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# Labor Supply When Parents Are in Need of Care

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# Labor Supply When Parents Are in Need of Care*


## Abstract

Using Norwegian administrative register data, we show that having a lone parent in the terminal stage of life has a small negative effect on the offspring's labor supply, both at the extensive and the intensive margins. While the effects at the intensive margin are reversed after the parent's demise, the negative employment effects are not. To investigate the potential for publicly provided long-term care to mitigate the influence of having a care-needing parent, we also study the offspring labor supply around the time of a lone parent's admission to a nursing home. As the demand for family-provided care most likely reaches its maximum in the period just prior to nursing home admission, we hypothesize that labor supply may be depressed in this period but then pick up afterwards. The empirical analysis confirms the decline prior to the event but rejects the hypothesis that it returns to its baseline level afterwards. Instead, it continues to decline. We present evidence indicating that labor supply changes around the times of parental death and admission to a nursing home are primarily driven by income effects related to a realized or forthcoming inheritance. Given the scale and quality of publicly provided longterm care in Norway, we conclude that having a parent in need of care does not noticeably affect offspring's labor supply. However, we find some evidence that short-term absence from work increases around the times of a parent's death or admission to a nursing home, particularly for daughters.



## JEL classification

J14, J22

## Keywords

long-term care, labor supply of offspring, inheritance



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# 1 Introduction

The number of pensioners relative to the number of working-age individuals is increasing in most European countries (EUROSTAT, 2023). In Norway, the number of people aged 67 or older relative to the size of the core working age population (age 20-66), has risen from around 20 percent in 2010 to 28 percent in 2026, and is expected to increase further to 40 percent by 2050 (Meld. St. 1, 2025-2026). This demographic trend will increase care needs, which combined with the constraints faced by the welfare state, may raise the need to mobilize more family resources to provide appropriate long-term care for older people (Meld. St. 15 (2017-2018)). However, the mobilization of family resources may make it more difficult for caregivers to participate fully in the labor market, undermining the fiscal sustainability it intends to achieve. Most likely, the trade-off between the aims of mobilizing family care provision, on the one hand, and mobilizing labor supply, on the other, will become central to the design of publicly provided care.

Informal care, which is the provision of care services by friends, family members or other unpaid providers with close relation to the individual in need, is also common in well-developed welfare states such as Norway (Gautun & Bratt, 2023). According to the European Social Survey (Verbakel, 2018), the fraction of people providing informal care ranges from 20% to 44%, and is highest in the Nordic countries. However, when it comes to intensive caregiving (at least 11 hours a week), the fraction is much lower, ranging from 4% to 11%, according to the same survey. The fraction of intensive caregivers is lowest in the Nordic countries and highest in Southern European, Eastern and Anglo-Saxon European countries. If parents live without a partner/spouse, their children tend to be the main caregivers (Kröger & Yeandle 2014; Gautun & Bratt, 2017; Ulmanen, 2017).

Understanding the nature of the trade-off between mobilizing family care provision and mobilizing labor supply is of paramount importance. There is an existing empirical literature examining how parental care requirements affect offspring's labor supply behavior. The empirical studies can broadly be classified in studies using survey data (Heitmueller and Inglis, 2007; Gautun & Hagen, 2010; Kotsadam, 2012; Ulmanen & Szebehely, 2015; Gautun & Bratt, 2017; Schmitz & Westphal, 2017; Vangen, 2021; Maestas et al., 2024), and studies using register data (Fevang et al., 2012; Løken et al., 2017; Norén, 2020; Kridahl & Silverstein, 2020; Vangen, 2021; Frimmel et al., 2025; Ramirez Lizardi et al., 2025; Fjællegaard Jensen & Zhang,

2026). The study of Vangen (2021) used a combination of survey data and register data. These results largely indicate negative effects on employment and earnings of having a parent in need of care. Providing intensive care to older parents may result in an exit from the labor market, increased use of part-time instead of full-time work, or increased sickness absence from work. This association between informal care and labor supply tends to be gendered and differ across context, depending on the provision of public care, with women in Southern and Eastern Europe being most affected (Labbas & Stanfors, 2025; Kotsadam, 2011).

In this paper, we examine the influence on offspring's labor market behavior of having a lone parent in the terminal stage of life. This examination is twofold. First, we analyze offspring's behavior in the years surrounding the demise of a lone parent. Then we move to a novel analysis where we study the effects of having a lone parent admitted to a long-term stay in a nursing home. The purpose of this analysis is to come closer to an understanding of the mechanisms behind the changes in offspring labor supply around the time of the lone parent's demise, and to identify the role potentially played by the parent's need for care and publicly provided services.

In these analyses we follow closely the study design in Fevang et al., (2012) and examine offspring's behavior in the years surrounding these two events, while conditioning on a saturated control vector including individual-fixed effects as well as age-by-cohort (or equivalently year-by-cohort) fixed effects. Hence, the basic idea is to study labor supply around these events as *if* other time varying variables (age and calendar time) were constant. We follow the approach in in Fevang et al., (2012) as closely as possible, not only in the specification of the model, but also in the construction of the analysis sample and definition of outcomes and explanatory variables.[1] Part of the motivation for this approach is to "tie our hands" to see whether the findings based on a model adapted to "old" data survive its confrontation with "new" and larger data, similar to what is typically achieved through pre-registration of empirical strategies.

Our results on the impacts of a lone parent's demise are qualitatively similar to those reported by Fevang et al. (2012). We find that employment and earnings start to decline 2-3 years before the parent's death, net of any changes that can be attributed to age or calendar time. In the year

[1] The only exception is that whereas Fevang et al. (2012) used a logit-model for some dichotomous outcomes, we use linear probability models in the present paper.

of death, the employment rate is approximately 1 percentage point lower than it would have been in the absence of the event. However, employment continues to decline by around 0.5-1 percentage point also in the years after the parent's demise. Conditional on continued employment, earnings also decline by approximately 1 percent and reach their lowest "local" point one year after the demise. They then gradually return to their baseline levels during the next 3-5 years. While these results are partly consistent with a need-for-care explanation, they are also partly consistent with an explanation based on income effects and behavioral responses to a realized or forthcoming inheritance. When estimating the model separately for offspring with outlook to a large versus a very small inheritance, we indeed find that the responses are considerably larger for the former group.

