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DISCUSSION PAPER SERIES

IZA DP No. 17232

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ABSTRACT

Effects of Health Shocks on Adult Children's Labor Market Outcomes and Well-Being

Using Norwegian administrative register data, we assess the impact of health shocks hitting lone parents, specifically stroke and hip fractures, on labor market outcomes and the well-being of adult offspring. We identify small, but statistically significant immediate responses in terms of an increase in physician-certified sickness absences and a higher risk of diagnosed mental disorders. However, these effects tend to fade out quickly, and the negative impacts on subsequent employment and earnings are small and only borderline statistically significant. In general, our results suggest that the responses to the deteriorating health of a parent tend to be short-lived and mostly manifest as temporary absences from work rather than complete detachment from the labor market.

JEL Classification: I12, I31, J14, J22

Keywords: health shocks, labor supply, mental health, informal care, parental health, event-studies

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1 Introduction

Older people face higher risks of experiencing adverse health events such as strokes or fractures. These shocks can temporarily or permanently affect patients and often require additional support and care, which, depending on the context, is provided by formal or informal caregivers. In high-income countries, the proportion of older people is growing fast, which is expected to drive up the demand for care services. Demographic projections from Norway indicate that by 2070, about 30% of its population will be above the age of 65 (Syse et al., 2020). Similarly, the old-age dependency ratio in OECD countries, which measures the percentage of people over 65 relative to the working-age population, is expected to double from around 28 % in 2015 to 57% by 2060 (OECD, 2019). These trends will likely make informal caregiving by family members more important in the coming years.

Recent evidence shows that when a family member's health deteriorates, or care needs arise, informal caregivers like spouses or adult children usually take on a caregiving role (Jolly & Theodoropoulos, 2023; Maestas et al., 2024). For adult children in the labor force, performing caregiving duties often conflicts with daily market work obligations (Gautun & Bratt, 2023). In addition, providing care for a close relative can potentially lead to a stressful situation and a deterioration of one's own physical and mental health (Abrahamsen & Grøtting, 2023; Amirkhanyan & Wolf, 2006; Bom et al., 2019; Glaser & Pruckner, 2023). In more serious cases, the deterioration of a family member's health may force adult children to reduce their labor supply or even withdraw prematurely from the labor market (Bolin et al., 2008; Fevang et al., 2012; Frimmel et al., 2023; Maestas et al., 2024). The way offspring are expected to take a direct part in the care of disabled parents may thus have implications for overall labor supply and fiscal sustainability (Fevang et al., 2012).

Although parental health shocks may result in caregiving provided by adult children, the decision to provide care varies depending on health status, skills, and family circumstances (Siciliani, 2013). Even in cases where it is possible to substitute informal care with formal care, children may be affected by distress, grief, and concern related to the deterioration of their parent's health[1]. Additionally, practical arrangements following discharge, institutionalization,

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[1] This is what Bobinac et al.(2010) and Bom et al. (2019) describe as the family effect, in contrast with the caregiving effect, which is the effect of caring for a family member and providing help with daily activities.

or death may pose a stressful period for adult children, which could be reflected in variations in labor supply. In addition to this bundle of responses to health shocks, the presence of inheritance may also shape adult children's responses through changes in labor supply around the time of parental demise and an expected increase in wealth.[2]

In the present paper, we investigate through a series of event studies how a severe and unexpected health shock hitting a lone parent impacts adult children's labor market outcomes and well-being. As indicators of such shocks, we use cases of first-time hip fractures or strokes. Both of these shocks are typically unexpected and associated with immediate functional impairment and disruption of daily life in older adults. We use individual-level data from Norwegian registers to identify these health shocks between 2011 and 2019. In addition to identifying the exact timing of events, these registers allow us to link families, and track labor market responses and visits to primary care services by the offspring.

To identify the effect of a parental health shock on offspring behavior, we need to take into account that parental health shocks are not randomly assigned. Offspring of parents who experience a stroke or a hip fracture may differ significantly from those whose parents do not experience these events, both in terms of health status and labor market attachment. To deal with this challenge, we use an approach similar to Fadlon & Nielsen (2019, 2021) and Golosov et al. (2023), and construct comparison groups based on offspring whose parents experienced the event in question, yet at a later time. This approach allows us to estimate the short- and medium-term effects of the parental health shock while accounting for selection biases associated with the event's occurrence. Under this design, treatment and control groups are expected to be comparable across key factors such as perceived risks, behaviors, and lifestyle (Fadlon & Nielsen, 2019).

Our findings indicate that when a lone parent is hit by a stroke or a hip fracture, there is an immediate rise in employed offspring's short-term absence from work and a corresponding increase in the probability of receiving a mental health diagnosis. Yet, although these effects are statistically significant, they are small from a substantive viewpoint. In particular, the probability of having a short-term physician-certified sick leave rises by around 1.7 percentage points. Estimates also indicate a small negative effect on earnings and employment the two first years after the event, but these effects are also small and only

[2] These adjustments around the time of inheritance are called the Carnegie effect. See Bø et al. (2019) for an examination of the Carnegie effect using Norwegian Registry data.

borderline statistically significant. Taking a closer look at how offspring responses depend on the survival time of the parent, we find that the effects are concentrated among the children of parents who die within a year after the shock, which constitutes approximately 25% of the parents in our data. This suggests that the labor supply effects are non-negligible in the more serious cases, although the two types of shock studied in the present paper rarely entail long-term commitments for the offspring. Our interpretation of the results is that the publicly funded healthcare system in Norway may relieve offspring of the main caregiving responsibility. However, serious parental health shocks still impose a stressful and disruptive period, making it difficult to combine work and family obligations.

This paper relates to the growing literature on health shocks and labor market responses using difference-in-differences and event studies. However, we depart from the literature that explores the effects of health shocks on household or spousal labor market outcomes, such as Coile (2004), García-Gómez et al. (2013), Fadlon & Nielsen (2021), and Arrieta & Li (2022). Instead, we focus on the literature concerned with responses to parental health shocks by adult children. Whereas adverse health shocks may be expected to affect the labor supply of adult offspring negatively – due to their impacts on care needs – the effect on a spouse's labor supply will often be positive – due to the need for income replacement.

The literature exploring the effects of parental health shocks using administrative data has grown in recent years, showing well-documented effects on labor market outcomes that vary depending on the institutional context. However, the portion investigating the short-term impacts of parental health shocks on offspring outcomes remains sparse.

Rellstab et al. (2020) use administrative data from the Netherlands to investigate how adult children respond to several parental shocks by observing labor market outcomes and mental health scores. The authors find no evidence of a change in income or labor market participation after a health shock. However, they observe detrimental effects on mental health scores. Similarly, based on Swedish register data, Norén (2020) finds no labor market effects for children whose parents experienced a stroke. By contrast, previous work has examined offspring's labor supply behavior during the terminal stages of parents' lives, which indicates significant negative responses to parental care needs. Fevang et al. (2012) use register data from Norway to track the trajectories of labor market outcomes around parental death. Their results show reductions in labor supply in the years that precede parental demise for both men and women, with a higher effect on daughters. Similar results have been reported for Sweden (Norén, 2020).

We contribute to the existing literature by examining short –and medium-term labor market outcomes and the well-being of adult children whose lone parents experience a sudden and severe health shock. In addition to commonly studied labor market outcomes such as earnings and employment, we include physician-certified sickness absences. By including sickness absences, we expect to learn about short-term variations in labor supply that could be driven by the deterioration of the offspring's health and yet not be reflected in the evolution of earnings and employment. Additionally, we focus on the children of lone parents suffering from hip fractures or strokes. In particular, hip fractures have not been extensively explored in the literature on health shocks. This type of fracture, which is prevalent among the elderly in Norway, often leads to a significant decline in mobility and a high probability of subsequent incidents and mortality (Figved et al., 2018; Fosse et al., 2021).

We also contribute to the literature by exploring the interaction between labor market outcomes and adult children's well-being. Except for Glaser & Pruckner (2023), who study the mental health effects of parental health shocks on young children, previous studies have explored the impact of shocks on mental health through mental health scores, prescription, and hospitalization data; see Böckerman et al.(2022), Frimmel et al. (2023). Instead, we base our analysis on visits to general practitioners, specialist psychologists, emergency doctors, and other outpatient care services. By including these services together with outcomes corresponding to diagnoses and symptoms of anxiety, stress, and sleeping disorders, we expect to capture a comprehensive set of responses related to mental health outcomes that might not be normally observed through the use of specialized services and prescriptions. In this way, we expect to observe not only severe cases, but also cases that may reflect short-lived responses to a distressful period for adult offspring. This inclusion is relevant since it allows us to relate visits to these services to the use of certified sickness absences in periods of distress for adult children who participate in the labor market. In Norway, a physician certification is needed if the sick leave period is longer than three days.

In general, our results contribute to the literature concerned with parental health shocks by providing a broad set of results that document how children's outcomes vary depending on gender, and the survival time of the parent after the shock. By including this last distinction, we attempt to differentiate between severe and less severe cases and the timing of any care requirements. Parents with more severe cases may have short survival and not require care for an extended period. However, this period may be highly distressful and require intense medical needs as well as support from offspring. Consistent with this, we find a significant increase in offspring's sickness absence in cases where the parent dies quickly. With somewhat longer survival times (3-12 months), we also identify small effects on employment and earnings, whereas for the presumably less serious cases – those with survival for more than a year – we find no significant effects at all.

The rest of this paper is organized into eight sections. The second section describes the shocks of interest and the Norwegian long-term care setting. In the third, we describe our data and sample selection. We present our empirical strategy in the fourth section, followed by descriptive measures of our sample in the fifth section. In the sixth, we present the results of our main analysis and a series of heterogeneity analyses that show differences by gender and survival time. In the seventh section, we present results from different subsamples and we test the sensitivity of our main results. In the eighth section, we discuss our results, how they fit into the literature, and the challenges of our study.

2 Stroke, hip fracture, and the organization of Long-Term care in Norway

When care needs arise, the organization of long-term care services (LTC) and societal preferences and norms regarding family obligations may shape how families respond to parental health shocks (Heitmueller, 2007; Norton, 2000; Siciliani, 2013). We use stroke and hip fracture as proxies for sudden increases in long-term care needs. These conditions often occur unexpectedly and lead to significant declines in the ability to perform daily activities. While the impact of strokes has been previously used in the health shock literature, hip fractures have not been similarly studied. Hip fractures are especially relevant in our context as they are highly prevalent among older adults in Norway and carry serious health implications. This section briefly describes specific health shocks used in our analysis and their management in the Norwegian context, followed by a brief description of the relevant long-term care setting.

a. *Strokes:*

A cerebrovascular accident, or stroke, is an acute condition that results from impaired blood flow to the brain, leading to potential motor dysfunction, language difficulties, and cognitive impairment (Peate, 2018). Stroke is one of the leading causes of serious long-term disability and is a significant contributor to morbidity and mortality in Norway. The prevalence of stroke increases with age, making it particularly relevant in the context of an aging population (Rand et al., 2019). In our analysis of population-wide patient registry data, we identify an annual average of 9600 distinct cases of stroke between 2008 and 2021, with the majority of cases occurring in male patients. In Norway, all suspected stroke cases are admitted to publicly funded hospitals, a network administered by four regional health authorities (Dahl et al., 2022). The Norwegian Directorate of Health (Helsedirektoratet) provides national treatment guidelines for acute stroke and many other acute conditions to secure high-quality care throughout the country (Helsedirektoratet, 2020). The guidelines provide a thorough approach for managing stroke from initial hospital admissions to post-discharge care. Initially, patients experiencing stroke symptoms should be quickly admitted to the emergency department for immediate treatment. After stabilization, they are moved to a dedicated stroke unit for specialized care. Upon completion of treatment in the stroke unit, it is critical to ensure a seamless transition to post-discharge care. This involves setting up a follow-up team that collaborates with local care services to craft a personalized rehabilitation plan. This plan is developed in close consultation with the patient and their family members to meet their specific needs. According to data from questionnaires gathered by the Stroke registry in Fjærtoft et al. (2022), three months after a stroke, approximately 57% of patients manage daily activities without any external assistance, while 24% receive assistance from family members; the remaining patients receive some kind of long-term.

