without introducing post-treatment or collider bias, for example, by estimating treatment effects only for those individuals who remain in the labor force. Given a 13.4% decline in labor force participation, and assuming that they all lose the pre-treatment average gross labor income of $24,248.72$ Euros, then we would observe an average decline of about $-3,249$ Euros, which is very close to the overall decline of $-3,313.74$ Euros. The same back-of-the-envelope calculation applies when made using the coefficients for event time 5. We infer from our results that most of the change in gross labor income presumably occurs at the extensive rather than at the intensive

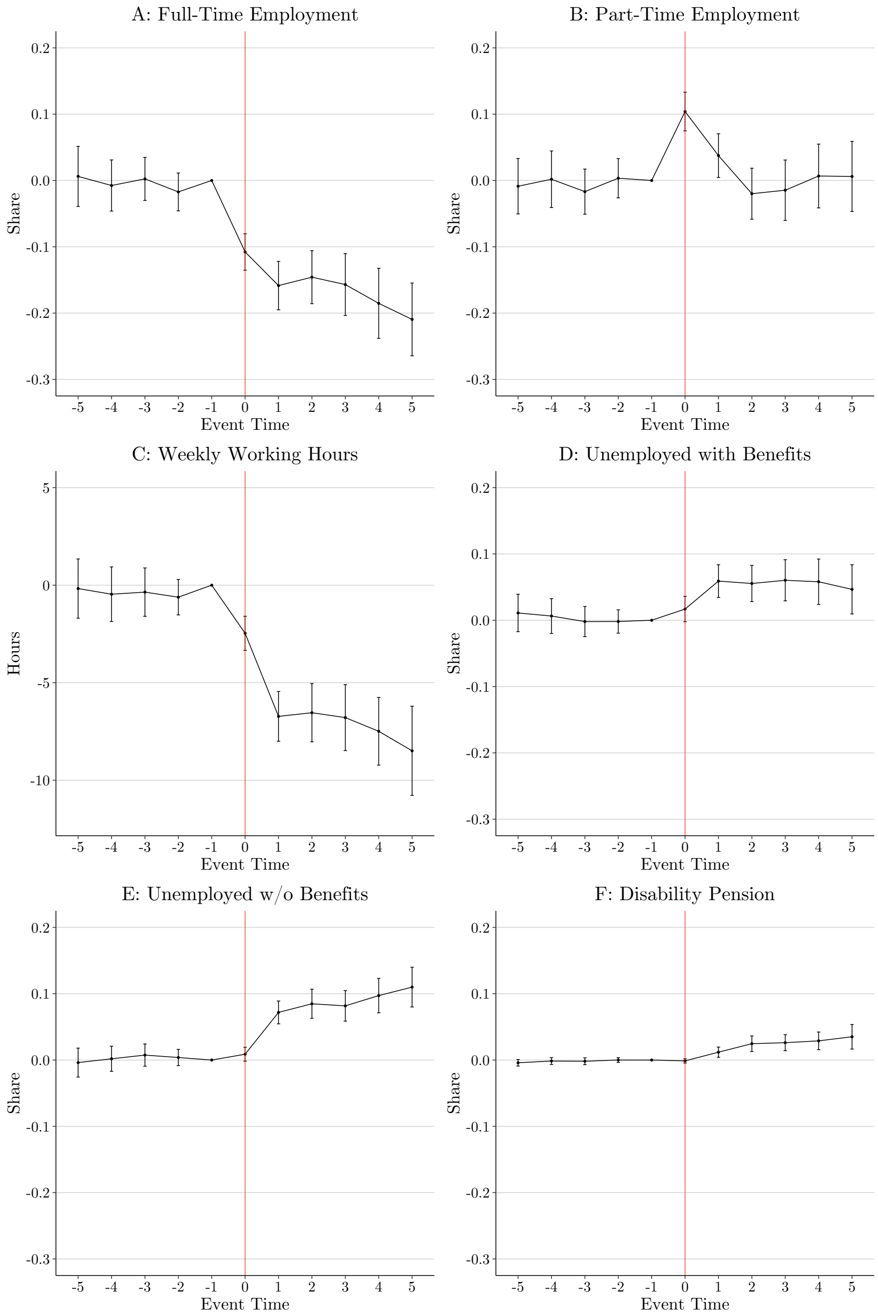

Figure 3. Labor Supply Decisions

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for binary variables indicating whether the treated person is employed full-time (panel A) or part-time (panel B), receives unemployment benefits (panel D), is unemployed without receipt of any kind of benefits (panel E), or receives a disability pension. Panel C shows the evolution of weekly working hours. The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

margin.

Figure 3 provides additional insight into the labor supply dynamics. The share of treated individuals working in full-time employment is reduced by −16pp (−23%) overall, and by −21pp (−30%) after 5 years. In contrast, the share of treated individuals working part-time remains stable over time. Note, that the increase in the year of the shock and the following year are mechanical, since the outcome variable classifies employment as part-time if working hours in a year are above 52 but below $1,820$. The employment of some individuals who experience the shock and stop working, either permanently or temporarily, may end up in this category, without actually switching to part-time. The overall coefficient for part-time employment is +2pp, though it is not significantly different from zero. The results for full- and part-time employment together imply that part-time employment becomes more common among the still-active population. While before the shock 72% of the active population worked full time, the estimates suggest that after the shock this share is reduced to about 64%. This may be due to part-time employees may be less exposed to the risk of unemployment after the shock, as the reduced workload may make it easier for them to keep their jobs.

Panel C of Figure 3 shows an overall decrease in weekly working hours by −6.42 (−17.5%). The effect reaches −8.49 hours (−23.2%) 5 years after the shock, mirroring the downward trend observed for labor force participation in panel B of Figure 2. The remaining panels of Figure 3 show more specific unemployment outcomes following the shock. Based on the overall coefficient, there is a 5pp increase in receiving unemployment benefits (panel D). This corresponds to an increase of 83%, given a share of 6% prior to the shock. The 5-year coefficient is roughly of the same magnitude, suggesting that the share of individuals receiving unemployment benefits remains stable over time. We also analyze the evolution of the share of the unemployed not receiving any unemployment or pension benefits (panel E). Here we see an increase by 8pp, or four times the pre-shock level, reaching +11pp after 5 years. As for the share of individuals receiving a disability pension, we find an increase of 2pp overall and 4pp after 5 years, from a pre-shock average of 1%.

Our findings indicate that, while some individuals leaving the labor market after a health shock do receive social security benefits in the form of unemployment payments or disability pensions, a surprisingly large share leaves the labor market without being eligible for these benefits. The increase in individuals in this group occurs soon after the shock, suggesting that this is not due to individuals exhausting their social security claims.

B. Income at the Household Level

In a next step, we investigate the size of the pass-through of the individual income shock to household income. We find that household pre-government income is reduced by an average of $-2,245.57$ Euros after the health shock, a reduction significant at the 1% level. This corresponds to a -4.8% loss, a more muted