To further examine the potential for the provision of public care to mitigate negative impacts on offspring's labor supply, we shift attention to the timing of a lone parent's admission to a long-term stay in a nursing home. The need for care laid on close family members as well as public care services, such as home nursing and short-term stay in nursing homes, may have reached a maximum level in the period just before this happens, as permanent stay in nursing homes are strictly rationed for those with the largest needs. We may therefore hypothesize that admission to a nursing home represents considerable relief for the offspring in terms of reduced care requirements, facilitating a restoration of any negative impacts on their labor supply. However, our empirical analysis does *not* indicate a recovery in offspring labor supply following the parent's admission to a nursing home. On the contrary, the results imply a significant post-admission decline. We interpret this finding as indicating that family-provided care does not have a form or a volume that noticeably undermines offspring's labor supply in Norway. This can also be viewed as evidence that the level of publicly provided care in Norway in most cases is sufficient for avoiding family care burdens that are incompatible with continued employment. Yet, we do see some indications of increased sickness absence and/or use of other income transfers around the parent's nursing home admission, particularly for daughters, suggesting that the situation of combining work with a care-needing parent can be stressful. This may also indicate that the threshold for nursing home admission and the general capacity of publicly provided care are likely to have an impact on offspring's sick leave and effective work hours, in line with previous findings reported for Norway (Løken et al., 2017; Gautun & Bratt, 2017; Abrahamsen & Grøtting, 2019; Gautun & Bratt, 2024). These results align with research from Altindag et al. (2026), who find that a parent's dementia diagnosis in Denmark does not affect significantly the labor supply of adult children but impacts their mental health.

Since in Norway, a substantial amount of nursing home residents are patients with dementia we can expect a similar pattern reflected in the uptake of sickness absences.

A corollary of our findings is that much of the variation in labor supply observed around the time of a lone parent's demise in previous studies, is most likely attributable to mechanisms other than the need for intensive care among family members. This conclusion is plausible at least in countries with well-developed publicly provided long-term care such as Norway. One such mechanism seems to be that the lone parent's demise or admission to a nursing home entails an inheritance and thus an improvement in the offspring's economic situation, triggering an income effect known in the literature as the Carnegie effect; see, e.g., Bø et al. (2019). Another is that the parent's demise may represent a grief process that affects offspring's mental health and/or work capacity, also on a more lasting basis (Fjællegaard Jensen & Zhang, 2026; Kamis et al., 2022). Finally, in case of sudden death of a parent, it may indicate loss of informal care for grandchildren, which in turn may affect offspring's labor supply (Fjællegaard Jensen & Zhang, 2026; Bratti et al., 2018).

In addition to examining how a forthcoming or realized inheritance affects labor supply around the time of a parent's demise, we also investigate the mediating role of other circumstances, such as the presence of siblings, the level of own human capital, the geographical distance between parent and offspring, the responsibility for own small children and differences between natives and immigrants with non-western backgrounds. Although the identified labor supply responses seem to be small across all groups, there are some notable differences. For example, we estimate slightly larger labor supply responses for only children and for offspring with their own small kids, perhaps indicating a larger risk for experiencing a time squeeze for these groups. Somewhat surprisingly, we find no evidence that immigrant offspring with parents from countries with a stronger take-care-of-your-own-parents norm, respond more strongly than natives.

Our interpretation and discussion of these heterogeneous effects is anchored in a theoretical model originally developed by Fevang et al. (2012) showing how a utility-maximizing offspring will allocate time between work, parental care, and leisure under alternative circumstances. In the appendix, we extend this model to account for the possibility of cultural differences in the assessment of family versus publicly provided care, for gender differences in the type of help

offered to parents, and for the potential "double-pressure" that arises when a person has care-needing parents and care-needing children at the same time.

This paper contributes to this growing literature examining offspring's labor supply trajectories around the time of parental death and periods of high care needs. We contribute to previous work in three distinct ways. First, we extend the literature by using administrative data to examine labor supply changes around the time of admission to long-term nursing home stays, a topic that has not been widely explored in previous work. Second, we complement this analysis by using detailed sick leave data to describe sick leave use around the time of admission to long-term nursing home stays. Since we expect that institutionalization is the end of a period of prolonged care provided by family members or other formal care services, these descriptive results allow us to see how short-term changes in the labor supply build up to the time of admission; for those whose parents die quickly in a nursing home, we observe how these changes continue through a period potentially marked by grief and distress. Third, we link these conclusions to a replication and update of earlier findings in Fevang et al. (2012). The qualitatively similar results from the replication and the nursing home analysis help us understand labor supply trajectories at terminal stages of a parent's life in a context where formal care services are provided to a substantial number of older adults at this last stage. Together, these results allow us to illustrate potential mechanisms that play an important role in determining labor supply trajectories, such as income effects from the realization of inheritances (i.e., the Carnegie effect).

Our paper proceeds as follows: in the next section, we briefly review the theory presented in Fevang et al. (2012) and discuss some extensions motivating parts of our new analysis. Section 3 presents the institutional background related both to the design of long-term care and to the outcomes used to capture labor supply responses. Section 4 describes the analysis samples and offers some descriptive statistics, whereas Section 5 presents our empirical strategy. Section 6 presents the results and Section 7 concludes.

# 2 Theoretical considerations

To study the impacts on the offspring's labor participation of having a lone parent in need of care, we start with predictions from a theoretical model. We build on a model from Fevang et al. (2012), which was solved in Fevang et al. (2008) and is further developed in the appendix to the present paper. The starting point of the model is that the motivation for the child to provide informal care to its lone parent is altruism. Thus, the child takes the utility of the parent into account when deciding how much care to give. However, care comes with a cost as the time budget of the child is given, and time for informal care competes with labor supply and leisure, both having an impact on the utility of the child. Labor income determines the monetary budget constraint, which again determines how much the child can buy of consumption goods, but total consumption is modelled as a household production function where leisure also enters. The cost of providing informal care is twofold, in addition to the time cost, which increases in travelling time as the child does not necessarily live in the same municipality as the parent, there may also be a monetary cost.

The model runs over three periods. In the first period, the parent is healthy and is not in need of care. The second period is the terminal stage of the parent's life, and informal care is demanded. The parent has died in the final period, and the child may receive an inheritance.[2] This inheritance is exogenous and therefore unaffected by the child's informal care giving. There are two versions of the model. In the first version, there is a perfect credit market with perfect foresight, and the child maximizes overall utility over the three periods, subject to an intertemporal budget constraint. The second version assumes credit constraints so that the child maximizes utility for each of the periods independently. A more realistic description would probably be imperfect credit constraints. Thus, we expect the observed behavior to be somewhere in between the two predictions.

The theoretical model in Fevang et al. (2012) studied the effects on informal caregiving of several factors, such as having siblings, receiving formal care, the role of inheritance, the effect of human capital, and the time cost of informal care provision. From the theory model, we highlight four relevant results.

[2] An alternative interpretation of the final period is that the parent has been admitted to sufficient publicly provided long-term care, such that the demand for informal care is limited.