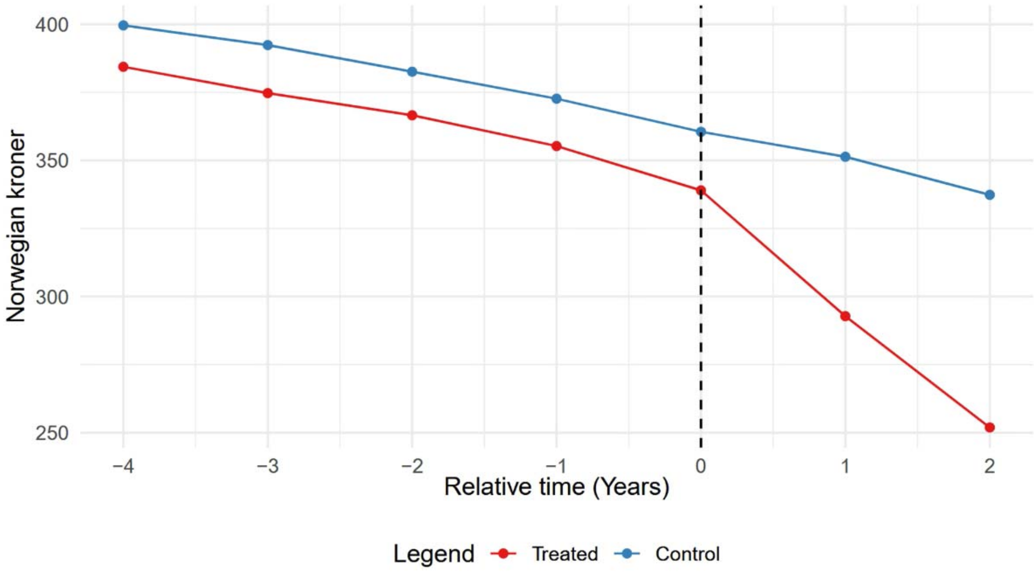
b. Hip fractures:

Hip fractures are serious injuries that involve the area around the femoral neck and are often linked to osteoporosis, making them common among older adults, particularly following a fall. Hip fractures are associated with significant functional impairment and a high risk of losing the ability to conduct daily life, often leading to the need for long-term care services (Figved et al., 2018; Fosse et al., 2021). Our data shows that in Norway, from 2008 to 2021, there has been an average of 8,100 distinct cases of hip fractures annually. Treatment for hip fractures typically involves surgical intervention at the hospital. Around 58% of patients with hip fractures receive surgery within 24 hours, and healthy patients tend to recover (Gjertsen et al., 2023; Helsedirektoratet, 2024). However, patients with many comorbidities and high age are at high risk of death or re-admission. As a result, 1-year and 5-year mortality is 24% and 53%, respectively (Gjertsen et al., 2023). The treatment of patients with hip fractures in Norway is highly heterogeneous; however, recommendations in Figved et al. (2018) emphasize the need for prompt intervention and coordination between municipal services, the family, and the patient to ensure rehabilitation and independence after discharge.

c. Overall impacts of strokes and hip fractures

To motivate the use of strokes and hip fractures as serious, sudden, and potentially randomly timed events, we present in Figure 1 the income trajectories of a sample of working-age (50-60 years) persons affected by these shocks conditional on survival for at least two years. In this illustration, the comparison group consists of persons who experience the same events three years into the future. We observe from the figure that in the three years before the health shocks, individuals show comparable trajectories in earnings, suggesting no major sign of anticipation of the event. In the years after the shock, earnings drop considerably and stay lower than in the pre-shock period, indicating a sudden disruption in labor market activity. In particular, in the year after the shock, real annual earnings fall by roughly 41,000 NOK, which represents around 11% of the earnings in the pre-treatment year, and by the following year, the earnings shortfall deepens to over NOK 61,000, marking a 19% reduction compared to the pre-treatment level.

Figure 1 Comparison of trends in earnings



Note: This figure reports the raw trends of annual earnings for both treatment and control groups. Our sample includes all patients of working age (50-60 years old) in Norway who experience stroke or hip fracture (n=12 011). The treated group comprises patients who experienced a health shock during the period from 2011 to 2016. This group is matched with patients who experience the same shocks three years later. The horizontal axis in the graph is centered at the time of the event (actual shock or placebo). Earnings are expressed in real terms using 2015 as the index year.

d. The Norwegian Long-Term Care System

The health shocks discussed in this section typically lead to needs for rehabilitation and long-term care services. In Norway, rehabilitation services are provided by both municipalities and hospitals. After discharge for both shocks, municipalities usually provide a coordinator or a coordinating unit for patients who require long-term services or a rehabilitation plan (*Health and Care Services Act*, 2011). Individuals requiring long-term care (LTC) services are legally entitled to publicly funded services. Public LTC services can broadly be divided into nursing home and home-based care services. Nursing homes provide comprehensive medical and nursing services around the clock, while home-based care delivers nursing and other necessary services to individuals living in their own homes or in community housing. Municipalities bear the financial responsibility for these services and must ration them based on assessed needs. The services are funded by block grants from the central government, local taxes on income, wealth, and (in some cases) property, and means-tested user payments (Borge, 2010).

Residents seeking care must submit an application to their local municipality, which conducts a needs assessment to determine the type and extent of services required. Municipalities can determine their service offerings and eligibility procedures, but services should be rationed according to need and should not be dependent on economic means (Bannenberg et al., 2021). Notably, children have no legal obligation to care for their parents in Norway. Despite this, informal care remains an essential part of the care system, and potential informal care can influence the level of services provided to an individual (Jakobsson et al., 2016).

e. Absence mechanisms in Norway

In Norway, employees are entitled to sickness benefits from the day they notify their employer about their own illness or injury. In general, employees must submit a self-reported sickness note that covers the first three days of sickness. After the third day, sickness absences must be documented with a certificate from a physician. The basis for sickness benefits is the current monthly income, and the replacement ratio is in most cases 100%. Although sickness absences are intended to cover one's own disease only, caring for family members can contribute to or lead to health deterioration that might lead to legitimate sick leave. In these situations, physicians should assess whether this condition is met (Helsedirektoratet, 2016).

Norwegian employees can also take temporary leaves to care for close relatives. Employees are entitled to 10 days of absence per calendar year to take care of close relatives such as parents, spouses, or partners and a maximum of 60 days to take care of close persons who are at home during a terminal stage of life (*Working Environment Act*, 2006). These types of leave are often unpaid, although public sector workers and employees in some large private firms may receive paid short leave to provide care for family members (Gautun & Bratt, 2024).

3 Data

Our study employs an extensive set of Norwegian registry data to evaluate the impact of parental health shocks on the labor market behavior and mental health outcomes of their adult offspring. Using an encrypted personal identifier, we link individuals and their families across various databases, encompassing detailed hospital admissions records and comprehensive socioeconomic data.

A. Health Data:

We use the Norwegian Patient Registry (NPR) to identify stroke and hip fracture patients using relevant diagnosis codes, date of diagnosis, level of urgency, and type of admission. In addition to NPR data, we complement this dataset by using data from the Norwegian Cause of Death Registry (CDR) to recover the time of death and construct groups based on survival time. Hospital data from NPR can be merged with all registers from 2008 to 2019 and cause-of-death data can be linked for the whole period.

Following Fadlon & Nielsen (2019, 2021), Norén, (2020), Bonekamp & Wouterse (2023), and Frimmel et al. (2023), we define health shocks based on the primary diagnoses of acute hospitalizations, classified according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (World Health Organization, 2019). We follow Rand et al. (2019) and classify stroke events as acute in-patient hospitalizations with primary diagnoses codes ICD-10 Codes I61, I63, and I64. Hip fractures are most accurately identified by employing a combination of diagnoses codes for femoral fracture and procedure codes that specifically indicate the treatment of an actual fracture (Øien et al., 2018). This approach helps to distinguish new fracture incidents from readmissions or complications related to previous fractures. We therefore follow Høiberg et al.(2014) and Øien et al. (2018) and classify hip fracture events as acute inpatients hospitalizations as a combination of ICD-10 codes S72 and NOMESCO codes for the treatment of femoral fractures (NFJxy, x = 0–9,y = 0–2) or replacement of hip joint (NFBxy, x = 0–4, y = 0–2; NFB62).

B. Outcomes:

We use data from Statistics Norway to track outcomes of interest. Our main outcomes are offspring's sickness absence spells, diagnosis, and symptoms related to mental health disorders, earnings, and employment. Our measure of earnings is the annual total of wage earnings and net income from self-employment. Earnings are measured in Norwegian Kroner (NOK) and adjusted to 2015 values using the Basic Amount (G) to deflate nominal values. The Basic Amount, often referred to as "G", is a key figure in the Norwegian social insurance system that is annually adjusted to reflect wage growth. When analyzing annual earnings as the outcome, we winsorize the data at zero and the 99th percentile to minimize the influence of extreme outliers.

Due to incomplete historical data on working hours, we adopt a similar approach to Fevang et al., (2012) and Løken et al. (2017) and consider an individual as employed if earnings meet or exceed G. This threshold corresponds to approximately 17% of the average full-time, full-year earnings in Norway.

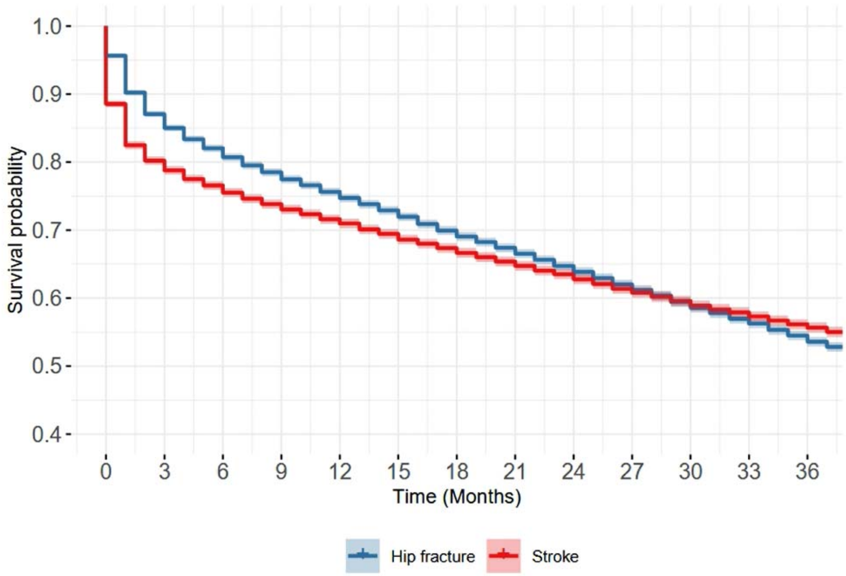
Regarding sickness absences, we observe physician-certified spells only, and certification is normally required if the spell lasts longer than three days. We divide the spells into short- and long-term spells, where we define a spell as long-term if it lasts longer than 16 working days. We include sickness absences as outcomes to capture short-term variations in labor supply that signal responses linked to caregiving decisions. Given that sick pay in Norway involves a replacement ratio of 100%, such responses will not be reflected in recorded earnings. Although sick pay is intended to cover own sickness only, it has been shown to be used to cover absences related to other critical events as well, such as serious illness in the family (Markussen et al., 2011).

Lastly, we want to explore the effects of parental health shocks on adult children's health and well-being. Experiencing a parental health crisis may represent not only a traumatic and stressful event for the children but also result in an increased mental burden due to new caregiving duties and their interaction with labor market participation. Therefore, in our analysis, we track the mental health outcomes of adult children around the time of the shock. We use the Norwegian Control and Payment of Health Reimbursements Database (KUHR) to identify mental health diagnoses within the primary care setting. Services in KUHR include visits to general practitioners, psychologists, emergency services, and other outpatient services. Using this registry, we identify diagnoses and symptoms related to stress, anxiety, depression, and sleep disorders (ICPC-2 codes: P01, P02, P03, P29, P74, P76; ICD-10 Codes: F32, F43, F41) and define a binary variable for any visit in which the offspring receive any of these diagnoses or symptoms. For employees, this outcome will, to some extent, overlap with outcomes related to sick leave, as physician-certified absences require a diagnosis.

C. Analysis Sample:

Our sample is all children aged 35 to 65 whose lone parent suffered a "first-time" stroke or hip fracture between 2011 and 2019, with offspring outcomes recorded from 2008 through 2021. To operationalize "first-time", we establish a three-year washout period set before the health shock to reduce the chance that the observed health event is a continuation of a previous shock. During these three years, we require that the lone parents must not have experienced a stroke or hip fracture. The final number of offspring in our sample is described in Table 1, whereas the sample of shock-affected parents is described in Appendix Table A1.

Figure 2 Survival probabilities following a health shock



Note: This figure shows the survival curves corresponding to the parents in the treated group in our sample (N = 35 121). This graph is divided by type of shock and represents the survival probability months after the health shock of reference in our sample.

We focus on lone parents –divorced, widowed, or unmarried – because their offspring are more likely to bear the caregiving responsibility. In cases where a spouse is present, caregiving tasks are typically handled by the spouse, reducing the caregiving burden on the offspring. For children with divorced parents, there is a possibility that both parents experience overlapping health shocks. To address this, we retain only the parent whose shock occurs first in the sample and use their admission date as a reference date. Table 1 contains the number of adult children identified in different stages of our sample selection.

D. Subsample analysis: Survival time

In addition to our main sample, we divide the sample into four groups based on how long the parents survive after experiencing the health shock: up to three months, three to six months, six months to a year, and twelve months or longer. The purpose of this partition is to distinguish among periods where we expect caregiving needs are likely to vary. For instance, short-term survival might be more influenced by acute medical care needs, while longer-term survival could involve more prolonged caregiving. Figure 2 shows that the risk of dying is large within the first months after the shock. In cases of stroke, we show that in the third month after the event, the overall survival rate in our data was 78.9%, a similar figure to that reported by Peng et al. (2022). Hip fractures show a slightly higher survival rate, with around 85% of the patients surviving within the same timeframe, which is consistent with the numbers reported by Holvik et al.(2023).

Table 1 – Sample: Identification of children	**Men**	**Women**	**Total**
Children of Parents with Health Shock (Stroke or Hip Fracture)	218.923	207.901	426.824
Children whose parents did not suffer a shock in the last three years	145.665	138.769	284.434
Number of children with an affected lone parent	64.237	66.126	130.363
Number of children aged 35-65 with an affected lone parent	55.769	54.722	110.491

Note: We consider lone parents, those affected parents, who, in the year before the shock were widowed, divorced, or separated.

4 Empirical Strategy

We follow the approach in Fadlon & Nielsen (2019, 2021) to estimate the effects of a parental health shock on adult children's labor market outcomes and well-being. This approach identifies the effects of health shocks by comparing the outcomes of affected individuals before and after the shock with those who will experience the same parental health shock at a later time. Specifically, in our analysis, we compare children who experience a parental shock in a given year with adult children who experience the shock three years later. To illustrate the method, consider the first cohort of adult children experiencing a parental health shock in 2011. Due to the three-year washout period, shocks occurring in 2008-2010 are excluded from the analysis. This initial treatment group is compared before and after the event to a control group of adult children who will encounter the shock three years later, in 2014. Therefore, the treatment group cohorts comprise offspring experiencing a parental health shock during 2011-2016, and the control group comprises offspring experiencing the shock in 2014-2019, implying that offspring experiencing the shock in 2014-2016 serve as both treated and controls. We combine these cohorts to obtain a dataset where each treatment group is compared to a control group that receives a placebo treatment at *t* (but receives the actual treatment in *t+3*). Using this dataset, we estimate the parameter of interest through a stacked regression similar to Cengiz et al. (2019), and Deshpande & Li (2019).