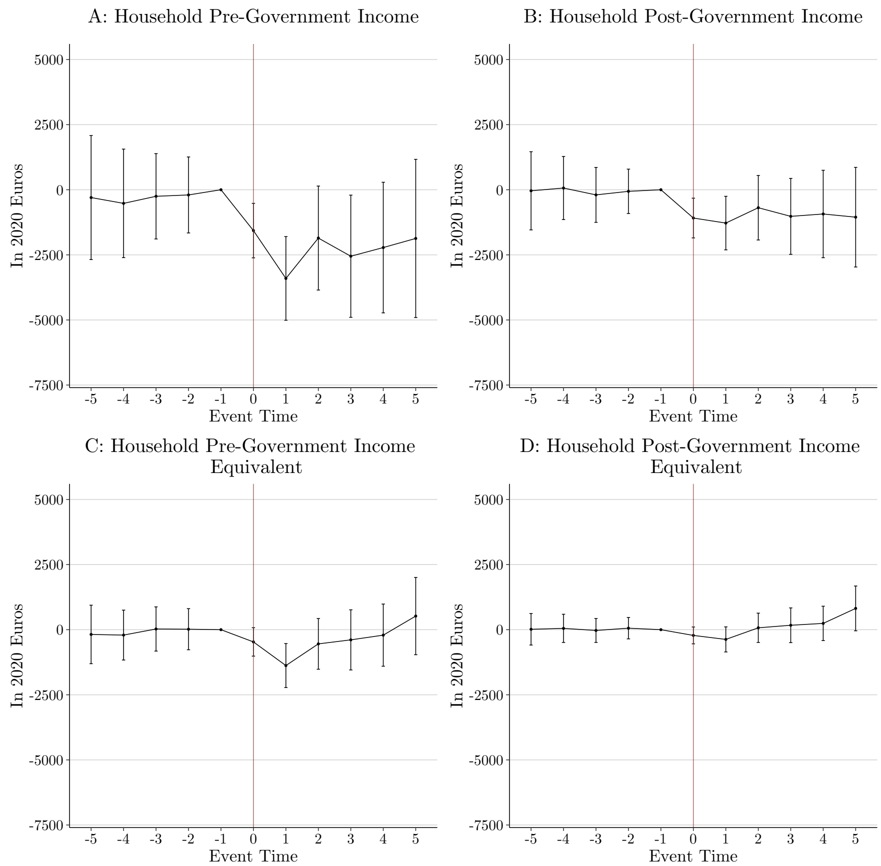

Figure 4. Evolution of total net Household income

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for different forms of household income. Household pre-government income includes labor earnings, asset income, private transfers, and private retirement income. Household post-government income includes pre-government income with public transfers, social security pensions but removing total household taxes. In panels C and D we use the OECD equivalence weights. We assign a weight of 1 to the first adult, 0.7 to any additional adult, 0.5 for each child. The results are based on estimating equation 1. All dependent variables are in 2020 Euros, and we trim the top and bottom 1%. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

result compared to the reduction in gross income at the individual level. Panel A of Figure 4 shows that the household's total pre-government income follows the declines of individual labor income almost exactly in the year of the shock and in the following year. We observe a slight recovery and leveling-off in event times 2 to 5. Although household pre-government income includes labor income, asset income, private transfers, and private retirement income of all family members from the age of 16 living in the household, we find that the declines we observe from event time 2 onward in Figure 4 is due solely to changes in labor income. In unreported results we find that asset income, and private transfers do not change significantly in any year following the shock and are precisely centered around 0. We do find a significant (5% level) overall effect of private retirement incomes, but the magnitude is minuscule (+15.72 Euros).[8] Panel B shows that public transfers absorb most of the shocks, highlighting their role as an insurance mechanism. The income loss is reduced to −1010.37 (−2.8%), although this estimate is significant at the 10% level. Thus, public transfers reduce financial losses by approximately half. We do not observe statistically significant effects from event time 2 onward.

Panels C and D take into account OECD equivalent scales, and enable a more nuanced comparison of the household's financial well-being, taking into account differences in household composition. We construct equivalent incomes by weighting assigning a weight of 1 to the first adult, 0.7 to each additional adult, and 0.5 to each child. The results in panels C and D show that the financial well-being of the household does not seem to be affected in any significant respect by the health shock. For both specifications, the overall income reduction is not statistically significant at conventional levels.

[8]It is possible that other non-spousal, adult household members may increase their labor supply following the shock, such as adult children. Based on the available data, we reject this as an important mechanism.

C. Labor Supply and Income at the Spousal Level

Next, we focus on responses in spousal labor supply following the health shock of their partner. In principle, spousal labor supply may increase to compensate for the lost income, or decrease in order to provide informal care for the sick partner. To analyze spousal outcomes in our framework, we use the spousal sample described in Section III. Table 3 presents the event study coefficients for the selected dependent variables.

Table 3— Event study coefficients: Spouses

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
Income and labor supply								
Gross labor income	2340.13	-82.52	894.15	2286.96	2456.31	3815.6	4670.29	
	(699.9)	(2340.13)	(2340.13)	(2340.13)	(2340.13)	(2340.13)	(2340.13)	2.68
In labor force	0.032	-0.0097	0.0255	0.0522	0.0327	0.0387	0.0526	
	(0.021)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	2.73
Full-time employment	0.0612	0.0237	0.0277	0.0664	0.0623	0.0953	0.092	
	(0.0162)	(0.0612)	(0.0612)	(0.0612)	(0.0612)	(0.0612)	(0.0612)	2.74
Part-time employment	-0.0415	-0.0308	-0.022	-0.0269	-0.0436	-0.0721	-0.0536	
	(0.017)	(-0.0415)	(-0.0415)	(-0.0415)	(-0.0415)	(-0.0415)	(-0.0415)	2.68
Domestic production								
Childcare (hrs/day)	0.1995	0.0357	0.1229	0.2867	0.2859	0.2539	0.212	
	(0.1816)	(0.1995)	(0.1995)	(0.1995)	(0.1995)	(0.1995)	(0.1995)	2.76
Household chores (hrs/day)	-0.139	-8e-04	-0.0763	-0.1018	-0.1969	-0.2371	-0.2213	
	(0.0659)	(-0.139)	(-0.139)	(-0.139)	(-0.139)	(-0.139)	(-0.139)	2.67

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of the spouses. The column "overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

Our results support the notion that spousal labor supply changes after the shock of their spouse, and plays an important role in insuring the household's available income. Panel A of Figure 5 documents a positive trend for annual gross labor income. We find statistically significant (5% level) overall increases of 2,340.13

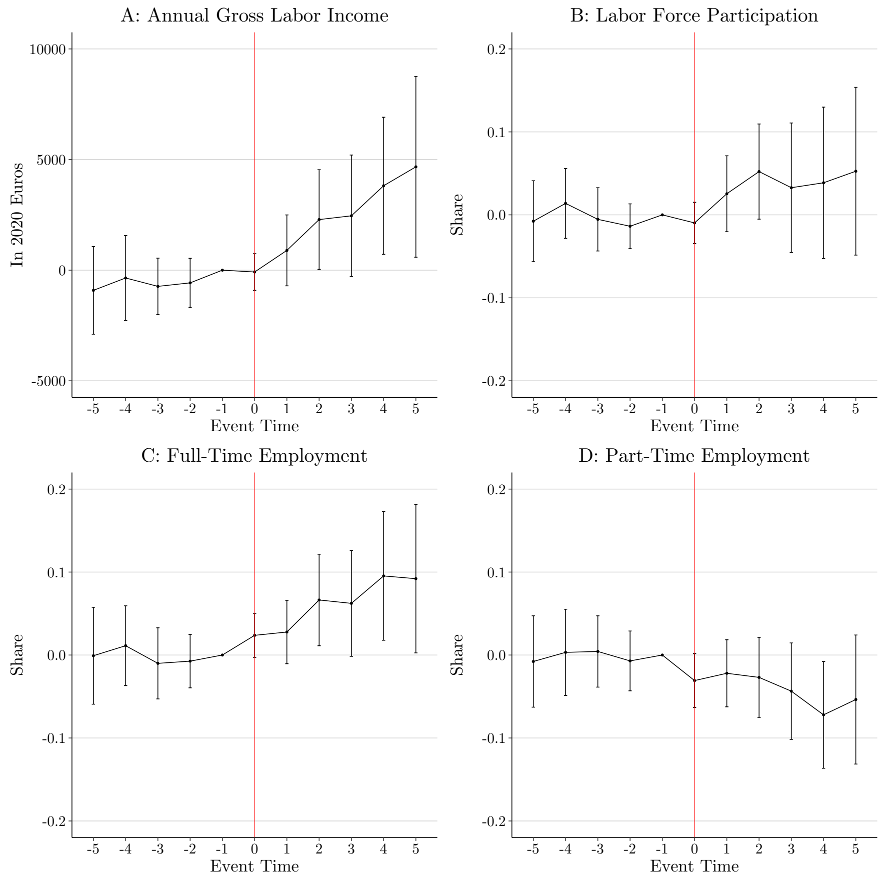

Figure 5. Labor Supply of Spouse

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) daily hours spent for childcare (panel A), and for household chores (panel B). The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

Euros (+12.9%), and of 4,670.29 Euros (+25.7%) after 5 years. Thus, a large part of the income loss at the individual level seems to be compensated by an increase in spousal labor income.[9]

Panel B shows that, although there is an upward trend in line with the increases

[9] With respect to household income, the sum of changes in individual labor income for the treated and their spouse appears to be higher than the results shown in Figure 4. This is due to the differences in sample sizes described in Section III. In unreported results, we repeat the analysis for the treated group conditional on observing their partner in the data, confirming that changes in individual incomes for the treated person and their spouse match changes in household pre-government income. We do not report results using this restricted sample due to its small size.

in panel A, the estimates for spousal labor force participation are never statistically significant. Full-time employment increases by 6pp (+14.2%) overall, and by 9pp (+21.4%) after 5 years. The decreases in part-time employment are somewhat smaller but also statistically insignificant, except for the coefficient in event time 4. However, the upward trend for full-time employment, and the downward trend for part-time employment suggest that on average spouses tend to increase their labor supply following their spouse's health shock. Thus, contrary to the treated individuals, we infer from the results that for spouses changes rather occur at the intensive margins.