First, with equal time budgets, no uncertainty and no inheritance, the labor supply will be lower in the second period than in the first and third periods. Further, the labor supply should be equal in the pre- and post-care periods. The degree of credit constraints will matter if we introduce inheritance. Assume first that the inheritance is received after the parent's demise. With credit constraints, the labor supply is also expected to decline in the second period, but it will be lower in the post-care period than the pre-care period due to inheritance. Whether it will be lower in the post-care period than in the care period depends on whether the removal of the care requirements or the income effects arising from inheritance dominates. There will be no effect of inheritance in the second period. With a perfect credit market, inheritance will reduce labor supply in the second period, giving more time available for caregiving. If a considerable transfer is given to the children before the demise (i.e., an advance on inheritance), we also get a reduction of labor supply in the second period in the case with credit constraints.

Second, an increase in other caregiving alternatives, for instance by siblings or the municipality, reduces informal care provided by the individual, thus increasing labor supply in the second period.

Third, higher human capital, such as education, will reduce informal caregiving as we assume that higher education does not have an effect on the productivity of caregiving, but it has an effect on the household production function. This will give a higher labor supply in the second period compared to those with lower education.

Lastly, the theory model predicts that an increase in the time cost, such as travel time, reduces informal care. The effect on labor supply is indeterminate as caregiving is more time demanding, but the amount of caregiving is unequivocally reduced.

In this paper, we do additional analyses based on the model with credit constraints, see the appendix. [3] This gives some new results.

A. The effect of also taking care of own children

Some young caregivers may be in a squeeze between taking care of their own children and providing care to their lone parent. This means that their time budget must be used for labor supply, leisure, and care provision for both children and a parent. In studying this, we assume that they do not want to compromise with the care of their children. Thus, this can be analyzed as a reduction in available time in the second period. In the appendix, we show that under

[3] We do not study these changes under perfect credit market, as perfect credit market mainly matters for inheritance.

reasonable conditions, both labor supply and leisure time will be reduced. However, the effect on caregiving is indeterminate.[4]

In the case of a sudden death of the parent and no care needs before the death, we see no effect on labor supply in the second period. However, if the parent used to babysit, there will be a reduction in available time for the offspring in the third period (the period after the parent's demise), as the caregiving for own children will increase. Again, this reduces labor supply and leisure.

In the empirical analysis, we may therefore expect that caregivers who also provide care to their children, will reduce labor supply and income more than other caregivers in the second period, and also possibly in the third period.

B. Men and women give different types of care

Studies show that men and women give different types of care to their parents (Sundlisæter Skinner and Sogstad, 2022; Gautun & Bratt, 2023). Sons give more practical assistance, such as digital help, repairs, shopping, and taking care of the garden, while daughters to a larger extent provide more intensive care including personal care services (help with dressing, eating, personal hygiene, etc.) and emotional support.

Assume that daughters spend more time on caregiving than sons do. Further, assume that the parent values care from sons and daughters equally independently on the time they use, such that the extra time spent on care by daughters is not valued. To do this analysis, we can change the interpretation of travelling time to time spent on care. As seen from the earlier conclusions from the theory model, more time spent on care has indeterminate effects on labor supply for daughters.

If the parent values positively the additional time spent on caregiving, more time with the parent increases her welfare. We show in the appendix that in this case, the time spent on care by sons and daughters is the same. The interpretation is that daughters spend more time per visit than

[4] The reason for an indeterminate effect on caregiving is the following. The direct effect of less time available is that the caregiver spends less time on all time-consuming alternatives, i.e., labor supply, leisure, and caregiving for the parent. Lower labor supply also gives lower levels of goods for consumption, and this gives an indirect negative effect on leisure as leisure and goods are complementary in the utility function. Another indirect mechanism is a substitution effect from leisure to caregiving. The child is altruistic, and caregiving enters positively in the child's utility function. When consumption and leisure are reduced, giving a lower utility level, the child may compensate by providing more care. We cannot say if this positive second effect is larger or lower than the negative first effect. However, it is reasonable to believe that this indirect effect is lower than the direct effect, and that caregiving to the parent is lower for those also taking care of own children.

sons but have fewer visits. This means that even if the parent values the time spent on care, we will not see any difference in labor supply by sons and daughters.

Within the framework of the model, daughters will spend more time on care than sons if they are more altruistic, meaning they put a larger weight on the utility of the parent than sons do. If this is the case, they will reduce other time-consuming activities such as labor supply and leisure as the time budget is given. Thus, we will expect that the fall in the labor supply is larger for daughters than for sons.

C. Informal and formal care are not perfect substitutes

In the analysis above, we assumed that caregiving provided by the child was a perfect substitute with other caregiving. We now relax this assumption and instead assume that other care, such as formal care provided by the municipality, is less preferred by the parent than care provided by the child. Formal care may, e.g., not provide the same emotional support as informal care. We show in the appendix that this can be analyzed as a negative shift in formal care. This will give an increase in informal care and reduced labor supply of the child compared to the case where informal and formal care were perfect substitutes.

Another way of interpreting this is social norms, for instance, that there is a social norm that the family should take care of older parents. In this case, the lone parent may not appreciate formal care in the same way as informal family care. Existing evidence suggests that such "family-care" norms vary considerably across countries and that they are particularly weak in Scandinavia and other western European countries (Verbakel, 2018). It is thus probable that certain immigrant groups respond differently to care-needing parents than natives do.

# 3 Institutional background

In this section, we describe some institutional features that are central to the interpretation of our empirical analysis. The first relates to the design of publicly provided long-term care in Norway, which essentially represents the alternative to family provided care. The second relates to social insurance programs relevant to offspring who are exposed to care demands from their lone parent to the extent that it negatively affects their labor supply. And finally, we briefly explain the norms and regulations regarding bequests in Norway.

*Long-term Care*

In Norway, long-term care services are provided by municipalities. By law, residents have the right to receive necessary health and care services from their municipalities (Norwegian

Ministry of Health and Care Services, 2011). When care needs arise, services (practical assistance and nursing) are typically first provided at home. The role of nursing homes is to cover patients' treatment, care, and assistance needs around the clock. They are heavily subsidized, but user payments can still be considerable. User payments are income tested, and municipalities can charge up to 75-85% of the residents' income. However, they are not tested against the residents' wealth.

According to Verbakel (2018), Norway has a more generous provision of formal long-term care than most other countries in Europe. Nonetheless, access to long-term care services is based on the user's needs and is determined by an individual assessment carried out by municipal case managers. After an assessment, case managers, in the case of nursing homes, grant access if living in a nursing home is the only option that ensures that the patients receive the necessary and appropriate care services (Helsedirektoratet, 2017). Yet, nursing homes play an important role during the terminal stages of life, and approximately 44 percent of the population above 60 is admitted to such an institution prior to death (Statistics Norway, 2020).