Following the structure of our data and the empirical design, we define our event-time window to span three years before the parental shock and up to two years after the shock, ending one year before the children in the control group experience the actual shock. We use the following event study specification:

$$y_{it} = \alpha + \beta D_i + \sum_{r=-3;r\neq-1}^{2}(\gamma_r D_i {I^r}_{i,t}) + \delta\, X_{i,t} + \epsilon_{it} \qquad (1)$$

where y_{it} denotes the outcome of interest for individual i at time t. The variable D_i indicates whether individual i belongs to the treatment group ($D_i = 1$) or the control ($D_i = 0$) group. ${I^r}_{i,t} = I[t - T_i = r]$ is a relative year indicator equal to 1 when there are r years to the event year T_i, which represents the actual shock for the treatment group and the placebo shock for the control group. For quarterly outcomes, r ranges from -12 to 8. The error term, ϵ_{it}, is clustered at the individual level.

The vector of control variables X_{it} includes calendar year fixed effects, which are interacted with the year of the actual or placebo shock, as well as a full set of age dummies. Including a full set of age dummies is crucial because, on average, individuals who experience a parental health shock are older than those who experience the same shock three years later (as demonstrated in the descriptive statistics in the next section). To address this age difference, we follow Golosov et al. (2023), who include a full set of age dummies in similar later-treatment-as-control designs.

Our parameters of interest are the set of γ_r, which measure the change in outcomes from the reference year ($k = -1$) to the specific years (ranging from $r = -3$ to $r = 2$) in the treatment group relative to the control group. These average comparisons capture the impact of the health shocks on the outcomes, assuming that the change in outcomes in the control group reflects how outcomes would have changed for the treatment group in the absence of the shock. The validity of this parallel trends assumption can be assessed by checking for differences in pre-treatment trends between the treatment and control groups. Specifically, if $\gamma_r = 0$ for all $r < 0$ it suggests that the trends would have moved in parallel in the absence of the shock.

5 Descriptive Statistics

Table 2 provides summary statistics for the treatment and control groups. The reported numbers refer to the pre-treatment measures, at t_{-1}, for adult children and affected parents. By construction, treatment and control groups differ slightly in relevant dimensions, such as the age of the parents and adult children, reflecting that controls experience the event three years after the treatment. Given how the treatment and control groups are constructed, it is no surprise that they are similar in terms of other observed characteristics such as gender, civil status, and education.

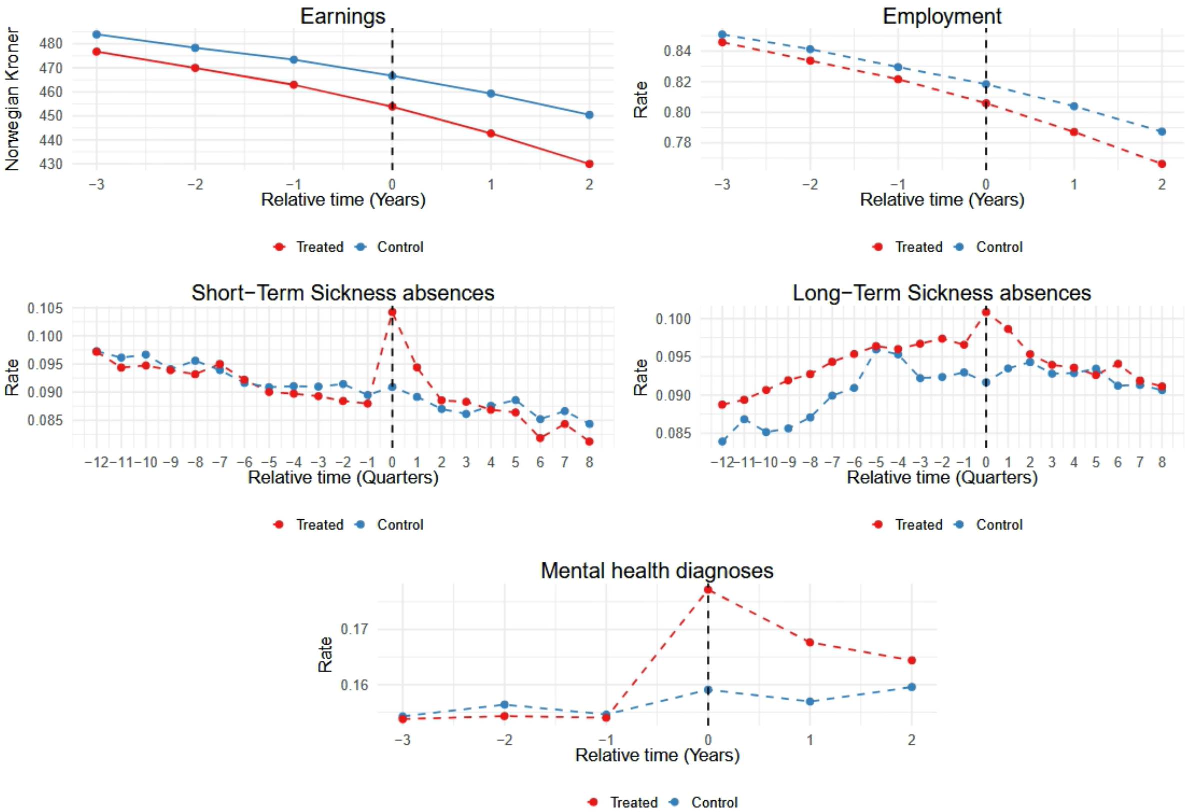
In Figure 3, we show the trajectories of outcomes for both groups. In the upper panel, we show that both earnings and employment tend to follow a similar trend throughout the observed period. In addition, we note small differences in levels that result from the differences in the age distribution of both groups. that result from the differences between calendar and event times between the treatment and control groups. Note that the downward slope of these two outcomes reflects the earnings-age profile of those in our sample. As we observe in Table 2 Pre-shock Summary Statistics: A much larger proportion of the treatment sample is between the years 55 to 65 at the time of the shock than what applies to the control group, and these are ages at which employment tends to start declining as shown in Fevang et. al, (2012).[3] Motivated by these differences, we control in our analysis for these differences in age profiles between the two groups.

For other outcomes, such as sickness absences and mental health diagnoses, we observe that treatment and control groups follow similar trajectories in the periods leading to the shock. These illustrations of trends in outcomes are reassuring if one is concerned about the impact of the higher use of specialized health care services in the treatment group relative to control (See Table 2). Despite these asymmetries, we find no visible sign of an anticipation effect.

To further motivate our Identifying assumption, in the appendix Figures A1 to A5, we include these outcomes trajectories divided by the year of each health shock (actual or placebo). Although we observe some differences for each shock cohort, we consider that these outcomes tend to follow a similar trend to those presented in Figure 3.

[3] Note that the controls are subject to an implicit assumption: at the time of the placebo shock at least one of their parents survive for at least three years, which may involve some intricate, but most likely negligible, selection issues.

Figure 3 Comparison of trends in adult children's outcomes



Note: This figure reports the raw trends in outcomes for both treatment (N= 75.841) and control group (N = 66.184). Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo). Earnings are expressed in thousands and in real terms using 2015 as the index year.

Table 2 Pre-shock Summary Statistics:

Group characteristics	***Description***	**Group** **Treated**	 **Control**
Offspring	*N*	75.841	66.184
Age		52.0 (7.3)	50.6 (7.4)
Age group	34-44 years old	17.7%	22.2%
	45-54 years old	40.9%	43.5%
	55-64 years old	41.7%	34.4%
Gender	Female	49.7%	49.5%
Siblings	Siblings sharing an affected parent	2.8 (1.3)	2.8 (1.3)
Civil Status	Married or in a Partnership	55.8%	54.5%
	Unmarried, widowed, or divorced *	44.2%	45.5%
Education	Primary Education	20.2%	20.4%
	Secondary Education	47.0%	46.1%
	Higher Education	32.8%	33.5%
Earnings	Income and earnings from self-employment (measured in thousand 2015-NOK)	463.8 (345.0)	474.3 (346.4)
Employed	Earnings above G in a given year	82.2%	83.0%
Mental Health	ICPC-2: P01, P02, P03, P29, P74, P76	15.4%	15.5%
Sickness absence days	Mean number of absent working days	4.9 (14.2)	4.7 (13.0)
Short-term sickness leave	Sickness absence spells below 16 working days	8.9%	8.9%
Long-term sickness leave	Sickness absence spells lasting 16 working days or more	9.7%	9.3%
Affected parent			
Age		81.2(8.3)	79.1(8.2)
Gender	Female	76.0%	76.9%
Diagnosis	Hip Fracture	54.3%	55.6%
	Stroke	45.7%	44.4%
Education	Primary Education	48.2%	46.1%
	Secondary Education	42.0%	43.2%
	Higher Education	9.8%	10.6%
Specialized care use	Acute overnight admission	25.6%	17.7%
	Acute ambulatory admission	12.2%	9.5%
	Planned overnight admission	8.6%	8.3%
	Planned ambulatory admission	8.6%	8.3%

Note: Mean (SD); %. The values shown in the table represent the pre-treatment (at r = -1) characteristics of both adult children and the affected parent. All characteristics are measured in the year before the shock (i.e., t = -1, actual or placebo), except for sickness absences, which we measure in the quarter before the shock, Earnings values in real terms, using 2015 as baseline. Acute inpatient admissions refer to emergency admissions that usually require patients to stay overnight. Acute ambulatory admissions refer to emergency visits that do not require patients to stay overnight and where treatment is more extensive than an outpatient visit.

6 Effects of Parental Health Shocks

In this section, we present our estimates of the effects of having a lone parent experiencing a health shock. First, we present the estimates corresponding to sickness absence and mental health based on quarterly sick leave records and annual patient records. Second, we show estimated effects on annual earnings and employment status. For each outcome, we estimate our model using the full sample of affected children. Then, we estimate the model using different samples categorized by the survival time of the affected parent. Additionally, in the Appendix, we include another set of heterogeneity analysis where we run separate models by type of shock, number of affected children, and place of residence (See Figures B1-B4).

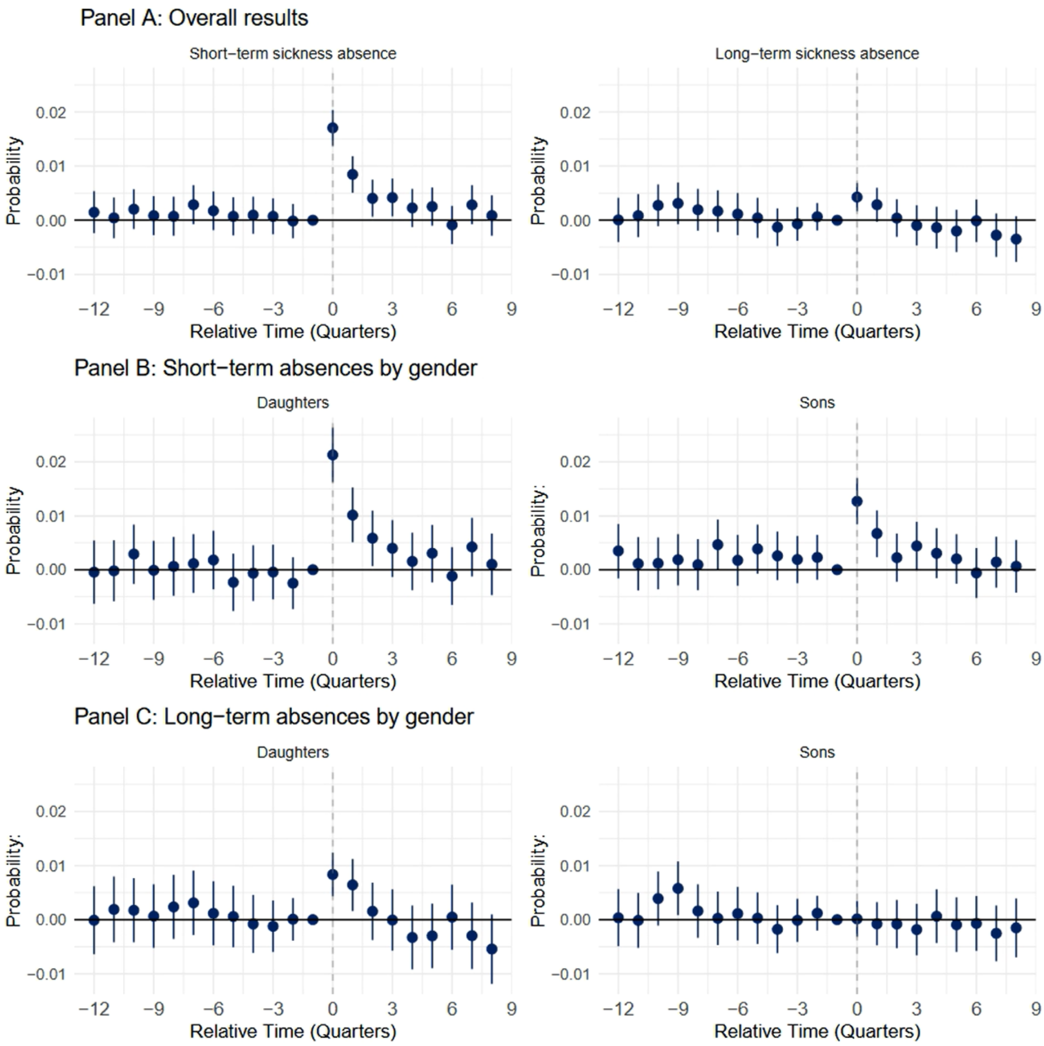
A. Immediate responses:

To examine sick-leave behavior, we limit the analysis to offspring that were employed in the year before the parental health shock (actual or placebo), and, hence, were exposed to the risk of sick-leave (82.5% of the sample). Figure 4 presents our main results. Our estimates correspond to the regression in equation (1). These estimates can be interpreted as the change in the quarterly probability of experiencing at least one short- or long-term absence spell, respectively, compared to the reference quarter (the last quarter before the shock occurs).