Our results suggest that the income losses induced by the health shock are successfully absorbed by a combination of government transfers, and adjustments in the spousal labor supply.

D. Domestic Production

We next examine time spent on domestic production for two reasons. First, it competes with time spent in the labor market. Second, it is part of the household's real income and thus an important metric for its welfare (Apps and Rees, 2020). Moreover, terminating labor activity may be the result of a joint decision at the household level.

Figure 6 plots the changes in weekly hours spent on childcare and general household chores for both the treated person and their spouse. For the treated person, we confirm our hypothesis and find an overall increase of around half an hour

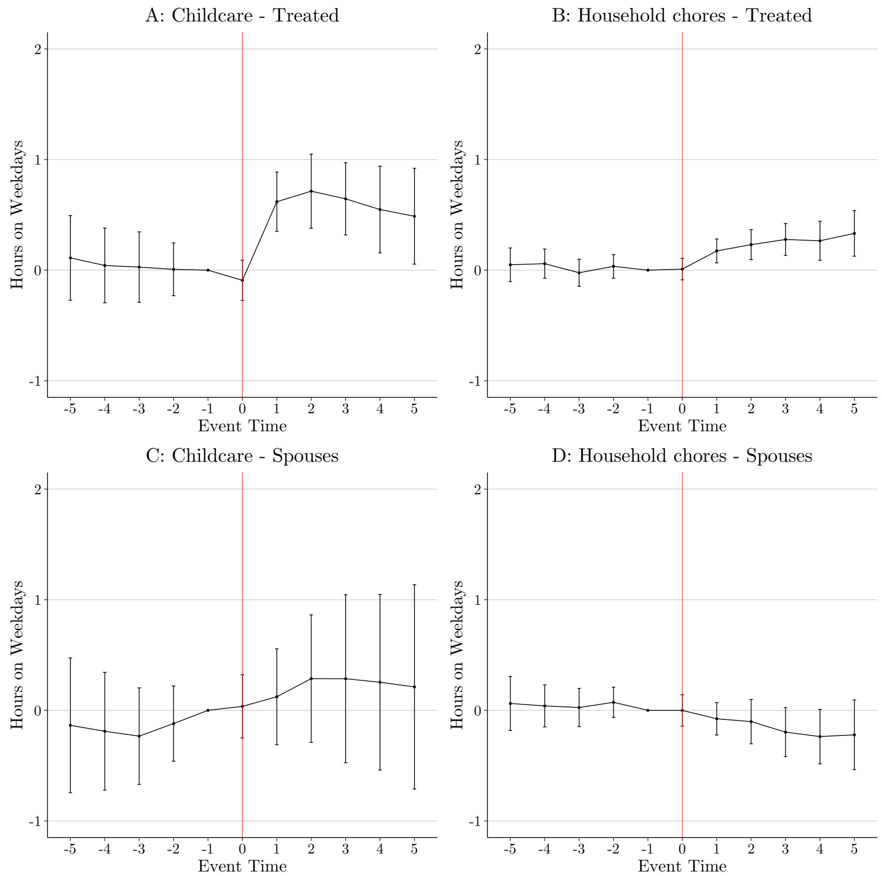

Figure 6. Domestic Production

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) daily hours spent for childcare (panel A), and for household chores (panel B) for the treated person, and for their spouse (panels C and D). The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

(+22.9%) for childcare, and less than 15 minutes (+13.9%) for household chores, although the effects reach almost half an hour after 5 years. For the spouse, we find no significant changes for either specification, but there is a downward trend for household chores that mirrors the increases observed for the treated individuals. We conclude that while there is solid evidence that the treated person in the household takes on more housework, we remain more agnostic about their spouses, although there is some evidence that they may reduce their share by the same amount, leaving total domestic production unchanged.

In Figure A7 in the appendix, we also explore changes in time spent on leisure activities and informal care provided to family members. While we find a modest increase in time spent on leisure activities for the treated person, we do not find any such changes for their spouse. Moreover, we reject the hypothesis that spouses increase the amount of time spent to care for their affected partner.

E. Gender Differences

Splitting our samples based on characteristics invariant to the shock may help to identify potential sources of heterogeneity. In particular, gender roles may play an important role in determining the impact of a health shock on labor supply and domestic production. Therefore, we repeat the analysis, dividing our samples by gender and focusing on selected dependent variables.

Figure 7 shows the effects for the treated population.[10] Although the confidence bands largely overlap at later event times, Panel A suggests that women may be affected differently than men. Overall, the average decrease in labor income is $-3,796.93$ Euros for women, and $-2,249.07$ Euros for men. Panel B shows that women are more than twice as likely to leave the labor market after the shock. Women's overall labor force participation is reduced by 18pp (-18.8%), compared to 8pp (-7.8%) for men. Both coefficients are significant at the 1% level and

[10]See Table A1 in the Appendix for a table of coefficients.

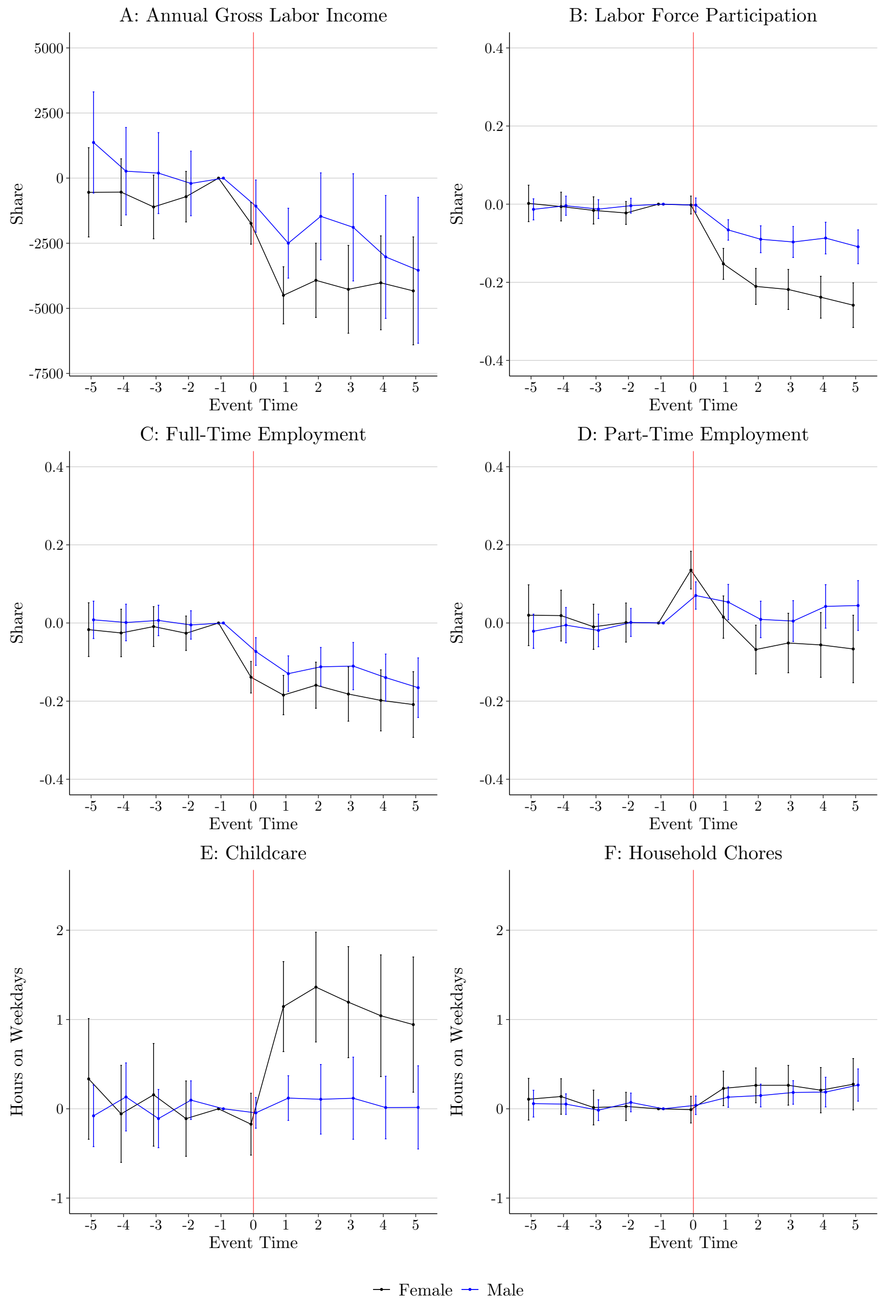

Figure 7. Labor Supply and Time Use by Gender - Treated

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for annual gross labor income (panel A, in 2020 Euros), a binary variable indicating labor force participation (panel B), full-time and part-time employment (panels C and D), daily hours spent for childcare (panel E) and for household chores (panel F). The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

confidence bands do not overlap. The decline in labor force participation seems to be driven by a decline in full-time employment for both genders. Changes in part-time employment are statistically insignificant for both genders. These results suggest that the majority of women still in the labor market work in part-time positions. Men, on the other hand, are still more likely to work in full-time jobs.