For more details about the organization of long-term care in Norway, see Appendix 4

*Social Security benefits*

To the extent that offspring's labor supply is negatively affected by parental care requirements, there are basically three types of social security programs that may cushion the potential income loss. The first is transfers covering wage replacement due to own health problems. The second is transfers covering wage replacement due to unemployment, and the third is means-tested social assistance. Norwegian social insurance programs are compulsory and regulated by law. They are not designed to compensate for parental care requirements but may nevertheless be relevant if a stressful situation leads to own health problems or makes it difficult to keep a job.

Health-related transfers include sickness benefits, work assessment allowance, and disability benefits. Sickness benefits are available only to labor force participants and normally provide 100% wage compensation for a maximum of one year. In the first days of sickness absence, employees have the right to self-certified sick leave, which means that they can inform their employer that they are unable to work due to illness or injury without providing a medical certificate. When the period for self-certification has expired, typically after three days, employees need a medical certificate from a physician. Beyond 52 weeks, workers are eligible for work assessment allowance with a compensation ratio of around 66% of previous earnings, provided that the work capacity is reduced by at least 50%. The minimum annual payment is 2

times the basic amount (G) and could also be paid to individuals with no or limited previous earnings.[5] The work assessment allowance is a temporary benefit with a maximum duration of 3 years, but under certain conditions, individuals may be granted an extension of up to 2 years. The third group of benefits are permanent disability benefits, which amount to around 66% of previous earnings.

Individuals may be entitled to unemployment benefits if they are involuntarily unemployed, provided that they have sufficient earnings over the past years (or the past three years). Social (financial) assistance may be provided to individuals when all other income opportunities have been fully exploited and the Norwegian social insurance agency has conducted an assessment of the case.

*Bequests*

There is a strong social norm in Norway that bequests are shared equally between children. Halvorsen & Thoresen (2010) find that when parents deviate from the equal-sharing norm, it is based on needs rather than to reward services provided by children. The survey-based evidence in the paper shows that only 1% of Norwegian parents think that transfers to their children should be allocated to "the most helpful child". This norm is also bolstered by legislation requiring that two thirds of the inheritance, up to 15 G (NOK 1,952,400 by 2025) from each parent, must be shared equally among the children.

The timing of the bequest varies depending on circumstances, but it is common to make considerable transfers prior to the lone parent's death. In particular, when a lone parent is admitted to a nursing home, the payment system described above provides incentives for making the transfer at this point, as any returns to wealth held by the parent will be calculated as income and thus largely "collected" by the care provider.

# 4 Data and descriptive statistics

## 4.1 Sample

We use rich administrative data from Norwegian registries covering the entire population of Norway from 1993 to 2020. These registers contain family ties, making it possible to link

[5] The Basic Amount is a central parameter in the Norwegian Social insurance system, corresponding to approximately 17% of average full-time earnings in Norway. It is indexed every year in line with average wage growth.

children to both their parents and their siblings.[6] Direct information about parents' care needs is not available, however. Instead, we use two proxies for parental care needs. The first proxy is the parent's time of death, which takes advantage of the empirical regularity that the need for care is typically concentrated around the final years of life. This strategy mirrors the analysis in Fevang et al. (2012). Hence, our first sample captures children's activity in the labor market during the terminal stage of a lone parent's life. In the analytical sample we focus on residents born between 1934 and 1982 who lost a lone parent between 2000 and 2020 and were aged 38-66 when the parent died. Additionally, we require the offspring to be between 35 and 66 years old throughout the observed window

In addition to parental death, we use information about a lone parent's admission to a long-term stay in a nursing home. The hypothesis is that the demand for family-provided care will be particularly large in the periods leading to this event, as the admission to a nursing home is conditioned on needs for round-the-clock care. Examining offspring's labor supply before and after this event may thus illustrate both the influence of parental care needs on offspring labor supply as such, and the potential relief associated with publicly provided care. Data on these events are available only for families living in the capital of Oslo and are included in GERICA, a registry containing information about all residents in Oslo who receive municipal health and care services during the period from 2009 to 2020, including the date of admission and type of service received. In our analysis of nursing home admittance in Oslo, we focus on residents born during the period 1940-1982 and were in the same age range (38-66) at the time when a lone parent was admitted to a nursing home. We also require the offspring to be between 35 to 66 years old throughout the observed window. For more details about the data and construction of variables, see appendix 4-5.

## 4.2 Subsamples

In addition to our analysis of overall responses by the sex of the children, we are interested in studying different groups based on the predictions of our theoretical model. In particular, we are interested in observing labor market trajectories for groups of children with and without siblings, with and without own small children, with different inheritance expectations, with different opportunity costs as measured by education levels, and with different national/cultural backgrounds.

[6] Family identifiers are incomplete for individuals born before 1953, for more details on family linkages see Fevang et al. (2012).

For the first group, we divide our sample depending on whether the person is a lone child or not. For the second group, we identify offspring who are themselves parents and have children between 0 and 12 years. We compare this group with other adult children who do not have children in this age group. For the third, we use the wealth of the deceased parent to separate our sample between those children whose expected inheritance is below the 25$^{th}$ percentile of the expected inheritance distribution and those children above the 75$^{th}$ percentile. We also divide our sample by the highest education achieved; i.e., with and without a university degree. Lastly, we create samples based on the national background of the lone parent where we distinguish between natives and immigrants from western countries, on the one hand, and immigrants from non-western countries, on the other.

## 4.3 Outcomes

We follow Fevang et al. (2012), where outcomes are *annual earnings, employment,* and *social security dependency*. Our measure of earnings contains information about salaries and net income from self-employment. We use this information to define three dependent variables. The first is total earnings measured in Norwegian kroner (NOK) inflated to 2020-value (using a wage index), regardless of employment status (i.e., we include zeros for the non-employed). The second is an indicator for being employed, defined as having annual earnings above a certain threshold, set to 1 G (NOK 130,160 in 2025). Finally, for those who are employed according to this definition, we use log-earnings as an additional dependent variable. In addition to these three earnings-based outcomes, we use a dichotomous variable capturing social insurance claims. This variable includes sickness absence benefits, temporary and permanent disability benefits, early retirement, unemployment benefits, and social assistance. Following the same definition of social security dependency as in Fevang et al. (2012), we construct an indicator for social security benefits that flags an individual as a recipient if that same person has received any of the social security benefits for at least three months in a given calendar year. In some parts of the analysis, we also consider sick leave as a monthly outcome (for employees only), and in this case the outcome indicator is defined as having at least one physician-certified absence spell during the month in question.

## 4.4 Descriptive statistics

In Tables 1 and 2 we present descriptive statistics for both samples by the sex of the adult children. Table 1 contains information about those adult children losing a lone parent, while Table 2 describes the sample of those whose lone parent is admitted to nursing homes in Oslo.