In Figure 4, we distinguish between the incidence of short-term absences (less than 16 working days) and long-term absences (more than 16 working days), and we show results for all (upper panels) as well as for daughters and sons, respectively. The results in Figure 4 indicate a significant rise in short-term sick leave in the quarter of the parental shock. On average, the effect is estimated to be a 1.7 percentage point increase, and is larger for daughters than for sons, with an increase of 2.1 and 1.2 percentage points, respectively. For long-term absences, the estimated rise one year after the shock is 0.4 percentage points. Given baseline propensities around 9 percent for both short-term and long-term absences, we consider these effects as small. Toward the end of our 8-quarter-long outcome period, we see indications of a *decline* in daughters' absence from work. As we return to below, this may be related to a small drop in employment (which implies that absences can no longer occur). Alternatively, it may be related to the fact that the shock raised mortality among the lone parents (conf. Figure 2), such that some of the daughters no longer faced any care obligations.

Figure 5 and Figure 6 show how these results vary by the survival time of the affected parent. The responses tend to be larger the shorter the parent's survival time. For children whose parents die within the first three months after the shock, we estimate average increases in short-term and long-term absences of around 5.7 and 2.5 percentage points, respectively in the quarter of the shock. With survival up to six or twelve months, we see somewhat smaller but also more prolonged responses in short-term absences. However, for parents living longer than a year (i.e., approximately 75% of the cases) there are hardly any effects on offspring's sickness absences at all. These patterns indicate that care needs are likely to be very limited in most of the cases, such that our finding of "small" effects on average probably conceal a combination of close-to-zero effects for the vast majority and moderate effects for the minority of cases where care needs do arise.

Figure 4 Probability of being absent from work due to sickness



Note: This figure shows our event-study estimates for the effects of health shocks on adult children's probability of being absent from work due to sickness (Shown in the Y-axis). These estimates are separated by spells' duration. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one-quarter before the shock. The bars around these estimates represent the 95% confidence intervals. Panel A shows the overall results, while panels B and C show the results for short-term and long-term absences divided by sex, respectively.

Figure 5 Short-term sickness absence by parents' survival time

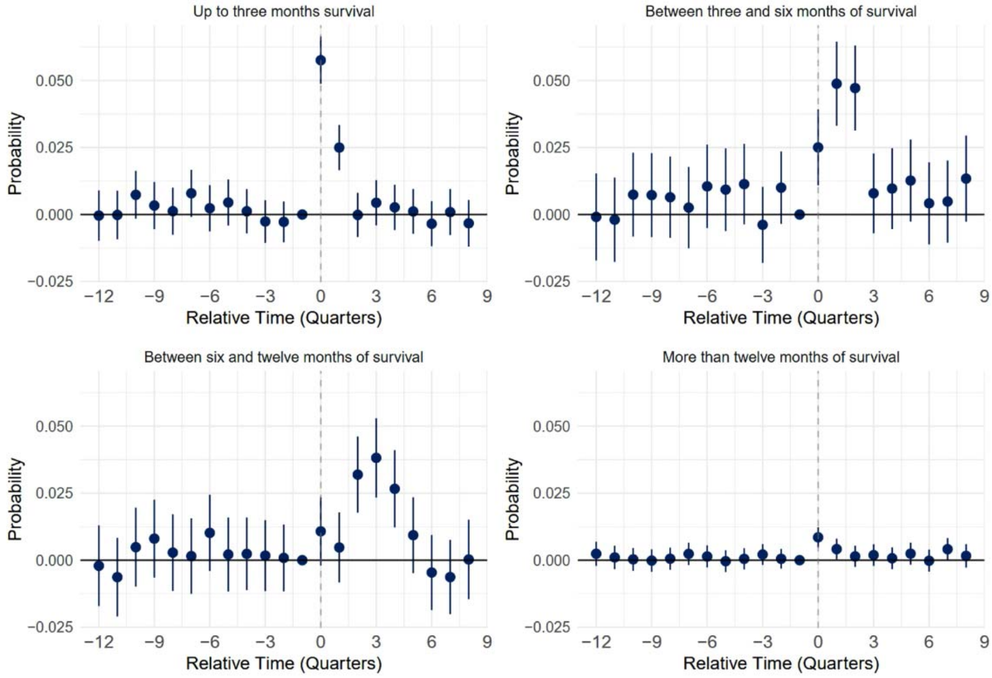
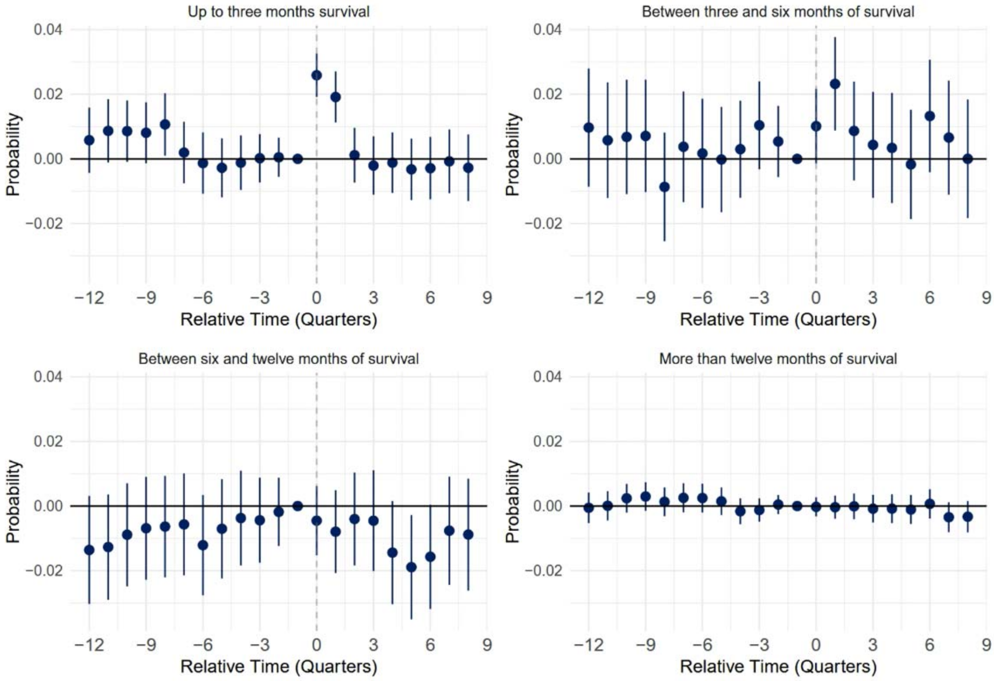


Figure 6 Long-term sickness absence by parents' survival time

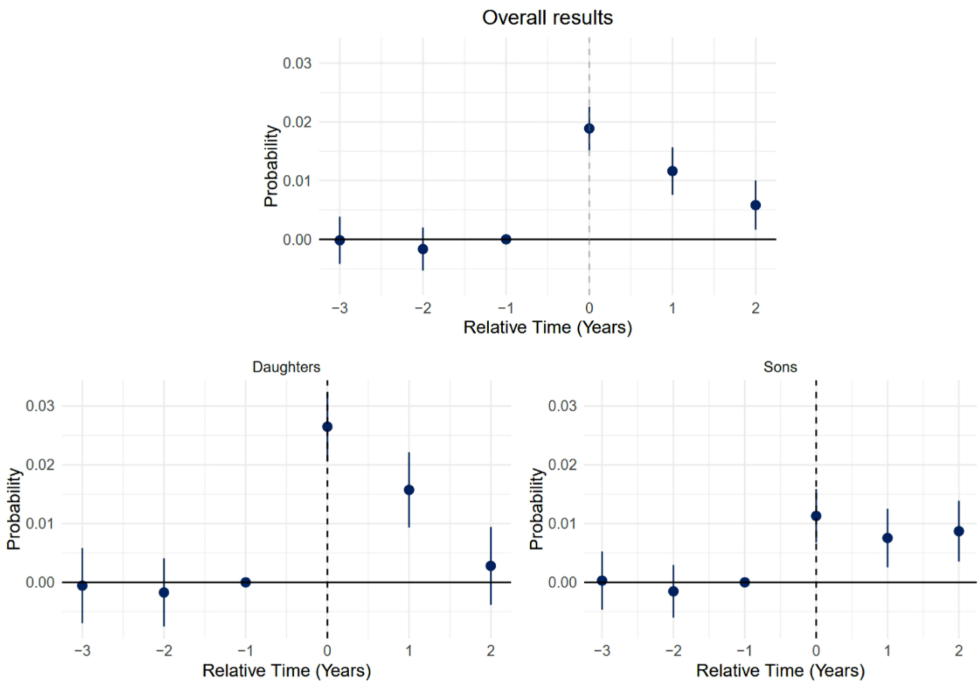


Note: Figures 5 and 6 show our event-study estimates for the effects of health shocks on adult children's probability of being absent from work due to sickness (Shown in the Y-axis). These estimates are separated by survival after the shock. Figure 5 shows results corresponding to short-term sickness absences, while Figure 6 shows results corresponding to long-term absences. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one-quarter before the shock. The bars around these estimates represent the 95% confidence intervals.

To explore more directly whether having a parent affected by a serious health shock and/or in need of care has any health effect on adult children, we turn to investigate the impact of such shocks on the offspring's mental health, as reflected in diagnoses resulting from a consultation with primary care providers. These data are annual only, and, although we now also include non-employed offspring in the analysis, the outcome could potentially be dominated by diagnoses provided in relation to sickness absence from work. Our estimates in Figure 7 show that the probability of receiving a diagnosis related to stress, anxiety, depression, or sleeping disorders increases significantly by 1.8 percentage points. This increase persists over the next two years after the event. Again, the effect is larger for daughters than for sons, and it is largest in the year of the event.

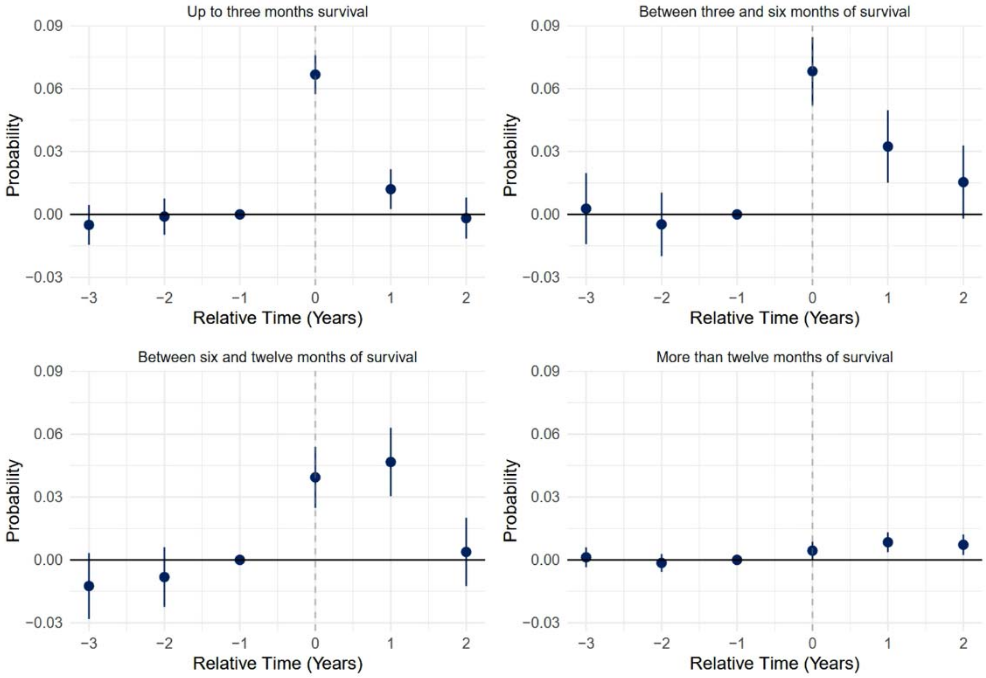
In Figure 8, we show responses by different survival profiles for the affected parent. These follow a similar pattern as what we saw for sickness absence: Large, but short-lived effects for children whose parents die within three months after the shock. Still large, and also more prolonged effects for children whose parents survive up to a year. And small, but persistent, effects for children whose parents survive longer than a year.

Figure 7 Probability of receiving a mental health diagnosis



Note: This figure presents our event-study estimates for the effects of health shocks on adult children's probability of receiving a mental health diagnosis related to stress, depression, anxiety, or sleeping disorders (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots in the graph represent the point estimates relative to one year before the shock. The bars around these estimates represent the 95% confidence intervals. The upper panel shows the overall results and the second row shows the results divided by gender.