In terms of domestic production, women completely drive the results for hours of childcare. We find an average increase of almost 1 additional hour per weekday, or an increase of 33%. The effect remains stable over time, with a comparable effect size after 5 years. As for the hours spent on household chores, we do not find statistically significant difference in the responses of women and men.

Overall, we infer that women are more likely than men to stop working after a health shock. Women also spend significantly more time in caring for children relative to the last period before the shock. These two effects may be closely related.

Finally, we investigate whether there are gender differences in the spousal responses. We report the estimates in Table A2, and the event-study plots in Figure A4, in the appendix. Given the small sample sizes, the confidence bands are too wide to make precise statements, and results should be interpreted with caution. Nevertheless, we may draw some lessons from this analysis. The overall coefficients for female full-time (+5.6pp) and part-time (-6.2pp) spousal employment are statistically significant (5% level) and almost symmetrical. For male spouses we do not find statistically significant changes for these two outcome variables. Female spouses have a significant probability to switch to full-time employment. The reduction in time spent on housework is significant, and more pronounced, only for male spouses.

VI. Robustness Checks

A. Parallel Trends Assumption

The coefficients in the pre-treatment periods are statistically insignificant and their point estimates generally centered around zero for our main results. We interpret this as supporting evidence in favor of the validity of our conditional parallel trends assumption. Evaluating the credibility of the parallel trends assumption by testing differences in pre-trends is common practice in applied work. However, a recent literature has shown that such tests may suffer from low power (Freyaldenhoven, Hansen and Shapiro, 2019; Roth, 2022). Rambachan and Roth (2023) provide a methodological framework that allows us to further probe the robustness of our conditional parallel trends assumption. In principle, point identification of the event-study parameters, δ_{es}, requires that parallel trends hold exactly. However, using the framework of Rambachan and Roth (2023), we may relax this requirement by explicitly setting restrictions on how much the parallel trends assumption may be violated. The causal parameters we are interested in are then partially identified, giving us a lower and upper bound within which our results are still valid.

Specifically, we investigate whether the coefficients continue to be significantly different from zero, if we were to assume that the violation of parallel trends in the post-treatment period is no more than a factor $\bar{M}$ of the maximum violation of parallel trends in the pre-treatment period (see Rambachan and Roth (2023) for other options). Figure A5 illustrates this exercise for two central variables in our research design. In each panel, we plot the original confidence interval followed by the conditional least-favorable scenario times a parameter $\bar{M}$.

In panel A, we plot the results for annual gross labor income for $\bar{M}$ values of 0, 0.5, 1, 1.5, and 2, where 0 denotes the original result. We observe that our estimated effect remains statistically significant throughout all event times when we assume a $\bar{M}$ value of 0.5, and is significant for the first two years of the shock with a value of 1. As can be seen in Panel B of Figure A5, the decline of labor force participation is particularly robust. Even when assuming that the post-treatment violation of parallel trends is equal to the largest violation before the treatment, our coefficients remain statistically significant at the 5% level. Taken together, these exercises tend to confirm our claim our identifying assumption is credible.

B. 2001 Reform of the Occupational Disability Insurance

Before 2001, a public disability pension could be received if it became physically impossible for a person to continue working in the same occupation. In 2001, a reform was passed that limited access to disability pensions by introducing Reduced Working Capacity Pensions (*Erwerbsminderungsrente* in German, in the following RWCP) for cases in which a person cannot perform *any* professional activity for a minimum of 3 hours per workday. In case the person can work between 3 and 6 hours per workday, they are entitled to half of the RWCP, although such cases remain rare, and a full pension is usually granted. The reform addressed all individuals born after 1960, also retroactively.[11] In this section, we examine whether and how the reform may have affected the behavior of individuals following the health shock. To do so, we split our sample into two groups, one composed by treated individuals born before 1960, and the other composed by individuals born after 1960 and experiencing the shock after 2001. Thus, we exclude the notch cohorts, i.e. those individuals born after 1960, who also experienced the shock before the implementation of the reform. Some of these individuals may have lost their disability pension, as they did not meet the new requirements for a RWCP pension.

Figure 8 shows the results for some of our main outcomes. See Table A3 in the appendix for the point estimates. Generally, we observe similar dynamics

[11] See Seibold, Seitz and Siegloch (2022) and Fischer, Geyer and Ziebarth (2023) for more extensive studies on the topic.

between the two groups, with the confidence bands for annual gross labor income (panel A), and unemployment without benefits (panel C) overlapping strongly. Labor force participation is reduced by 17pp for the pre-reform group, and by 9pp for the post-reform cohort. The overall coefficient on the receipt of disability pensions is +3pp for the pre-reform group, and +1pp for the post-reform group. Although one might expect that the stricter eligibility rules for disability pensions would have forced more people to leave the labor market without compensation, this does not seem to be the case. The overall coefficients for panel C are +8pp for the pre-reform cohort, and +6pp for the post-reform.

These results suggest that the reform was successful in reducing the number of people leaving the labor force and benefiting from the relatively more generous disability pension before 2001. However, we still find a propensity for sick individuals to leave the labor market without being reintegrated in the medium term.

C. Pregnancy-Related Illnesses

One potential concern about our results in relation to changes in domestic production is that some of the sick leaves we measure are pregnancy-related illnesses. However, this scenario is unlikely in the context of German labor law. First, pregnancy-related leaves are not classified as sick leaves. Moreover, the "Maternity Protection Act" (*Mutterschutzgesetz* in German) in Germany provides comprehensive support to pregnant women and mothers, making cases of

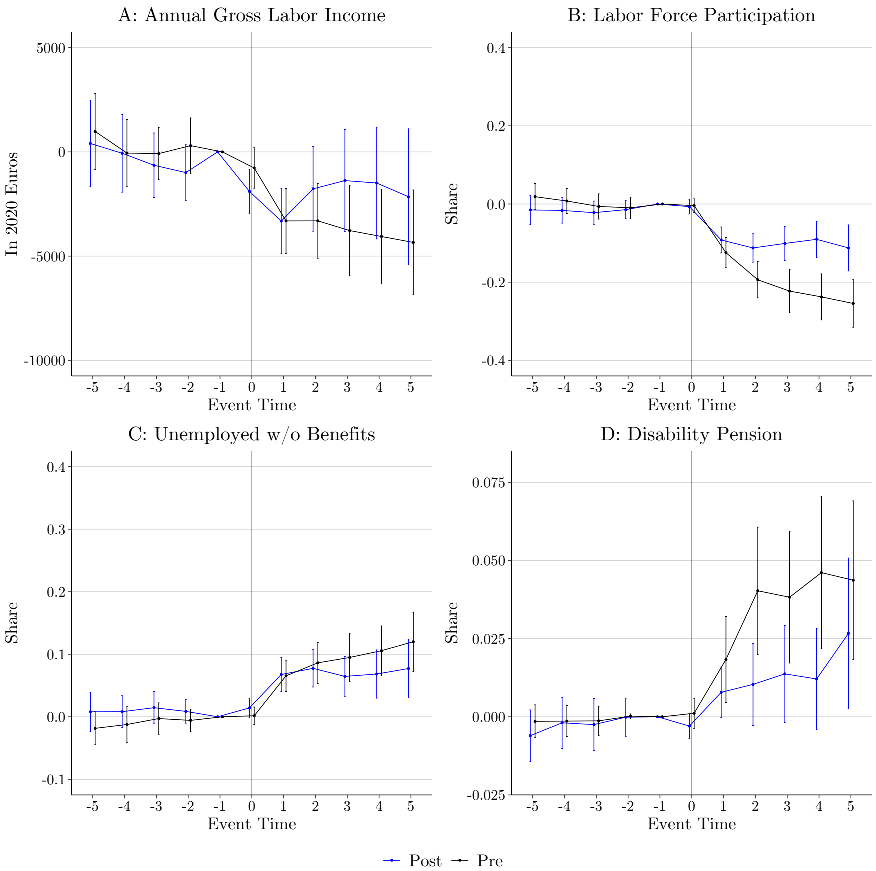

FIGURE 8. LABOR SUPPLY: REFORM

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for annual gross labor income (panel A, in 2020 Euros, top and bottom 1% is trimmed), labor force participation (panel B), unemployment without further information of receipt of benefits (panel C), and the receipt of the disability pension (panel D). The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The post-sample includes treated individuals belonging to the cohorts affected by the reform and who experienced the shock after 2001. The pre-sample includes treated individuals who do not belong to the cohorts affected by the reform.