From both tables we observe similar age distributions for men and women, with most individuals older than 45 years old at the time of parental death (Table 1) or nursing home admission (Table 2). In addition, we observe notable differences in terms of labor market profiles between men and women. Men tend to have higher employment rate and earnings both conditional and unconditional on employment. In terms of social security, we observe that women tend to be more likely to have claimed social security benefits in the year prior to the events of interest.

In terms of family situation, we observe from both Tables 1 and 2 that about half of adult children reside in the same municipality as their parent and share similar family sizes between men and women. Additionally, we also observe that very few adults with non-western immigrant background have experienced the loss of a lone parent in Norway. This group constitutes less than 1% of our national sample.

Based on the data from Oslo (Table 2), Figure 1 shows parents' use of municipal care during the two-year period prior to admission to a long-term nursing home stay. According to the figure, most parents receive some type of service before admission to a long-term stay in nursing home. The month before admission only 10% do not receive any kind of service from the municipality. Additionally, in the figure, we show that home nursing is the most used service throughout the period, suggesting important care needs well before institutionalization. Its use peaks about 6 months before admission, with around 60% of the parents receiving home nursing. Then home nursing declines sharply together with other services provided at home (practical help and welfare technology). These services are then substituted rapidly by short-term stays in nursing homes, suggesting more crisis episodes requiring assessment of the person's health, care needs, and potential rehabilitation, while also providing temporary relief for family caregivers.

In Table 2, we observe that most parents have a relatively short life expectancy upon admission to a nursing home. There is a large variation in the time from nursing home admission until death. About a third resides for less than a year, which highlights the difficulty of separating the effects of admission time and parental death, since both events occur within a relatively short period.

**Table 1. Descriptive Statistics: Offspring in Parental Death Sample**

| Variable | Men | Women |
|---|---|---|
| *Number of individuals* | *372,959* | *345,019* |
| Mean age | 53.1 | 52.9 |
| Age distribution (%) | | |
| 37–44 | 14.0 | 14.5 |
| 45–54 | 40.5 | 41.2 |
| 55–65 | 46.6 | 44.2 |
| **Annual earnings (1,000 NOK)** | 611.9 | 380.0 |
| **Earnings conditional on employment (1000 NOK)** | 748.3 | 504.6 |
| **Social security dependence (%)** | 29.3 | 38.6 |
| **Employed (%)** | 81.6 | 74.8 |
| **Employed the whole pre-period* (%)** | 61.8 | 52.9 |
| **Expected inheritance (1000 NOK)** | | |
| Low inheritance | 36.1 | 36.9 |
| High inheritance | 1085.3 | 1138.7 |
| **Family situation (%)** | | |
| Same municipality as parent | 49.0 | 55.0 |
| Both parents died in outcome period | 6.1 | 6.3 |
| Years between the death of both parents | 6.5 | 6.6 |
| **Education (%)** | | |
| Compulsory school | 22.4 | 23.6 |
| Secondary school | 50.2 | 45.6 |
| College/ University education | 27.0 | 30.5 |
| Unknown | 0.45 | 0.34 |
| **Number of siblings (%)** | | |
| 0 siblings | 11.1 | 10.5 |
| 1 sibling | 29.5 | 29.4 |
| 2 siblings | 28.3 | 28.3 |
| ≥3 siblings | 31.2 | 31.9 |
| **Number of own children (0–12 years, %)** | | |
| 1 child | 11.2 | 8.4 |
| 2 children | 6.3 | 4.1 |
| ≥3 children | 1.7 | 0.96 |
| No children | 80.8 | 86.6 |
| **Background (%)** | | |
| Non-Western immigrants | 0.85 | 0.88 |
| **Parent's mean Age** | 83.3 | 83.1 |
| **Parents' age distribution (%)** | | |
| <70 | 6.5 | 6.7 |
| 70–79 | 21.2 | 21.8 |
| 80–89 | 49.9 | 49.4 |
| ≥90 | 22.5 | 22.1 |

Note: This table contains adult children's characteristics. All values are measured in the year before the parental death. Earnings are expressed in real terms, using 2020 as index year.

* Those employed in the pre-period have earnings higher than G, in the nine years before parental death.

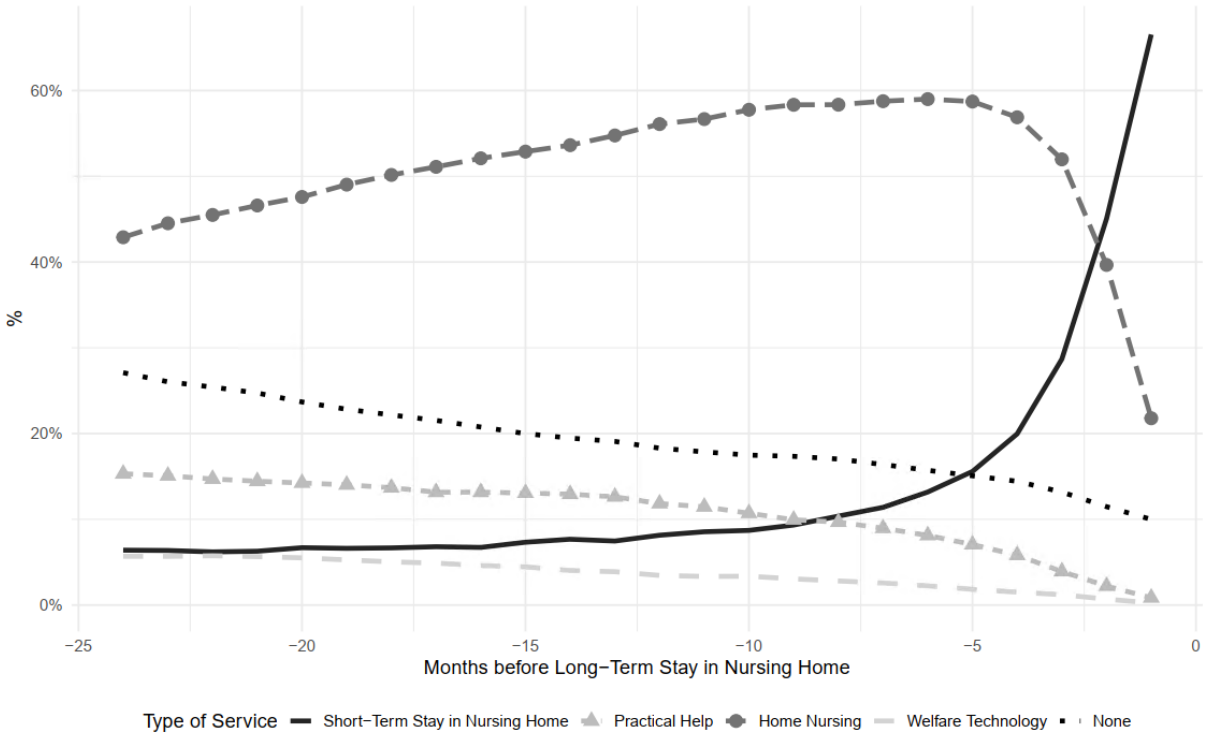


**Figure 1:** *Parents' pathway before admission to a long term stay in a nursing home*
Note: The figure shows the percentage of individuals receiving a specific type of service in the months leading up to a long-term nursing home admission in Oslo. Each line corresponds to a specific type of service at each time point, measured in months before admission (month 0). We classify the use of services hierarchically (short-term stay > home nursing > practical help > welfare technology > other > none) with each individual assigned to the highest intensity service received in that period. In practice, people could receive many services at the same time.