Figure 8 Probability of receiving a mental health diagnosis by parents' survival time



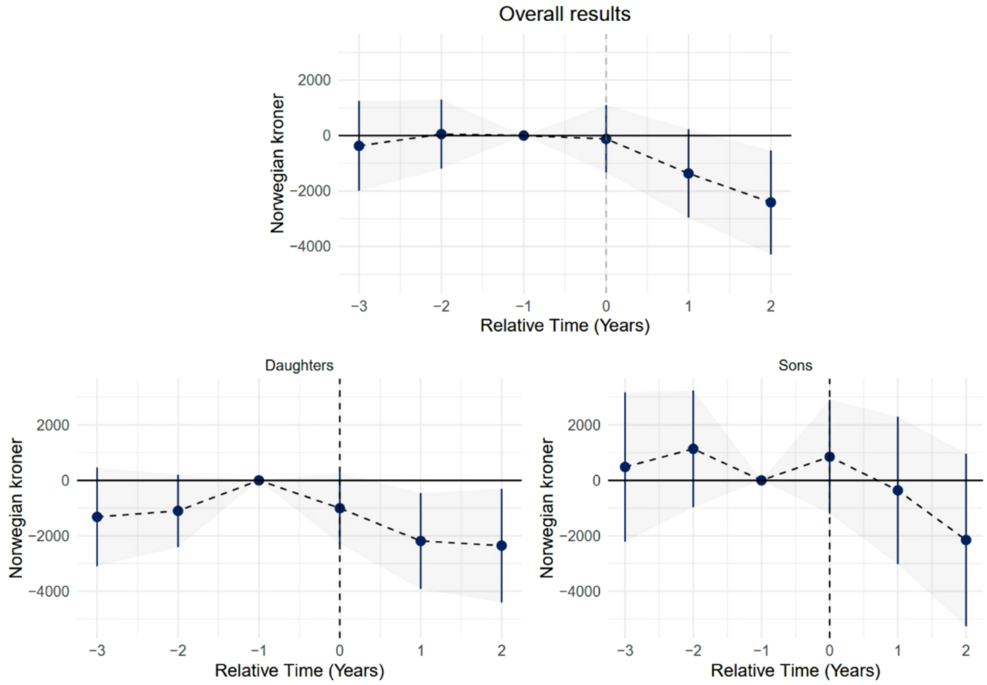
Note: This figure presents our event-study estimates for the effects of health shocks on adult children's probability of receiving a mental health diagnosis related to stress, depression, anxiety, or sleeping disorders (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots in the graph represent the point estimates relative to one year before the shock, and the bars around these estimates represent the 95% confidence intervals.

B. Earnings:

In Figure 9, we show the estimated effects of the parental health shock on the evolution of labor earnings for adult children. These results are based on the complete sample of offspring, irrespective of initial employment status. Our estimates suggest that offspring earnings drop in the two years after the event. But, although the effects are borderline statistically significant, they are small from an economic viewpoint. Two years after the shock, the point estimate implies earnings drop equal to NOK 2,409 for the sample as a whole, roughly 0.5% of mean baseline earnings. These responses are similar for sons and daughters.

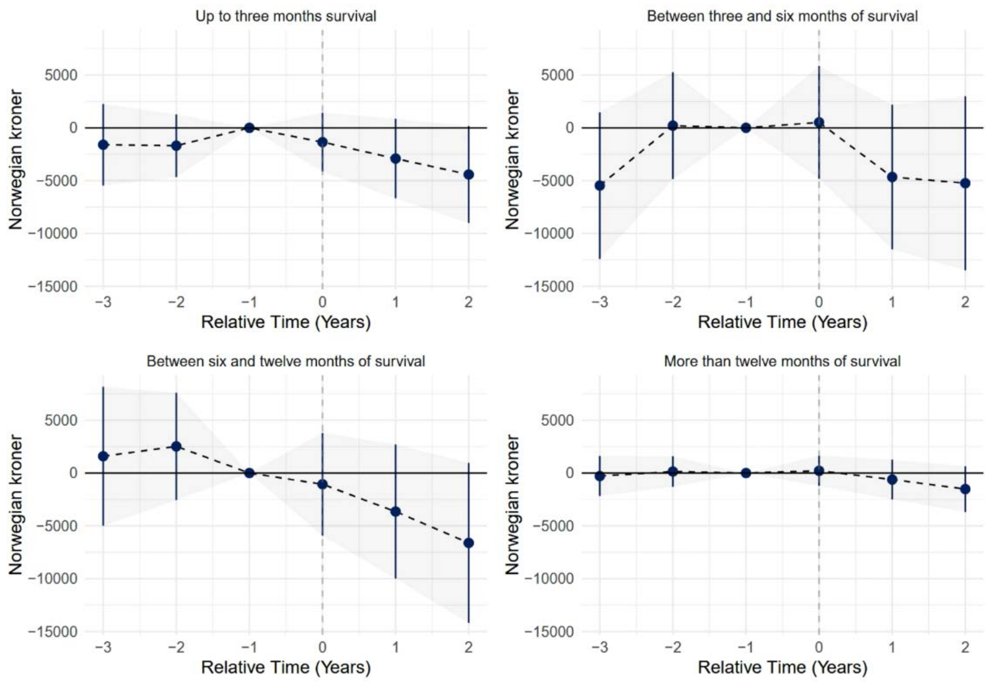
The small earnings effect again conceals a combination of almost zero estimated effect for the majority of offspring whose parents survive more than a year and larger effects for offspring whose parents die within the first year after the shock. However, as shown in Figure 10, these separate effects are estimated with considerable statistical uncertainty.

Figure 9 Effects of parental health shocks on adult children's earnings



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's earnings (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dotted line denotes the point estimates relative to one year before the shock, and the bars around these estimates represent the 95% confidence intervals. Earnings are expressed in real terms using 2015 as the index year. The upper panel shows the overall results, and the second row shows the results divided by gender.

Figure 10 Effects on earnings by parents' survival time



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's earnings (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dotted line denotes the point estimates relative to one year before the shock, and the bars around these estimates represent the 95% confidence intervals. Earnings are expressed in real terms using 2015 as the index year.

C. Employment:

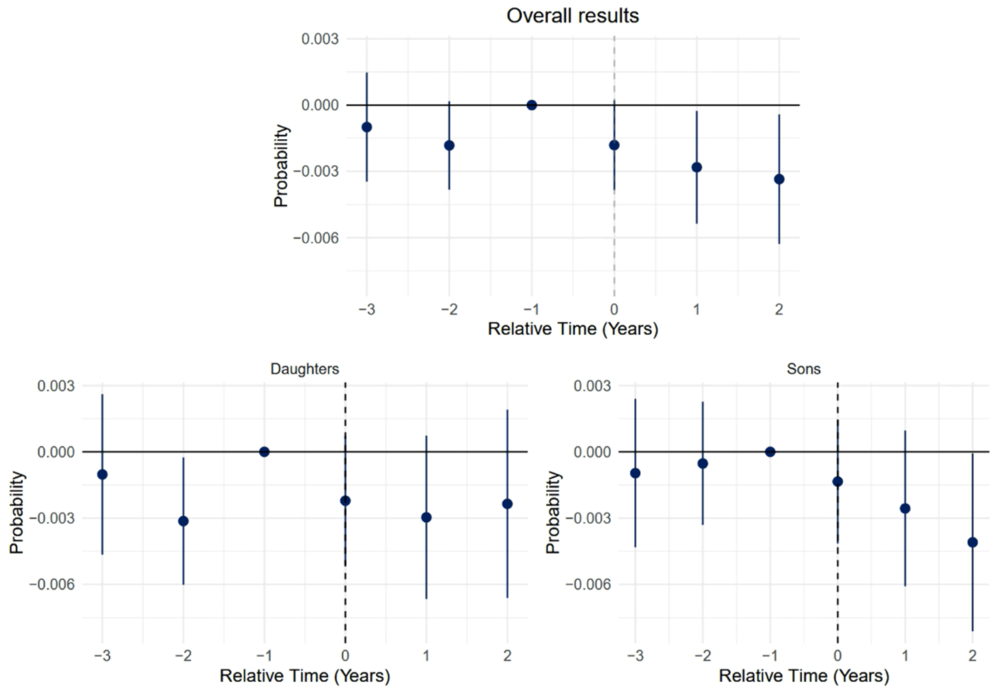
Our employment results, presented in Figure 11, demonstrate the estimated effects on the probability that adult children have earnings equal to or above the Basic Amount, which is our indicator of employment.

We generally observe that point estimates indicate a small negative impact on offspring employment in the two years following the parental health shock, with similar results for sons and daughters. Although none of the estimates is statistically significant in isolation, they form a consistent pattern of slightly reduced employment propensity.

Furthermore, as shown in Figure 12, we observe that adult children whose parents survive from three to six months experience a 0.9 percentage point reduction in their employment propensity in the year of the event, followed by an additional decrease of nearly 1.3 percentage points in the subsequent year.

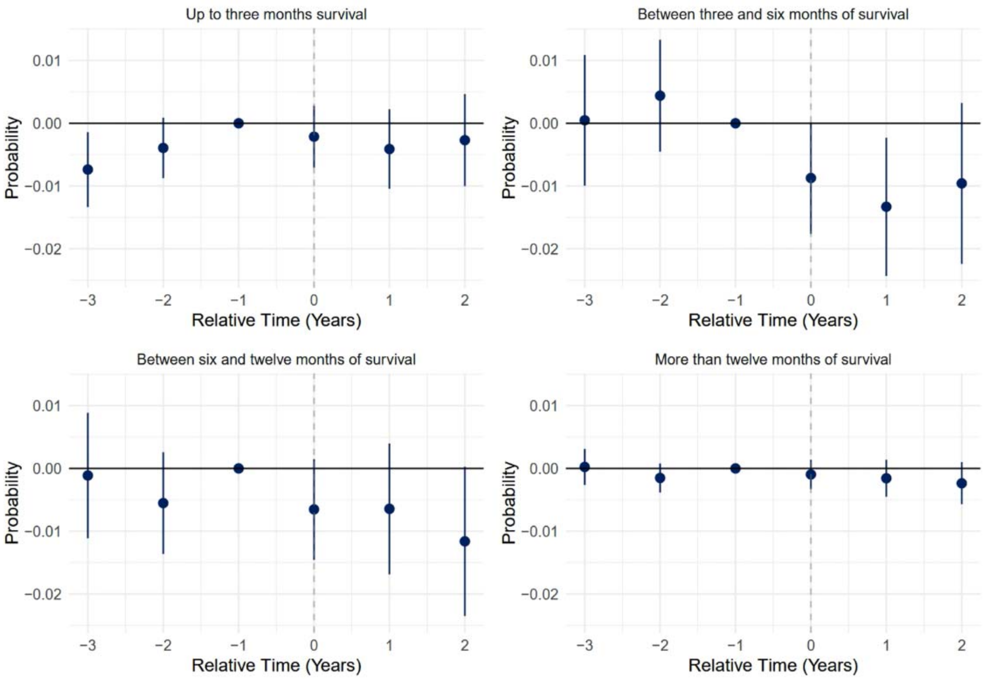
While only borderline significant, results for children whose parents survive between six months and twelve months, suggest a gradual decline in employment propensities.

Figure 11 Effects of parental health shocks on adult children's propensity to work



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's propensity to be employed (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent the point estimates relative to the year before the shock, and the bars around these estimates represent the 95% confidence intervals.

Figure 12 Effects on employment by parents' survival time



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's propensity to be employed (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots denote the point estimates relative to the year before the shock, and the bars around these estimates represent the 95% confidence intervals.

7 Heterogeneous results and robustness check

In Appendix Figures B1-B4, we report separate results by diagnosis (stroke or hip fracture), by the number of offspring in the family (only child or siblings), and by residential circumstances (living in the same or a different municipality as the parent). The patterns are similar across shock types and groups, with sick-leave responses somewhat more long-lasting for only-children and offspring living in a different municipality than the parent. Effects on mental health are similar across groups, except for those children of parents hit by a stroke. These estimates show larger and short-lived responses compared to hip fractures. In line with our main estimates corresponding to different survival times and sick-leave responses, these differences are potentially driven by higher mortality in parents affected by stroke (As reflected in Figure 2).

To test the robustness of our results, we replicate our main analysis using a longer time between shocks to construct treatment and control groups. Instead of using the previous window of three years, we now take a four-year difference between the treated and control units. As a result, our analysis in figures B5-B7 in the appendix has a smaller sample size

(Treated: 50.168; Control: 43.143), than our main analysis. In this sensitivity analysis, we do not allow control units to serve as treated in the future due to the periods covered in our data.

In general, our results are similar to those in the main analysis. We observe increased uncertainty around some estimates, especially those corresponding to earnings for sons. We find, however, that the small reductions in earnings observed in the main analysis tend to disappear from the overall results and those divided by gender. In terms of sickness absences and mental health diagnoses, we observe similar increments to those in the main analysis.

8 Conclusion

In this paper, we estimate labor market responses for adult children when a lone parent experiences a health shock. We define health shocks as episodes of stroke or hip fractures. Using Norwegian administrative data, we create treatment and control groups using only a sample of individuals affected by similar shocks in different years. The analysis is formulated as a series of event studies, where we follow offspring from three years before to two years after their lone parents experience the health shock in question.

Our main findings show a significant increase in short-term sick leave around the time of the parental health shock and an elevated risk of experiencing mental health problems. In addition, we find indications of modest reductions in the annual earnings after a parent experiences a health shock, with point estimates suggesting a small negative employment effect. Notably, we find differences in the effects by gender, with daughters being more affected than men, particularly in terms of short-term absence from work.

Whereas the identified effects are small on average, we find considerably larger effects for the 25% of the offspring whose parents die within 3-12 months after the shock. Our interpretation of this pattern is that the cases in which the parents die within a year may be the more serious cases in terms of care requirements. Hence, it seems plausible that the small estimated *average* effect conceals a combination of a quite large effect for a small proportion of offspring and a close-to-zero effect for most cases.

Adult children's responses to parental shocks may be attenuated or offset by the availability of formal care substitutes and other social assistance programs (Ettner, 1996; Jolly & Theodoropoulos, 2023). These services may provide additional resources, skills, and technologies that adult children could not provide or produce otherwise (Norén, 2020). In addition, the shocks we study may offer quicker access to care services, thus reducing the burden on family members after hospital discharge. This is particularly relevant in institutional settings where health services are universally and publicly provided. In such contexts, households experiencing non-fatal shocks such as strokes or hip fractures might be well insured through formal care or other social insurance mechanisms (Fadlon & Nielsen, 2021; Jolly & Theodoropoulos, 2023; Norén, 2020; Rellstab et al., 2020). Looking at the Norwegian context, Kotsadam (2012) finds that being an informal caregiver in Norway does not have a statistically significant impact on the probability of being employed or on wages.