strategic behavior of women sorting into sick leaves improbable. The Maternity Protection Act ensures protection during the last 6 weeks of pregnancy and the first 8 weeks postpartum, guaranteeing full net income without the obligation to work. Moreover, illnesses or injuries during pregnancy may result in a medical Employment Ban, which offers continuous remuneration similar to sick leave but is not constrained by the 6-week limitation, meaning that the replacement rate is not decreased after this period. Clearly, instances of non-pregnancy-related health issues leading to sick leaves exceeding 6 weeks may occur. They may be to be eventually covered under the Maternity Protection Act, if they are likely to affect the pregnancy.[12] Therefore, if pregnant women in our sample were to engage in strategic behavior to receive payment without working, avoiding sick leave might be a more advantageous approach. Nevertheless, we repeat the analysis for time spent for childcare and household chores, excluding women reporting a childbirth in event times 0 and 1. The results in Figure A6 still show a significant increase of almost 30 minutes per day, hence somewhat lower than in the main result. Overall, we can conclude that treated individuals increase the time spent on childcare after their health shock.

VII. Discussion and Conclusion

In this paper, we investigate the impact of health shocks on household's labor supply decisions and financial well-being in Germany. We find compelling evidence that health shocks lead to persistent declines in the labor supply of affected individuals, predominantly through the exit from full-time positions. These exits point at the German labor market's limited capacity to facilitate downward

[12] Employment Bans are not the only tool available to protect pregnant women, but they are reported to be the most common measure employed (BMFSFJ, 2022). In addition, pregnant women are largely protected against dismissal from the start of their pregnancy until four months postpartum, with exceptions being extremely rare and typically associated with severe financial distress of the employer. The Maternity Protection Act has remained largely unchanged since its inception in 1952 (BMFSFJ, 2022). See also Nebe (2020) for an excellent overview.

adjustments, such as transitions from full-time to part-time employment.

Following these exits, we observe a significant negative impact on household financial well-being. Nonetheless, our findings also demonstrate that households are generally able to compensate for these financial losses through a combination of public transfers and an increase in spousal labor supply. These two mechanisms play a crucial role in insuring households from income shocks.

Our analysis uncovers significant gender differences in the labor supply response to health shocks. We highlight two interrelated findings. Female labor supply reacts more sensitively than male labor supply when women themselves are directly affected by a health shock. In such cases, women are significantly more likely than men to exit the labor market. Conversely, female spouses demonstrate a greater propensity than their male counterparts to increase their labor supply when their spouse falls sick. This gender-specific response to health shocks extends beyond the labor market into the realm of domestic production. Affected women assume a greater share of childcare responsibilities than their male partners – further entrenching traditional gender roles.

Our results may inform the discourse on the equity-efficiency trade-off on the generosity of public transfers. While generous public transfers provide critical insurance against income shocks, their generosity may lead to disincentives for the labor supply of the affected person.

In the German setting, these disincentives are exacerbated by joint-taxation schemes and highly elastic means-tested benefits. Such a system inadvertently penalizes secondary-income earners in households by subjecting them to an excessively high marginal tax rate. A reform of the taxation and transfers system may prove to be especially beneficial for female labor supply.

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Appendix

A1. Correlation between treatment and health outcomes

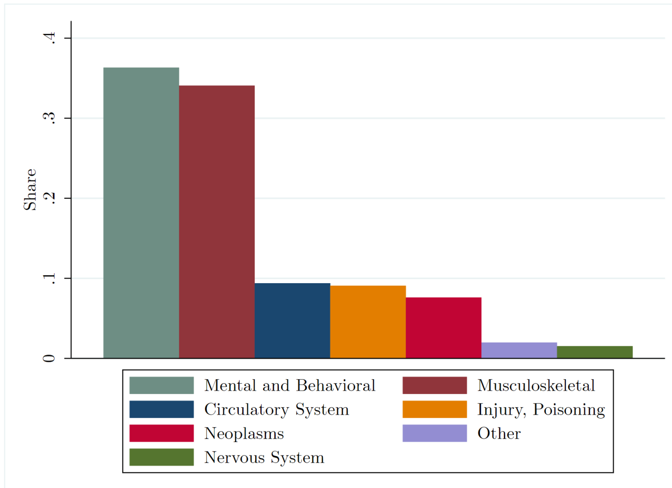

Figure A1. Most common causes for a prolonged sick leave (> 42 days) in 2019

Note: Own calculations based on data by the German Health Ministry.

While general questions about a person's health status and illnesses may not be reliable proxies for identifying extended sick leaves on their own, we may still use them to validate our treatment variable. As a reference, Figure A1 reports the most common causes for a prolonged sick leave in 2019. The vast majority is represented by mental and behavioral disorders, and by musculoskeletal diseases, with little difference between genders.

Figure A2 shows that several health-related measures are affected by instantaneous changes at the time of the health shock, based on specification 1. We observe that individuals are significantly more likely to have spent nights at the hospital. For the average person affected in our sample, we observe an increase of almost 8.5 nights spend at the hospital, which returns to its pre-treatment level two years after the shock. We also find that these individuals are significantly less satisfied with their health, are much more likely to worry about it, and report to be in worse health in the year they have reported to have spent at least 6 weeks in sick leave. We only see a recovery of these changes three to four years after the shock.

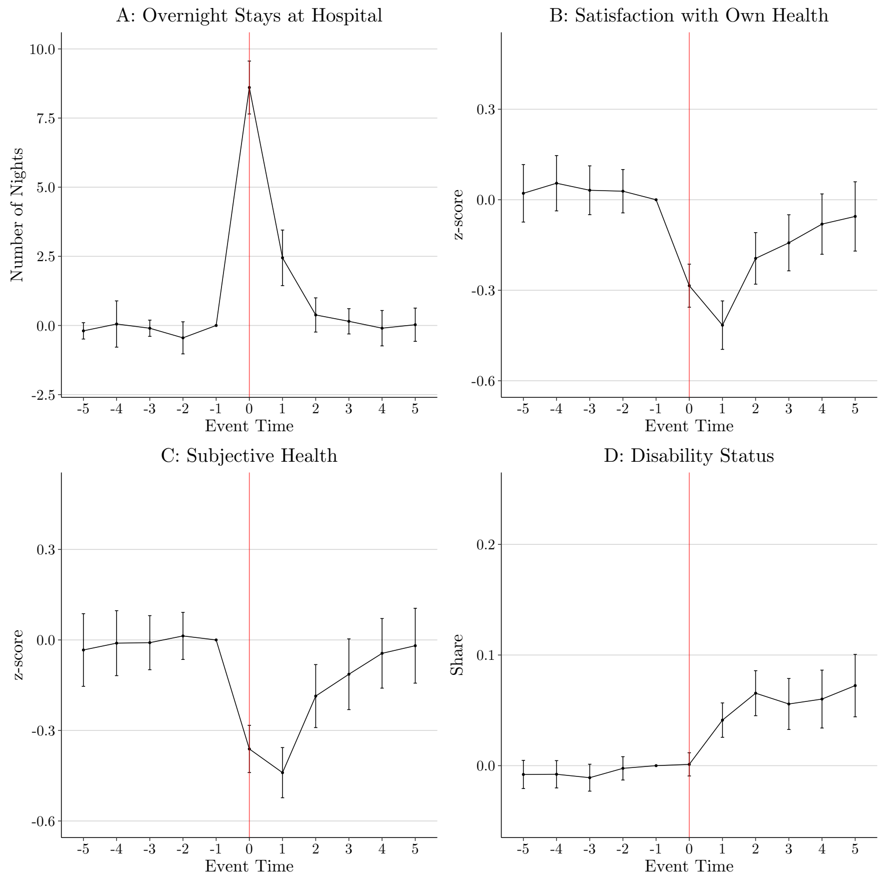

Figure A2. Development of health outcomes

Note: Data are from the SOEP (1985-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for overnight stays at hospitals (panel A), the deviation from satisfaction with the own health (panel B) and from a subjective, general assessment of the own health (panel C), and for a binary variable on the receipt of the official disability status. For panels B and C we calculate z-scores by subtracting the mean and dividing by the standard deviation in each year. The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