**Table 2. Descriptive Statistics: Offspring in Nursing Home Sample**

| Variable | Men | Women |
|---|---|---|
| **Number of individuals** | 9,132 | 8,971 |
| **Mean age** | 54.5 | 54.4 |
| ***Age distribution* (%)** | | |
| 37–44 | 7.3 | 7.3 |
| 45–54 | 33.0 | 34.0 |
| 55–65 | 59.7 | 58.7 |
| **Annual earnings (1,000 NOK)** | 455.6 | 292.8 |
| **Earnings conditional on employment (1,000 NOK)** | 556.3 | 388.1 |
| **Social security dependence (%)** | 24.3 | 35.1 |
| **Employed (%)** | 81.6 | 74.9 |
| **Employed the whole pre period* (%)** | 52.7 | 40.4 |
| **Expected Inheritance** | | |
| Low wealth (1,000 NOK) | 156.8 | 150.3 |
| High wealth (1,000 NOK) | 2765.1 | 2757.3 |
| ***Family situation* (%)** | | |
| Single child | 15.7 | 14.8 |
| Same municipality as parent | 55.9 | 58.3 |
| | | |
| ***Education* (%)** | | |
| Compulsory school | 15.6 | 16.3 |
| Secondary school | 41.3 | 37.9 |
| College/university education | 42.7 | 45.5 |
| Unknown | 0.39 | 0.40 |
| **Length of stay in nursing home** (years)** | 2.3 | 2.3 |
| ***Length of stay - distribution* (%)** | | |
| 0-3 months | 19.5 | 17.7 |
| 4-6 months | 7.0 | 6.2 |
| 7-11 months | 8.0 | 8.8 |
| 12-23 months | 16.2 | 16.7 |
| 24-35 months | 14.4 | 14.1 |
| 36 months + | 34.9 | 36.5 |
| ***Background* (%)** | | |
| Non-Western immigrants | 1.8 | 1.6 |
| **Parent's mean Age** | 84.8 | 84.8 |
| ***Parents' age distribution* (%)** | | |
| <70 | 3.0 | 2.7 |
| 70–79 | 14.0 | 14.8 |
| 80–89 | 49.7 | 50.1 |
| ≥ 90 | 33.2 | 32.5 |

Note: This table contains adult children's characteristics. These values are measured in the year before the parental admission to a long-term stay in nursing home. Earnings are expressed in real terms, using 2020 as the index year. * Those employed in the pre-period have earnings higher than G, in the five years before the nursing home admission. ** Length of stay represents the difference in years between the day the nursing home period starts until its end due to parental death, this corresponds to those whose admission is before the year 2017, since, until that year, we can observe them for three full years.

# 5 Empirical strategy

Adopting the empirical strategy used in Fevang et al. (2012), we examine the evolution over time of different labor market outcome measures before and after critical dates. These dates are defined by the death of a lone parent *or* admission to long-term care in a nursing home. We estimate the parameters of interest through fixed effects specifications of the form:

$$E[y_{rti}|s_{cti}, d_{tki}, \alpha_{ri}] = \sigma_{rct}s_{cti} + \delta_{rk}d_{tki} + \alpha_{ri}, \quad (1)$$

Where $y_{rti}$ are the outcomes of interest ($r$ = earnings, employment, social security dependency) for individual $i$ at time $t$. To control for differences in labor market profiles across the life cycle we include $s_{cti}$, a vector of dummy variables that represent cohort-specific age/time effects (an interaction between the year of birth $c$ and calendar year $t$). $d_{tki}$ is the number of years relative to the event. In the analysis of parental death, we use ($k = \leq -9, -8, \ldots, 0, \ldots 4, \geq 5$), whereas in the analysis of admission to a nursing home, we use ($k = \leq -5, -4, \ldots, 0, \ldots 4, \geq 5$). $\alpha_{ri}$ are individual fixed effects to control for time-invariant heterogeneity. $\delta_{rk}$ is our parameter of interest and can be interpreted as the variation in the relevant outcome relative to the reference year. Standard errors are clustered at the individual level.

In our analysis, we split our sample by the sex of the adult children and estimate model (1). In the first part of our analysis, we are interested in overall responses around the time of the event, this means that we estimate equation (1) on our full sample. In the second part of our analysis, we focus on heterogeneous responses; therefore, we estimate model (1) by looking at different subgroups defined by the availability of alternative caregivers, the time costs of care provision, presence of own children, size of expected inheritance, level of human capital, and national background.[7]

# 6 Results

In this section, we present the results of our main analysis. In each figure, we show our results for earnings (conditional and unconditional on employment), employment probability, and take-up of social security benefits. These results are presented separately by the sex of the adult children. Throughout our analysis, we present the point estimates corresponding to model (1) graphically together with 95% confidence intervals, indicated by the dotted lines around the coefficients. We present our results as changes in outcomes relative to the reference period,

[7] In subsample estimations including offspring with own children, we include age-by cohort controls for the youngest child as well

which is set to more than eight years prior to parental death and four years prior to nursing home admission. Earnings unconditional on employment are measured in 2020 Norwegian kroner, while earnings conditional on employment are measured in logs. Employment and social security dependency are evaluated as percentage point deviations from the reference period.

## 6.1. Parental death

Results in Figure 2 show the estimates corresponding to those children experiencing the death of a lone parent between the years 2000 and 2020. In general, we observe steady but small reductions in both earnings and employment in the years leading up to the lone parent's death, together with an increased uptake of social security benefits. Recall that time and age is controlled for in a saturated fashion in the estimation, such that these patterns arise from changing the time-to-parental-death, holding age and time effects fixed.

In panels A and B of Figure 2, we show a small, but statistically significant, decline in earnings (unconditional of employment) during the years prior to the lone parent's death for both men and women. In the year of death, the estimated decline is approximately 15,000 NOK for men and 10,000 NOK for women. Relative to the average gender-specific baseline earnings, these effects correspond to a 2% decline for both men and women. After the death of the parent, the decline in offspring earnings continues, and it is clear from panels E and F of Figure 2 that this is caused by a decline in employment propensity. For both men and women, employment declines by approximately 1 percentage point toward the year of parental death and then continues to decline by half a percentage point in the years after. These changes are largely matched by corresponding increases in social security dependency, suggesting that for a small group of offspring with a marginal attachment to the labor force, the situation with a care-needing and/or dying parent may become the straw that breaks the camel's back and triggers a health-related labor market exit. For those still employed, on the other hand, it seems that the negative earnings effect peaks at approximately 1.2% in the first year after the parent's demise, after which labor supply gradually returns to its reference level. This pattern suggests that for the vast majority of offspring, the negative labor supply responses triggered by caregiving responsibilities or distress linked to parental death are small and strictly temporary.