Together with the effects on earnings and employment propensities, the increased probability of receiving physician-certified sickness absences and the increase in mental health diagnoses may indicate a short period of distress for adult children after these shocks, especially for those whose parents die within a short time after the health shock. These estimates may contain a bundle of effects that we cannot disentangle throughout our analysis. For example, a significant portion of the rise in absences from work is concentrated around the time of the event and may thus arise from grief and psychological stress rather than care needs.

Our results contribute to the growing literature on health shocks and labor market outcomes. Although these effects have been widely explored in the context of spousal responses, the impact of these shocks through other channels, such as sickness absences and well-being of adult children, remains inconclusive. The extent to which our results can be extrapolated to different settings may depend on context-specific factors such as the organization of long-term care services, the social insurance system, and societal norms toward providing care within the family.

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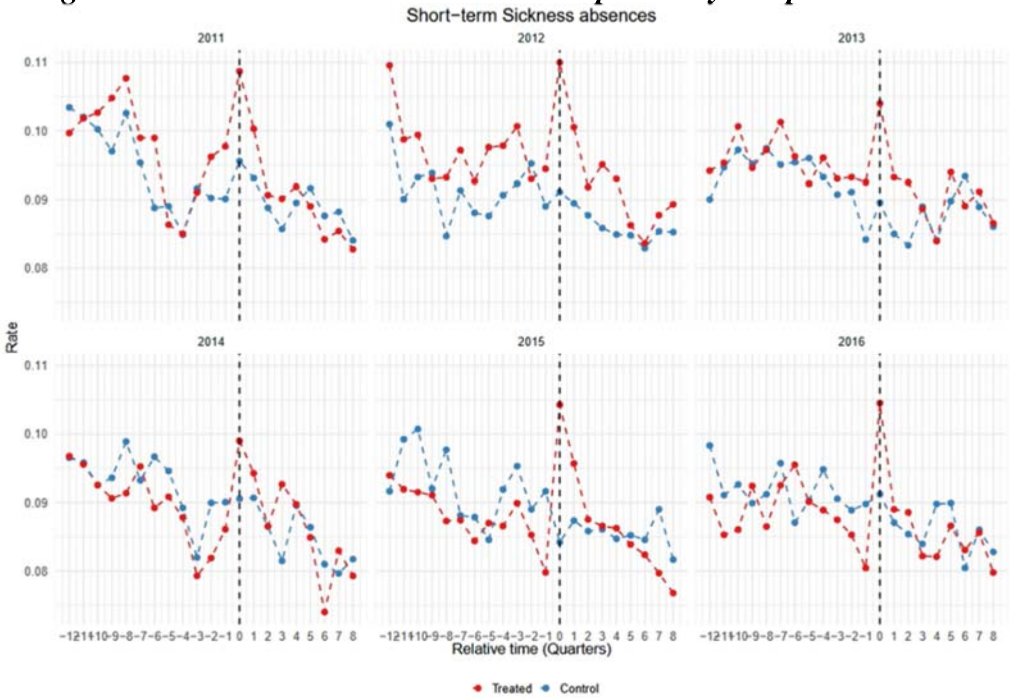
Appendix A: Sample of parents and trends by cohort

Table A1 - Sample - Identification of cases	**Men**	**Women**	**Number**
Parents who suffer a health shock (stroke or a hip fracture)	78.021	104.290	182.311
Parents who did not have a similar shock in the last three years	50.791	68.216	119.007
Number of parents who experience the shock first	49.107	66.166	115.273
Number of parents who are divorced, separated, or widowed in the year before the shock	16.909	41.735	58.644
Number of parents who are alone the year before the shock and have at least one child between the ages of 35 and 65 (at the actual or placebo shock)	12.534	38.133	50.667

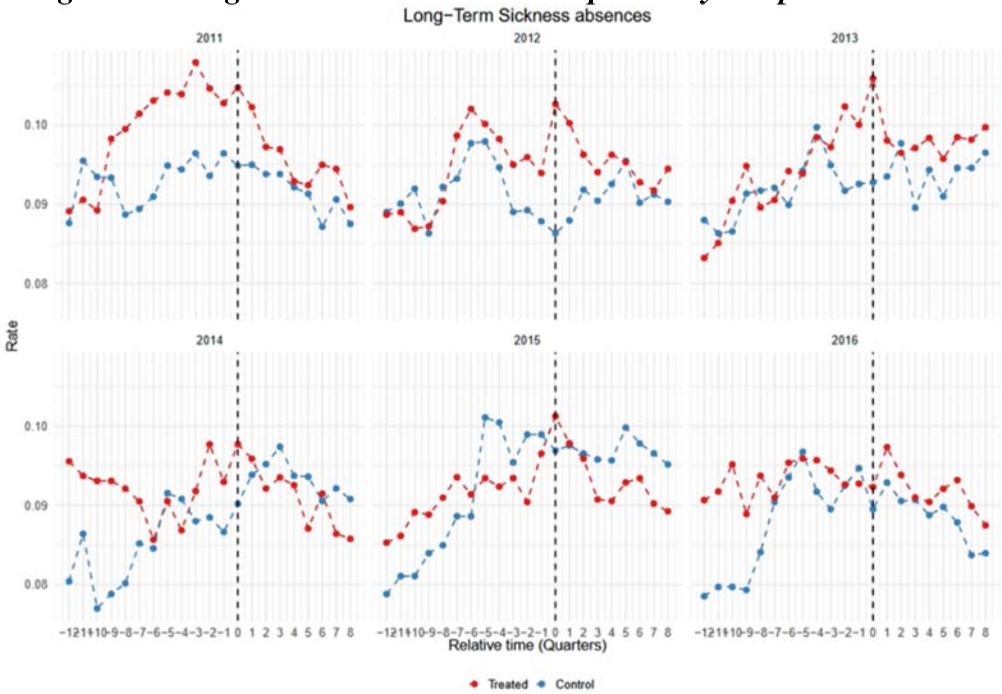
Note: We consider lone parents, those affected parents, who, in the year before the shock were widowed, divorced, or separated.

Figure A1 Short-term sickness absence responses by comparison cohort



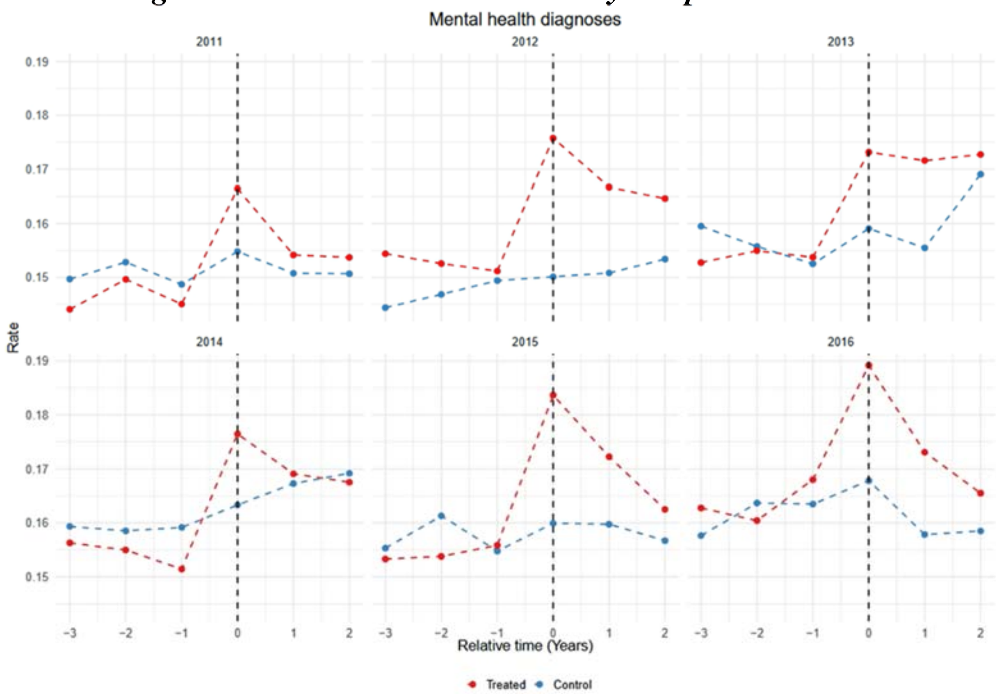
Note: This figure reports the raw trends in short-term sickness absences by shock cohort. Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo).

Figure A2 Long-term sickness absence responses by comparison cohort



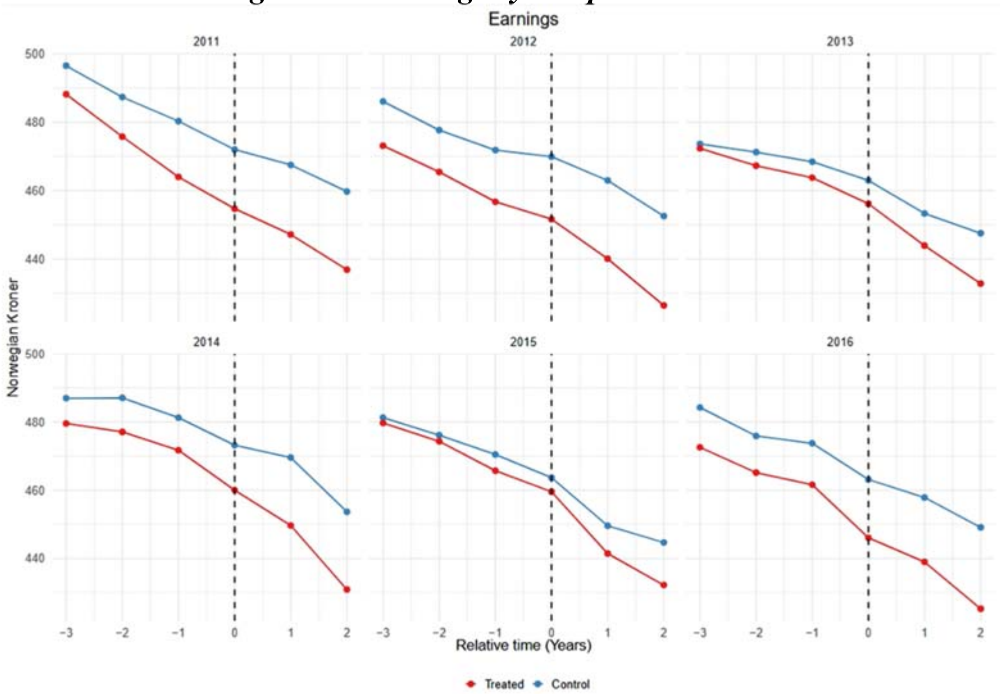
Note: This figure reports the raw trends in Long-term sickness absences by shock cohort. Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo).

Figure A3 Mental health outcomes by comparison cohort



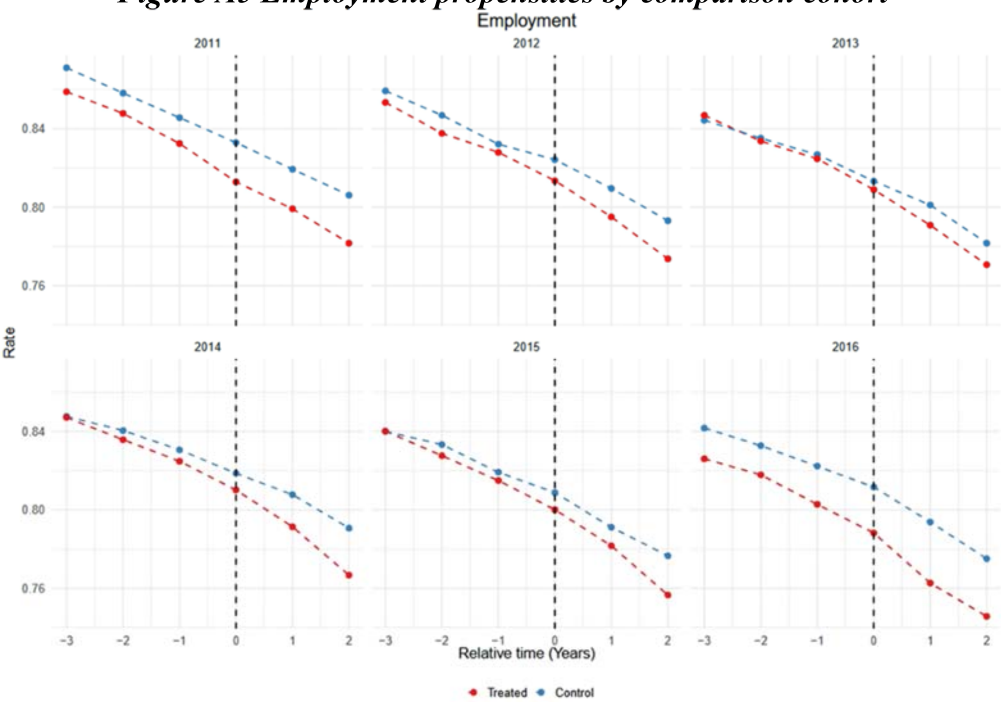
Note: This figure reports the raw trends in mental health outcomes by shock cohort. Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo)..

Figure A4 Earnings by comparison cohort



Note: This figure reports the raw trends in earnings by shock cohort. Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo). Earnings are expressed in real terms using 2015 as the index year.