A2. Different Estimators

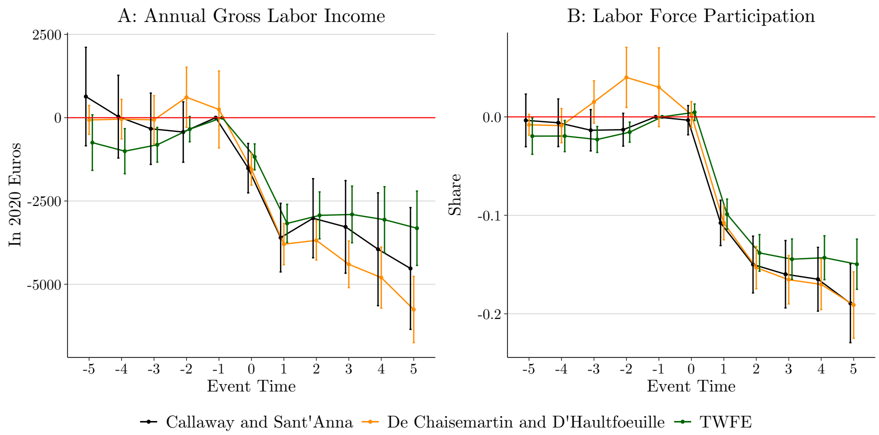

Figure A3. Robustness Test: Different estimators

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for labor force participation (panel A), and for annual gross labor income (panel B) and, based on estimating equation 1, as well as the coefficients from De Chaisemartin and d'Haultfoeuille (2020) and a two-way fixed effects (TWFE) regression. For panel A, the dependent variable is in 2020 Euros, and we trim the top and bottom 1% of it. For panel B, the dependent variable is of binary type. For the results via 1 and TWFE, Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

We test different estimators to further validate our approach. Figure A3 compares the estimator by Callaway and Sant'Anna (2021) with the one proposed by De Chaisemartin and d'Haultfoeuille (2020), as well as with a standard TWFE regression, for two of our main outcomes (annual gross labor income and labor force participation). As expected, the TWFE results are biased by negative weights, which lower the point estimates. This is due to the staggered fashion and treatment effect heterogeneity. Also, TWFE rejects the hypothesis of parallel trends before the treatment. This is probably due to the correlation between treatment and outcome variable, as only employed individuals can go into sick leave. Both

Callaway and Sant'Anna (2021) and De Chaisemartin and d'Haultfoeuille (2020) can better account for this correlation and correct the pre-tends, thus outperforming the standard TWFE approach.

A3. Additional Tables and Results

Table A1— event study coefficients: Treated, by gender

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
				Women				
Income and labor supply								
Gross labor income	-3796.93	-1738.08	-4500.31	-3924.28	-4269.7	-4019.76	-4329.48	
	(457.99)	(-3796.93)	(-3796.93)	(-3796.93)	(-3796.93)	(-3796.93)	(-3796.93)	2.67
In labor force	-0.1801	-0.0022	-0.1528	-0.2105	-0.2183	-0.2382	-0.2586	
	(0.0136)	(-0.1801)	(-0.1801)	(-0.1801)	(-0.1801)	(-0.1801)	(-0.1801)	2.78
Full-time employment	-0.1786	-0.1388	-0.1845	-0.1593	-0.1819	-0.1981	-0.2087	
	(0.0198)	(-0.1786)	(-0.1786)	(-0.1786)	(-0.1786)	(-0.1786)	(-0.1786)	2.63
Part-time employment	-0.0152	0.1354	0.0151	-0.0679	-0.0512	-0.0561	-0.0665	
	(0.0198)	(-0.0152)	(-0.0152)	(-0.0152)	(-0.0152)	(-0.0152)	(-0.0152)	2.68
Domestic production								
Childcare (hrs/day)	0.919	-0.1725	1.14	1.36	1.19	1.04	0.9429	
	(0.1785)	(0.919)	(0.919)	(0.919)	(0.919)	(0.919)	(0.919)	2.72
Household chores (hrs/day)	0.2048	-0.0095	0.2284	0.2626	0.2635	0.2085	0.2752	
	(0.0615)	(0.2048)	(0.2048)	(0.2048)	(0.2048)	(0.2048)	(0.2048)	2.8
				Men				
Income and labor supply								
Gross labor income	-2249.07	-1075.72	-2498	-1466.76	-1889.94	-3025.86	-3538.16	
	(596.97)	(-2249.07)	(-2249.07)	(-2249.07)	(-2249.07)	(-2249.07)	(-2249.07)	2.65
In labor force	-0.0752	-0.0024	-0.066	-0.0898	-0.0968	-0.0868	-0.1091	
	(0.0098)	(-0.0752)	(-0.0752)	(-0.0752)	(-0.0752)	(-0.0752)	(-0.0752)	2.74
Full-time employment	-0.1218	-0.073	-0.1297	-0.1121	-0.1103	-0.1398	-0.1656	
	(0.0165)	(-0.1218)	(-0.1218)	(-0.1218)	(-0.1218)	(-0.1218)	(-0.1218)	2.68
Part-time employment	0.0375	0.0703	0.0535	0.0092	0.0049	0.0425	0.0447	
	(0.0137)	(0.0375)	(0.0375)	(0.0375)	(0.0375)	(0.0375)	(0.0375)	2.79
Domestic production								
Childcare (hrs/day)	0.0548	-0.0454	0.12	0.1065	0.1182	0.0139	0.0157	
	(0.1156)	(0.0548)	(0.0548)	(0.0548)	(0.0548)	(0.0548)	(0.0548)	2.59
Household chores (hrs/day)	0.1591	0.0394	0.1305	0.1485	0.1828	0.1872	0.266	
	(0.0413)	(0.1591)	(0.1591)	(0.1591)	(0.1591)	(0.1591)	(0.1591)	2.65

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of the treated individuals, by gender. The column "Overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

Table A2— Event study coefficients: Spouses, by gender

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
				Women				
Income and labor supply								
Gross labor income	866.88	8.8	518.15	741.97	511.77	1287.57	2133	
	(484.43)	(866.88)	(866.88)	(866.88)	(866.88)	(866.88)	(866.88)	2.72
In labor force	0.0091	-0.0107	0.0172	0.0364	-0.0015	-2e-04	0.0136	
	(0.0199)	(0.0091)	(0.0091)	(0.0091)	(0.0091)	(0.0091)	(0.0091)	2.77
Full-time employment	0.0553	0.0302	0.0259	0.0588	0.0523	0.0883	0.0764	
	(0.0166)	(0.0553)	(0.0553)	(0.0553)	(0.0553)	(0.0553)	(0.0553)	2.7
Part-time employment	-0.0621	-0.037	-0.0333	-0.0431	-0.069	-0.1106	-0.0794	
	(0.0206)	(-0.0621)	(-0.0621)	(-0.0621)	(-0.0621)	(-0.0621)	(-0.0621)	2.77
Domestic production								
Childcare (hrs/day)	0.3503	0.238	0.2108	0.4037	0.508	0.3963	0.3451	
	(0.2172)	(0.3503)	(0.3503)	(0.3503)	(0.3503)	(0.3503)	(0.3503)	2.69
Household chores (hrs/day)	-0.0933	0.0345	-0.0396	-0.0297	-0.1634	-0.1851	-0.1764	
	(0.0867)	(-0.0933)	(-0.0933)	(-0.0933)	(-0.0933)	(-0.0933)	(-0.0933)	2.66
				Men				
Income and labor supply								
Gross labor income	2513.22	-398.21	422.39	2530.25	2872.12	4842.59	4810.2	
	(986.28)	(2513.22)	(2513.22)	(2513.22)	(2513.22)	(2513.22)	(2513.22)	2.66
In labor force	0.0113	-0.0062	0.0126	0.0221	0.0139	0.0248	0.001	
	(0.0144)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	2.71
Full-time employment	0.0217	0.0063	0.0152	0.0226	0.0245	0.042	0.0198	
	(0.0203)	(0.0217)	(0.0217)	(0.0217)	(0.0217)	(0.0217)	(0.0217)	2.73
Part-time employment	-0.0186	-0.0123	-0.0111	-0.0084	-0.0187	-0.0275	-0.0336	
	(0.018)	(-0.0186)	(-0.0186)	(-0.0186)	(-0.0186)	(-0.0186)	(-0.0186)	2.78
Domestic production								
Childcare (hrs/day)	0.0212	-0.1011	-0.0075	0.0996	0.0892	0.0396	0.0076	
	(0.1008)	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0212)	2.67
Household chores (hrs/day)	-0.1772	-0.0471	-0.1187	-0.1265	-0.2278	-0.2992	-0.2437	
	(0.048)	(-0.1772)	(-0.1772)	(-0.1772)	(-0.1772)	(-0.1772)	(-0.1772)	2.73