For women, there is a notable spike in social security dependency in the year of the lone parent's demise; see again panel H of Figure 2. In Appendix Figure A1, we show that this is explained by a rise in estimates on sickness absence from work around the time of the parent's death, most likely reflecting a combination of caregiving tasks, grief, and practical arrangements around the

time of death. But it may also reflect that women are more altruistic and spend more time on care than men as discussed in the theoretical model.

Together, these results show that the time around parental death has a significant role in shaping labor market decisions for adult children and motivate our analysis of relevant groups of adult children based on the predictions from our theoretical model.

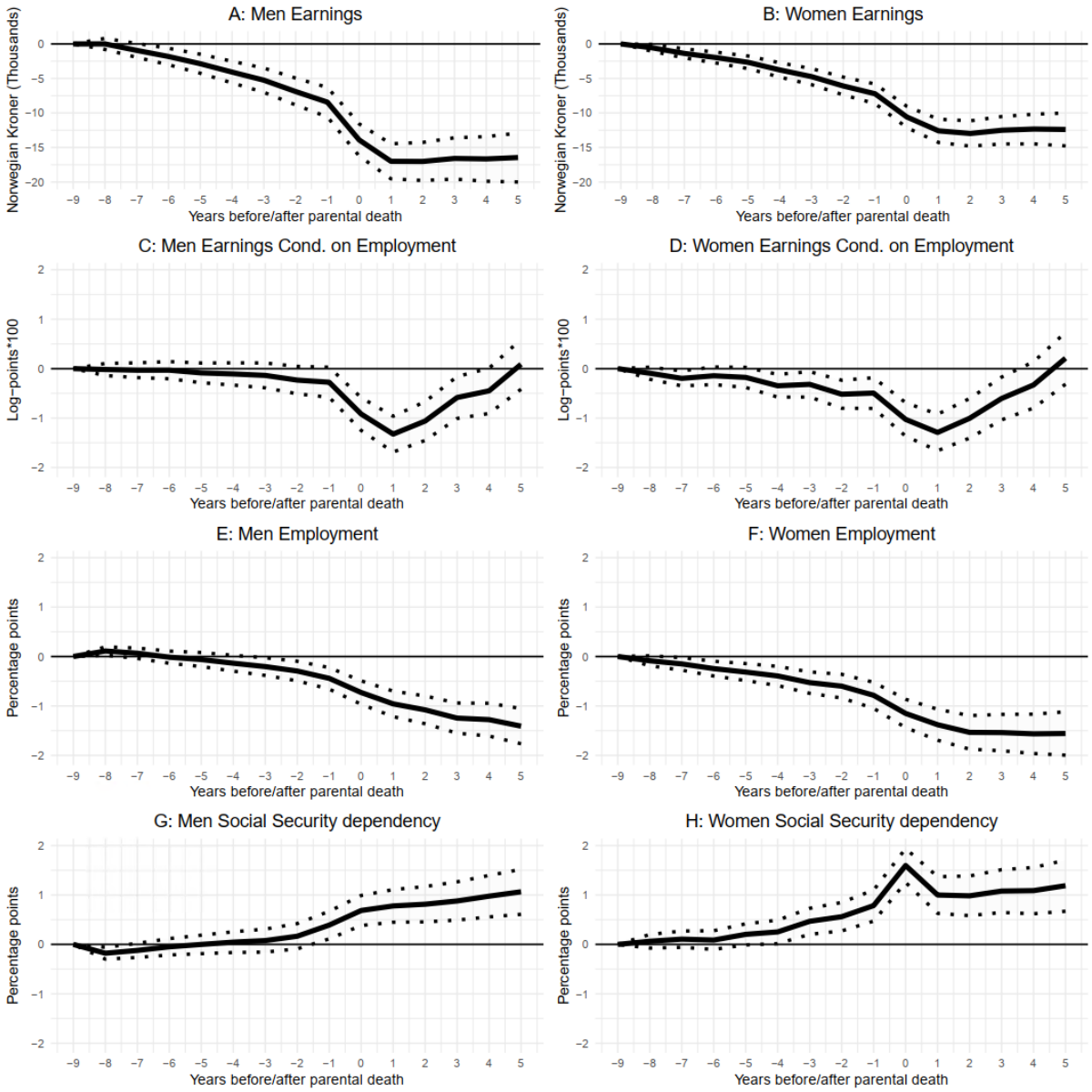


**Figure 2:** *Labor market outcomes around the time of parental death*
Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on the complete sample described in Table 1 and indicate effects of years until/after the death of a lone parent relative to more than 8 years before.

While the decline in labor supply around the time of a lone parent's death may be explained by the parent's need for care and assistance, an alternative explanation discussed in Section 2 is that labor supply is affected by changes in economic conditions related to a realized or forthcoming inheritance. In our theoretical model, this income effect is justified by the existence of credit constraints, but in practice it may also be related to debt-aversion and/or improved information and certainty regarding the size of the bequest. To assess the role of income effects, we estimate the model separately for offspring with and without outlook to a significant inheritance. As explained in Section 4, we let the upper quartile in the expected inheritance distribution represent the large-inheritance group, with mean expected inheritance well above a million NOK. The bottom quartile represents the small-inheritance group, with mean expected inheritance very close to zero; see Table 1.

The results are presented in Figure 3. We observe that children who expect a significant transfer of wealth tend to experience a larger reduction in earnings and employment in the years leading up to parental demise, in line with theoretical predictions. The reduction becomes more visible in the year of parental death and increases considerably afterwards. These findings suggest that a significant part of the responses in labor supply around the time of a lone parent's death is indeed a reflection of an income effect rather than the effect of family care requirements. However, there are statistically significant negative earnings effects in the years prior to the parent's demise, also in the absence of an outlook to a noticeable inheritance (panels A and B), indicating that provision of family care is likely to be part of the story.

To the extent that the family-care explanation is important, it follows from the theoretical discussion in Section 2 that the size of the responses may depend on factors such as the number of siblings, the presence of own kids, the geographical distance between the parent and the offspring, the level of the offspring's human capital, and of cultural/social norms regarding children's responsibility for taking care of own parents. In the appendix figures A3-A8, we present groups-specific estimates to investigate such interactions. Without going into any detail on these results, we note that point estimates largely confirm the theoretical predictions from a model of family care, but that the differences between the various groups are small and often not statistically significant.