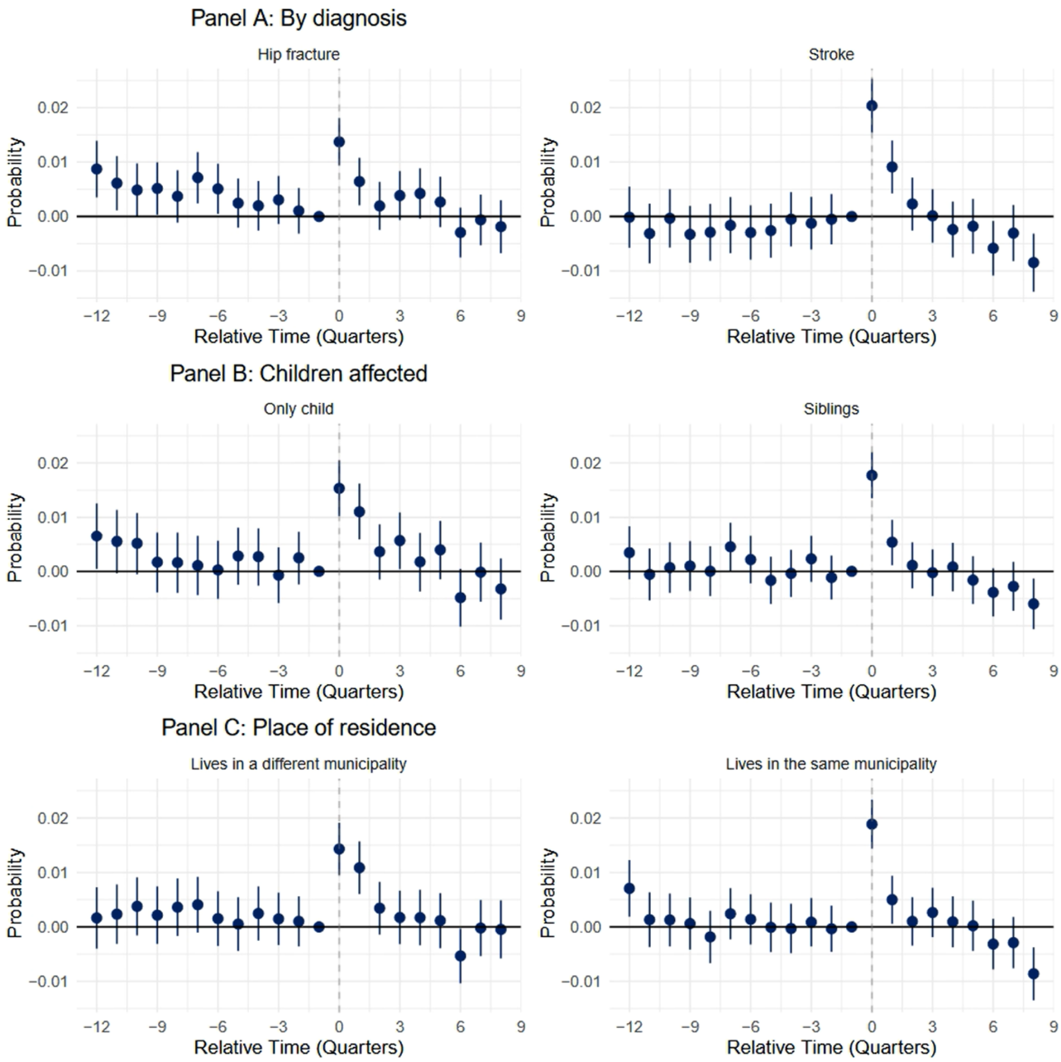
Figure A5 Employment propensities by comparison cohort



Note: This figure reports the raw trends in employment by shock cohort. Our sample includes adult children who suffer a parental health shock. The treated group is comprised of children who experience a parental health shock from 2011 to 2016. This group is matched with adult children who experience the same shocks three years later. The X-axis in the graph is centred at the time of the event (actual shock or placebo). Employment is an indicator variable for those who earn G or more.

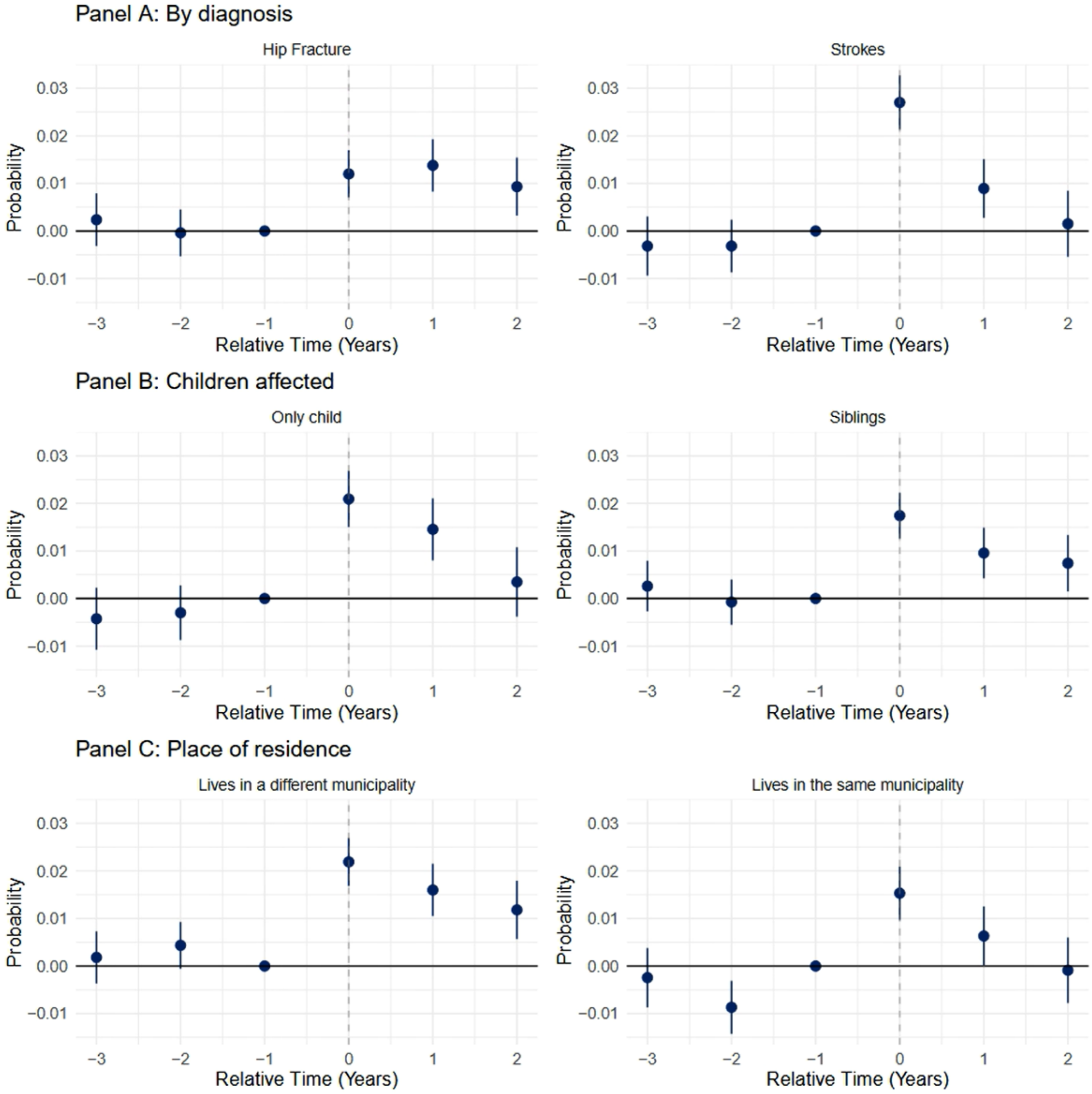
Appendix B: Heterogeneous Results and Robustness checks

Figure B1 Short-term sickness absence responses by diagnoses, number of affected children, and residence



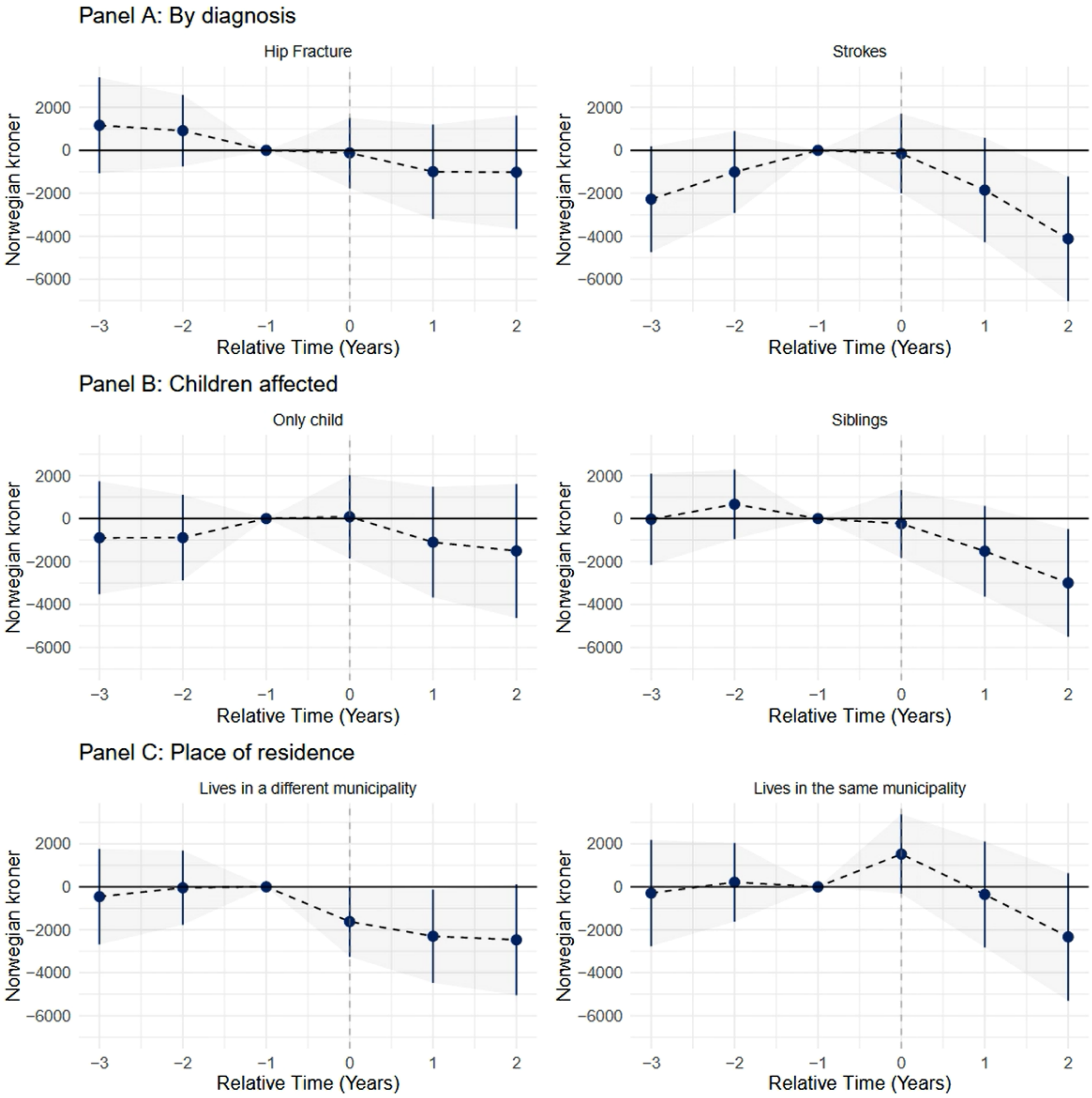
Note: This figure shows our event-study estimates for the effects of health shocks on adult children's probability of being absent from work due to sickness (Shown in the Y-axis). These estimates are separated into different groups. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one-quarter before the shock. The bars around these estimates represent the 95% confidence intervals. Panel A shows the overall results, while panels B and C show the results for short-term and long-term absences divided by gender, respectively.

Figure B2 Effects on mental health diagnoses by number of affected children, and residence



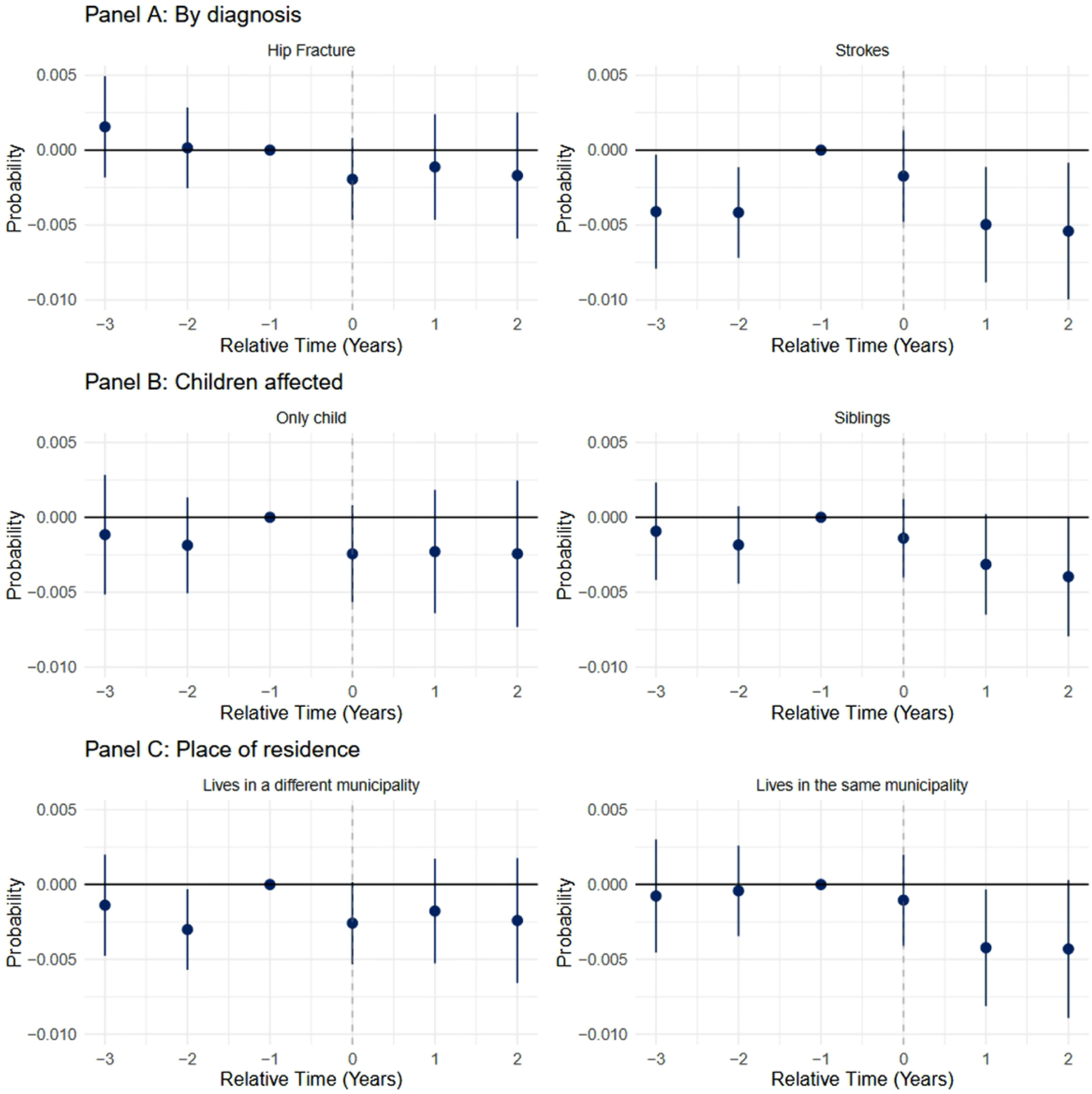
Note: This figure presents our event-study estimates for the effects of health shocks on adult children's probability of receiving a mental health diagnosis related to stress, depression, anxiety, or sleeping disorders (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one year before the shock. The bars around these estimates represent the 95% confidence intervals.