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of the spouses, by gender. The column “overall” contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

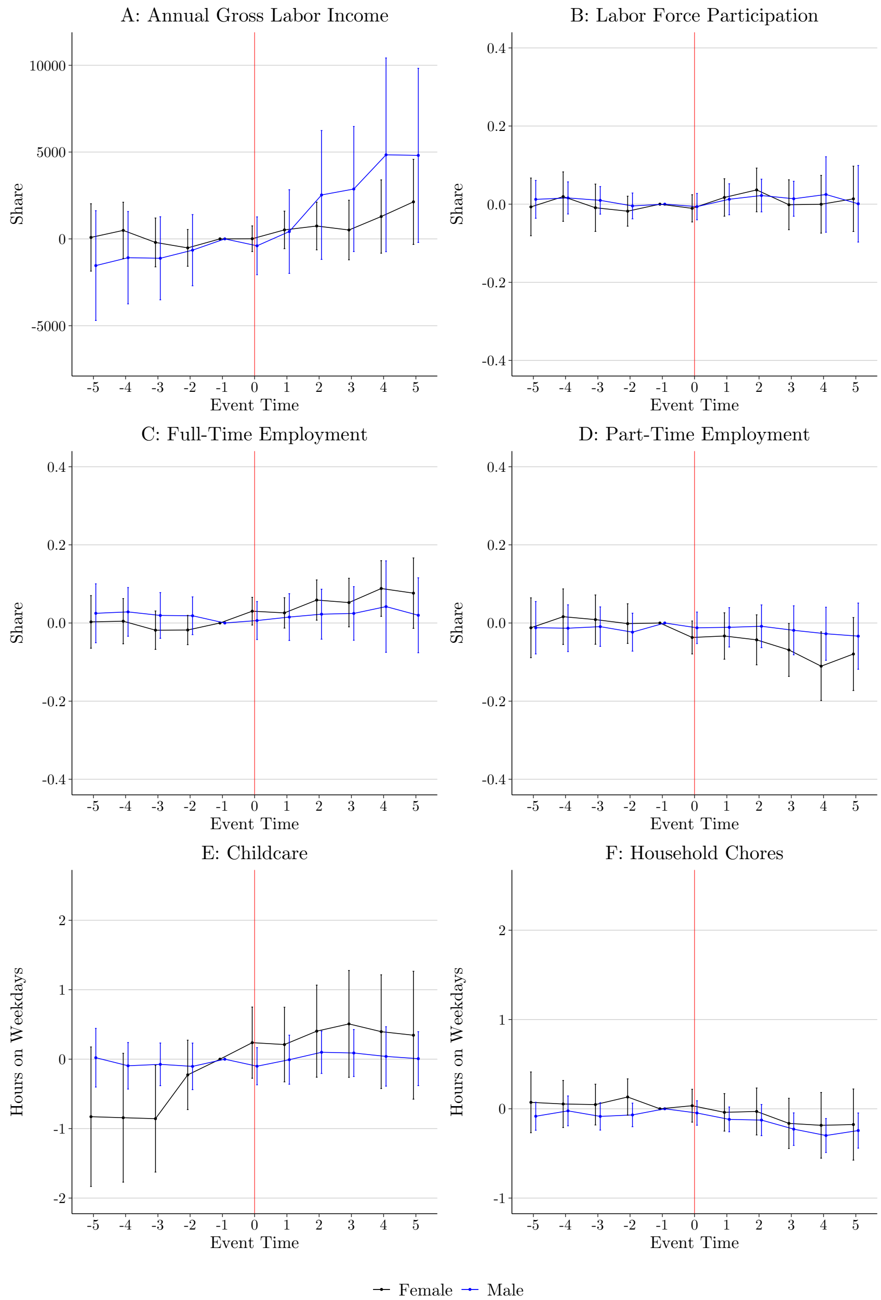

Figure A4. Labor Supply and Time Use by Gender - Spouses

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) for annual gross labor income (panel A, in 2020 Euros), a binary variable indicating labor force participation (panel B), full-time and part-time employment (panels C and D), daily hours spent for childcare (panel E) and for household chores (panel F). The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

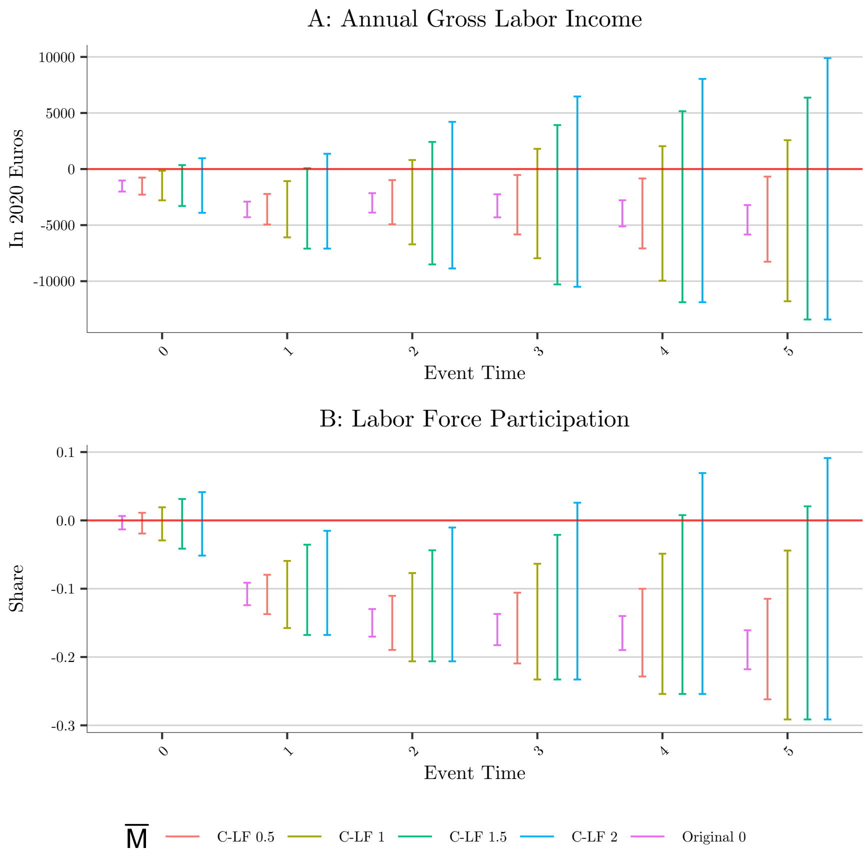

FIGURE A5. ROBUSTNESS TEST: CREDIBLE PARALLEL TRENDS

Note: Data are from the SOEP (1984-2020). The figure plots the coefficients (simultaneous 95% confidence bands) based on the robustness test detailed in Section VI.A. The original confidence intervals are reproduced without taking multiple hypothesis testing into account. In addition, for different values of $\bar{M}$, end points of successive confidence intervals may not change, as the **HonestDiD** packages constructs the confidence intervals by testing a discrete number of grid points, which can lead to imprecision if $\bar{M}$ values are too close to each other, given the number of grid points. We find that increasing the number of grid points does not affect this result visibly. The dependent variable for annual gross labor income is in 2020 Euros, and we trim its the top and bottom 1%.