Figure B3. Effects on earnings by diagnose, number of affected children, and residence.



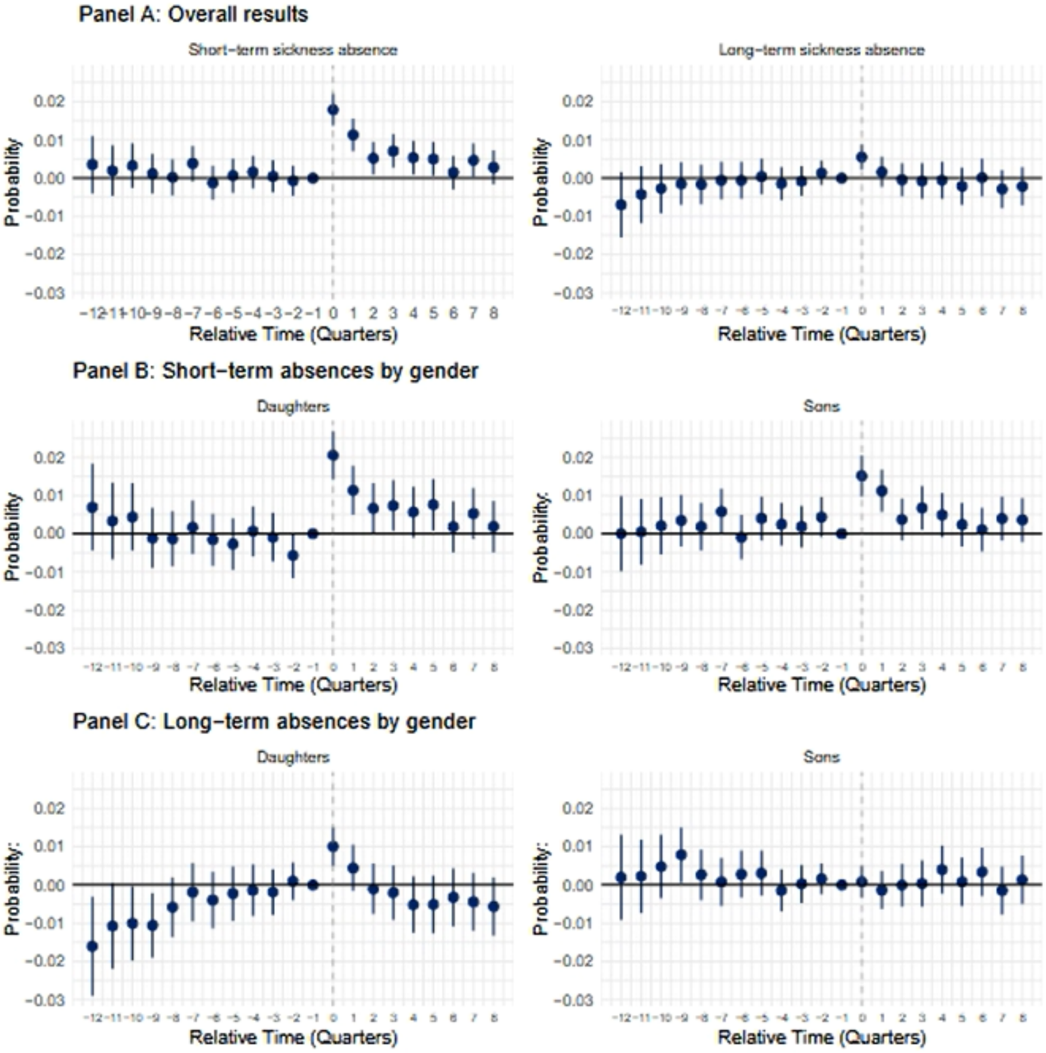
Note: This figure reports our event-study estimates for the effects of health shocks on adult children's earnings (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one year before the shock. The bars around these estimates represent the 95% confidence intervals. Earnings are expressed in real terms using 2015 as the index year.

Figure B4 Effects on propensity to work by diagnose, number of children affected, and residence



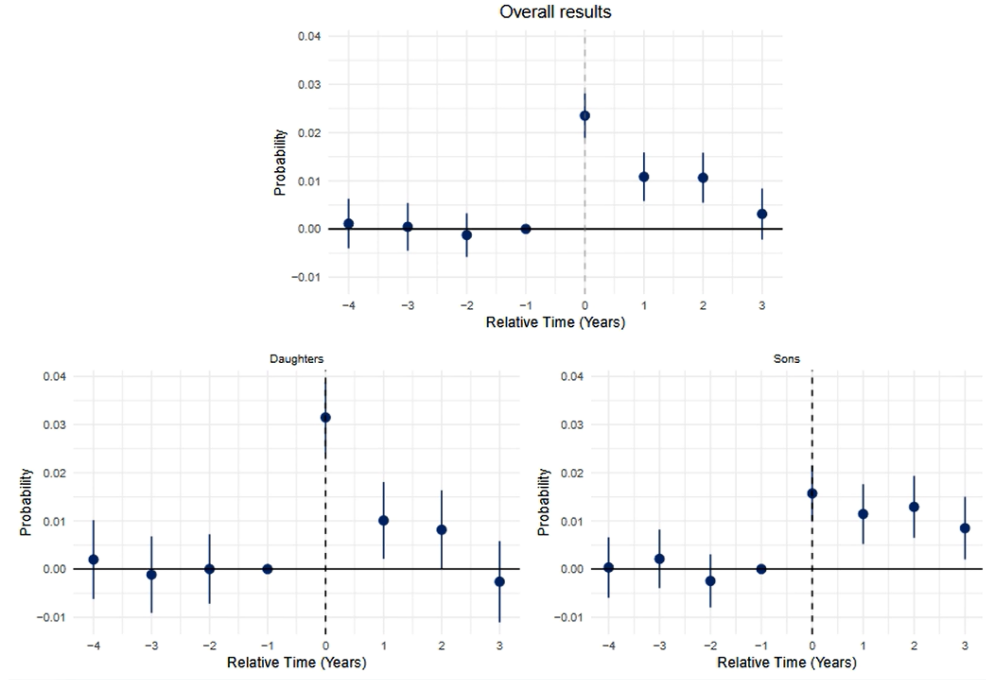
Note: This figure reports our event-study estimates for the effects of health shocks on adult children's propensity to be employed (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one year before the shock. The bars around these estimates represent the 95% confidence intervals.

Figure B5 Robustness: Probability of being absent from work due to sickness



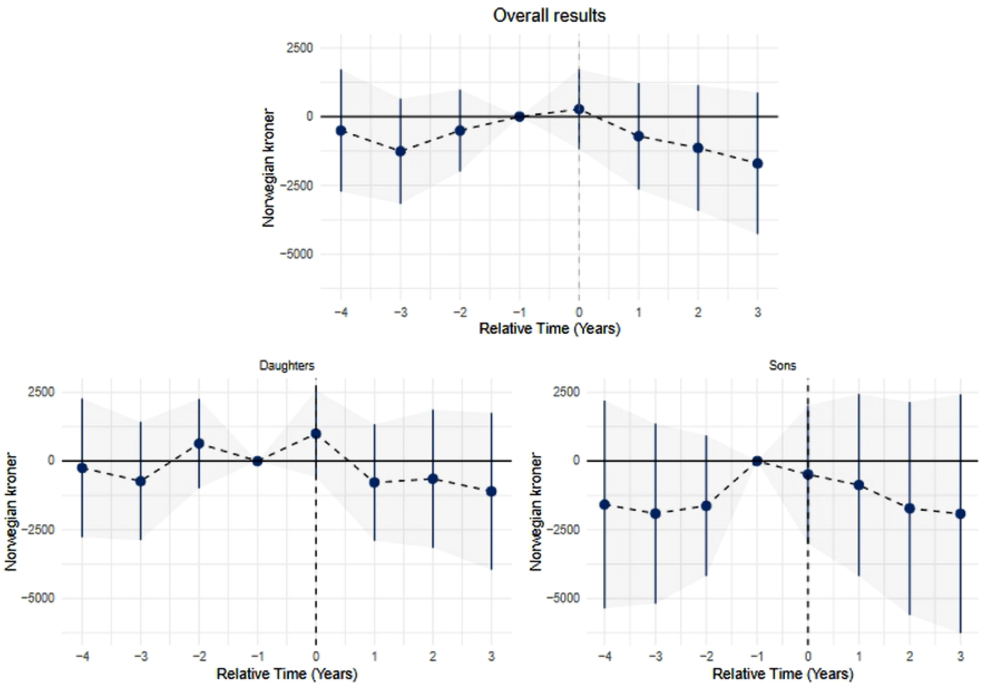
Note: This figure shows our event-study estimates for the effects of health shocks on adult children's probability of being absent from work due to sickness (Shown in the Y-axis). These estimates are separated by spells' duration. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dotted line denotes the point estimates relative to relative one-quarter before the shock, and the area around these estimates represents the 95% confidence intervals. Panel A shows the overall results, while panels B and C show the results for short-term and long-term absences divided by gender, respectively.

Figure B6 Robustness: Probability of receiving a mental health diagnosis



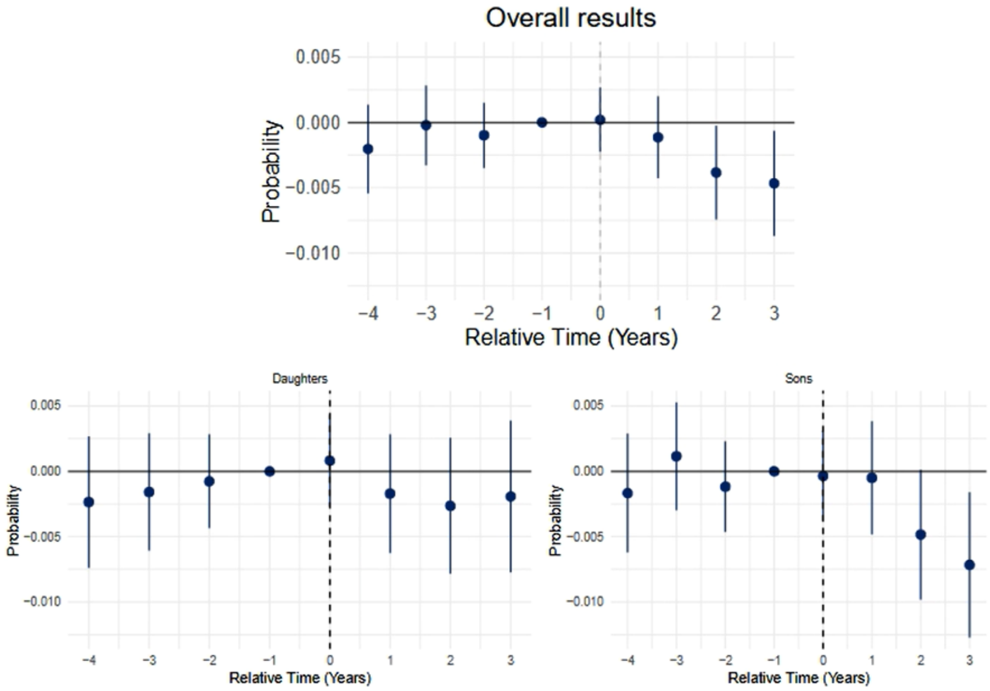
Note: This figure presents our event-study estimates for the effects of health shocks on adult children's probability of receiving a mental health diagnosis related to stress, depression, anxiety, or sleeping disorders (Shown in the Y-axis). The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dots represent point estimates relative to one year before the shock. The bars around these estimates represent the 95% confidence intervals. The upper panel shows the overall results, and the second row shows the results divided by gender.

Figure A.12 Robustness: Effects of health shocks on adult children's earnings



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's earnings (Shown in the Y-axis). The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dotted line denotes the point estimates relative to relative one year before the shock, and the bars around these estimates represent the 95% confidence intervals. Earnings are expressed in real terms using 2015 as the index year. The upper panel shows the overall results, and the second row shows the results divided by gender.

Figure B7 Robustness: Effects of health shocks on adult children's propensity to work



Note: This figure reports our event-study estimates for the effects of health shocks on adult children's propensity to be employed (Shown in the Y-axis). This estimation contains the full sample of individuals affected by a parental health shock. The X-axis in the graph is centered at the time of the event (actual shock or placebo). The dotted line denotes the point estimates relative to relative one year before the shock, and the bars around these estimates represent the 95% confidence intervals.