Table A3— Event study coefficients: Treated, pre- and post-reform

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
				Post-reform				
Income and labor supply								
Gross labor income	-2001.73	-1895.5	-3318.45	-1774.15	-1375.89	-1492.58	-2153.83	
	(590.34)	(-2001.73)	(-2001.73)	(-2001.73)	(-2001.73)	(-2001.73)	(-2001.73)	2.81
In labor force	-0.0858	-0.0067	-0.0921	-0.1125	-0.1009	-0.0904	-0.1123	
	(0.0111)	(-0.0858)	(-0.0858)	(-0.0858)	(-0.0858)	(-0.0858)	(-0.0858)	2.73
Unemployment w/o benefits	0.0616	0.0142	0.0676	0.0775	0.0646	0.0684	0.0772	
	(0.0089)	(0.0616)	(0.0616)	(0.0616)	(0.0616)	(0.0616)	(0.0616)	2.73
Disability pension	0.0113	-0.003	0.0078	0.0104	0.0137	0.0121	0.0267	
	(0.0043)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	2.61
				Pre-reform				
Income and labor supply								
Gross labor income	-3261.38	-771.4	-3311.85	-3308.23	-3774.5	-4059.12	-4343.18	
	(600.2)	(-3261.38)	(-3261.38)	(-3261.38)	(-3261.38)	(-3261.38)	(-3261.38)	2.7
In labor force	-0.173	-0.0043	-0.1247	-0.1939	-0.2229	-0.2376	-0.2545	
	(0.0148)	(-0.173)	(-0.173)	(-0.173)	(-0.173)	(-0.173)	(-0.173)	2.69
Unemployment w/o benefits	0.079	0.0016	0.0655	0.0863	0.0949	0.1057	0.12	
	(0.0106)	(0.079)	(0.079)	(0.079)	(0.079)	(0.079)	(0.079)	2.69
Disability pension	0.0313	0.0011	0.0183	0.0403	0.0382	0.0461	0.0437	
	(0.006)	(0.0313)	(0.0313)	(0.0313)	(0.0313)	(0.0313)	(0.0313)	2.45

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of the spouses, by gender. The column "Overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

Table A4— Event study coefficients: Treated women, without newborns

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
Domestic production								
Childcare (hrs/day)	0.6717	-0.1793	0.4447	0.9415	0.9888	0.9268	0.9079	
	(0.1816)	(0.6717)	(0.6717)	(0.6717)	(0.6717)	(0.6717)	(0.6717)	2.74
Household chores (hrs/day)	0.1355	-0.0651	0.1028	0.173	0.1874	0.1701	0.2451	
	(0.0662)	(0.1355)	(0.1355)	(0.1355)	(0.1355)	(0.1355)	(0.1355)	2.8

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of treated women excluding those reporting a childbirth in event times 0 and 1. The column "Overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

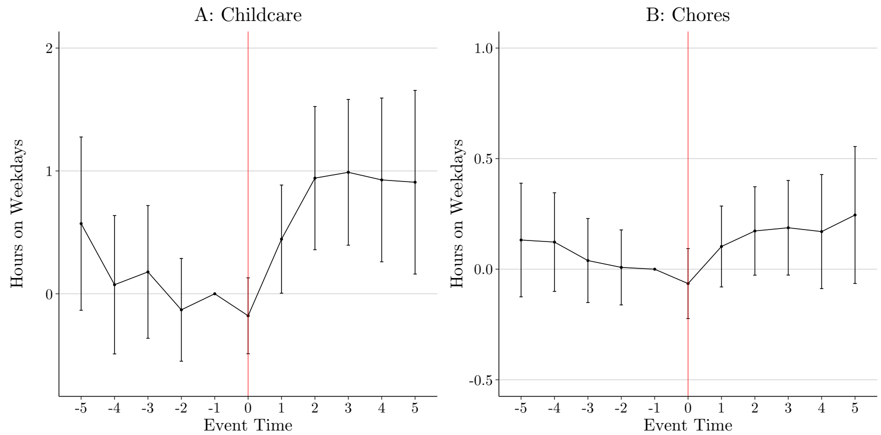

Figure A6. Domestic Production of Women Without Births Around Shock

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) daily hours spent for childcare (panel A), household chores (panel B). The results are based on estimating equation 1. This sample excludes mothers with births in event times 0 and 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.

Table A5— Event study coefficients: Leisure and informal care

Dep. variable	Overall	Post-treatment event time						Crit. value
		0	1	2	3	4	5	
				Treated				
Leisure activities (hrs/day)	0.1658	0.0197	0.1121	0.1573	0.1745	0.2073	0.3237	
	(0.0442)	(0.1658)	(0.1658)	(0.1658)	(0.1658)	(0.1658)	(0.1658)	2.7
				Spouse				
Leisure activities (hrs/day)	-0.1499	0.0568	-0.1671	-0.1753	-0.1805	-0.2604	-0.1729	
	(0.1518)	(-0.1499)	(-0.1499)	(-0.1499)	(-0.1499)	(-0.1499)	(-0.1499)	2.64
Informal care (hrs/day)	-0.0173	0.0103	-0.0458	0.0269	0.0026	-0.0264	-0.0714	
	(0.0407)	(-0.0173)	(-0.0173)	(-0.0173)	(-0.0173)	(-0.0173)	(-0.0173)	2.49

Note: Data are from SOEP (1984-2020). The table displays the event study coefficients and standard errors for the analyzed outcomes of treated individuals and spouses. The column "Overall" contains the average treatment effects on the treated. The coefficients for single periods after the treatment are displayed in column 3 to 8. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy. The last columns display the critical value for significance at the 5% level from the bootstrapped simultaneous confidence band.

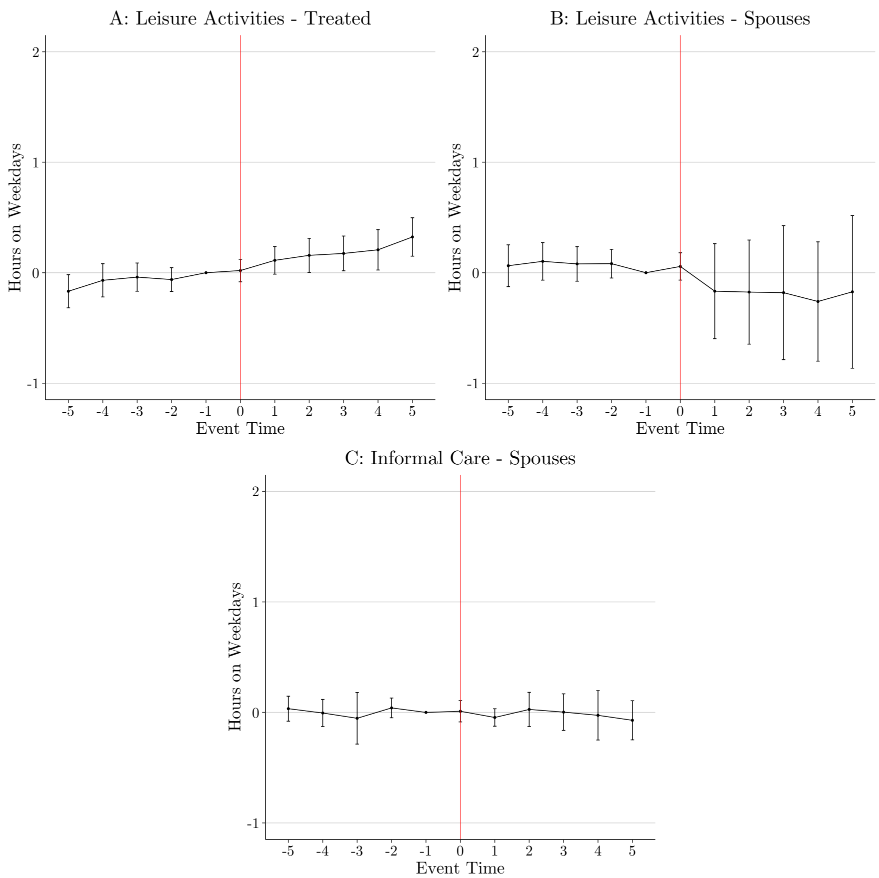

Figure A7. Domestic Production - Additional Outcomes

Note: Data are from the SOEP (1984-2020). The figure plots the event study coefficients (simultaneous 95% confidence bands) daily hours spent on Leisure (panel A and B), and for informal care (panel C) for the treated person, and for their spouse. The results are based on estimating equation 1. Changes are in relation to the status quo one year before the health shock (i.e. in event time -1), and in comparison to the not-yet-treated control group. See Section IV for a detailed description of our estimation strategy.