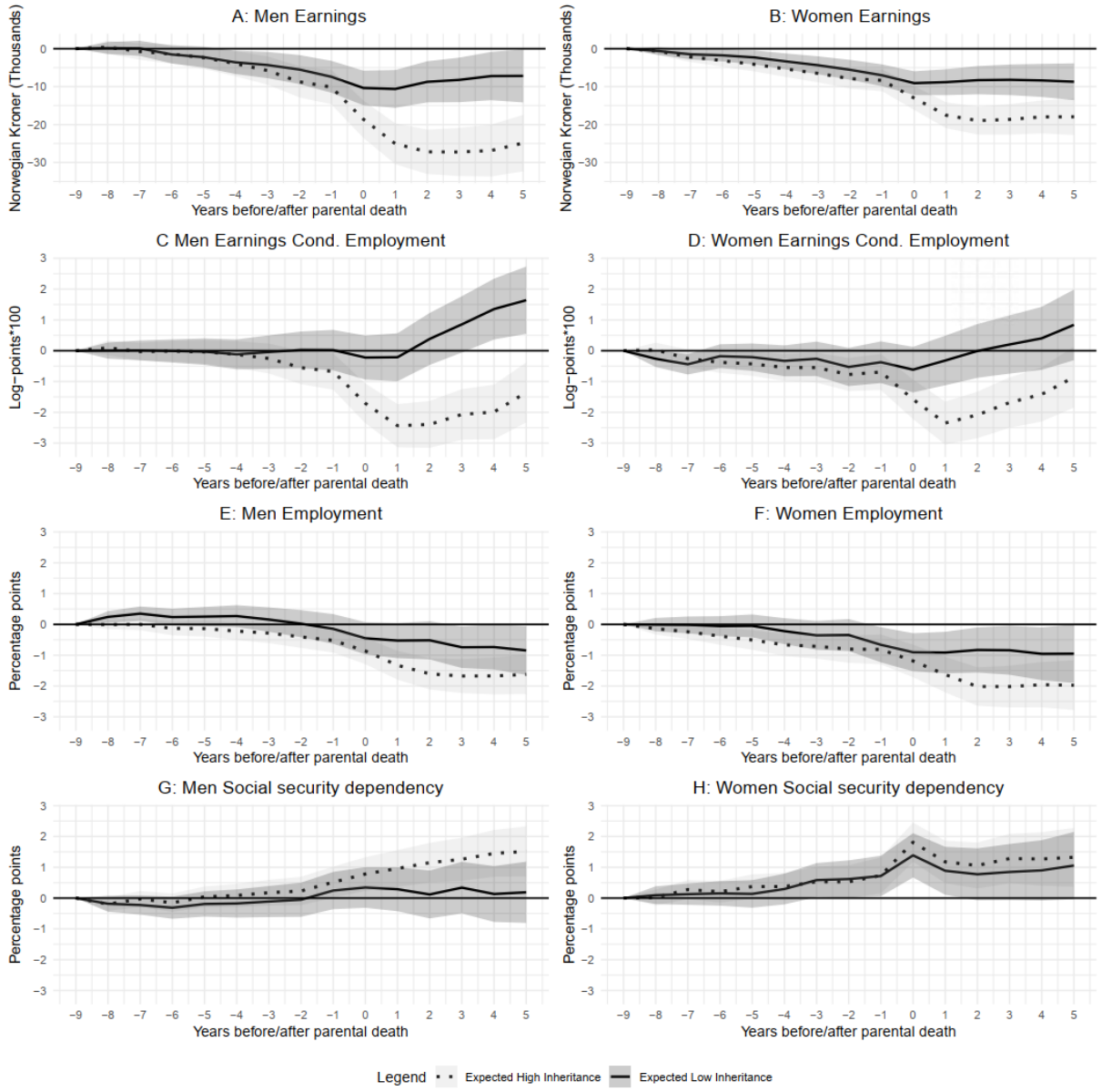


**Figure 3:** *Labor market outcomes by expected wealth*

Note: These figures present estimates based on Equation (1) with 95% confidence intervals (grey bands). All estimates are based on a subsample of our main sample in Table 1 divided by the size of expected inheritance as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the high inheritance group; the solid line and dark-grey confidence intervals correspond to the low inheritance groups. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before.

We note the following suggestive takeaways from the heterogeneity analysis. Only-children tend to have slightly larger negative labor supply responses in the period prior to the parent's death than offspring who can share the "burden" with siblings. After the parent's demise, the estimated effects converge. Turning to the distance to the parent, we find that labor supply responses of offspring living in another municipality than the care-needing parent tend to be larger on the extensive margin, but smaller on the intensive margin, than the responses of offspring living closer to the parent. Also, these negative labor supply responses are generally larger for offspring with responsibility for their own small kids. Following a similar pattern, we find that the labor supply responses of offspring with low education tend to be larger on the extensive margin, but smaller on the intensive margin (measured in earnings), than the responses of offspring with university education. Lastly, we observe that descendants of immigrants with background from a country with a strong "take-care-of-your-own-parents" norm do not appear to have stronger labor supply responses than natives.

The last of these findings may appear a bit surprising, and not in line with our theoretical prediction. As described in Section 4, we have used offspring with parents that immigrated from a non-Western country, whose children, we assume, have a strong "take-care-of-your-own-parents" norm. However, the number of offspring belonging to this group with a lone parent observed to die in Norway during our data period is very limited and probably highly selected. In fact, the low number of observations make it impossible to estimate the very flexible model described in Equation (1), such that the comparison of immigrants and natives must be based on observed labor supply behavior around the time of parental death; see Figures A7 and A8. This particular result should therefore be interpreted with care.

## 6.2 Admission to a nursing home

Another way of studying the importance of care-requirements for offspring's labor supply is to focus on the event of a lone parent's admission to a long-term stay in a nursing home. A condition for being admitted to a long-term stay in a nursing home is that the health condition is seriously affected and requires round-the-clock care and assistance on a lasting basis. Consequently, such admissions typically follow a period of considerable pressure on close relatives; hence, to the extent that the demand for care has a noticeable negative effect on the offspring labor supply, this effect should be eliminated or strongly reduced upon nursing home admission.

Based on the data from Oslo (Table 2) and the regression model described in Equation (1), we show in Figure 4 the results for labor market outcomes around the time of a parent's admission to a nursing home between 2006 and 2020. As for the event of parental death, we find a reduction in earnings prior to admission, particularly for men. Yet, there is little sign of a reversal of these negative effects after the parent has been admitted to a nursing home. On the contrary, the decline continues, and for men we also see a rise in the use of social security transfers, although non-significant, results likely driven by increases in sickness absence as shown in Figure A2, in the appendix.

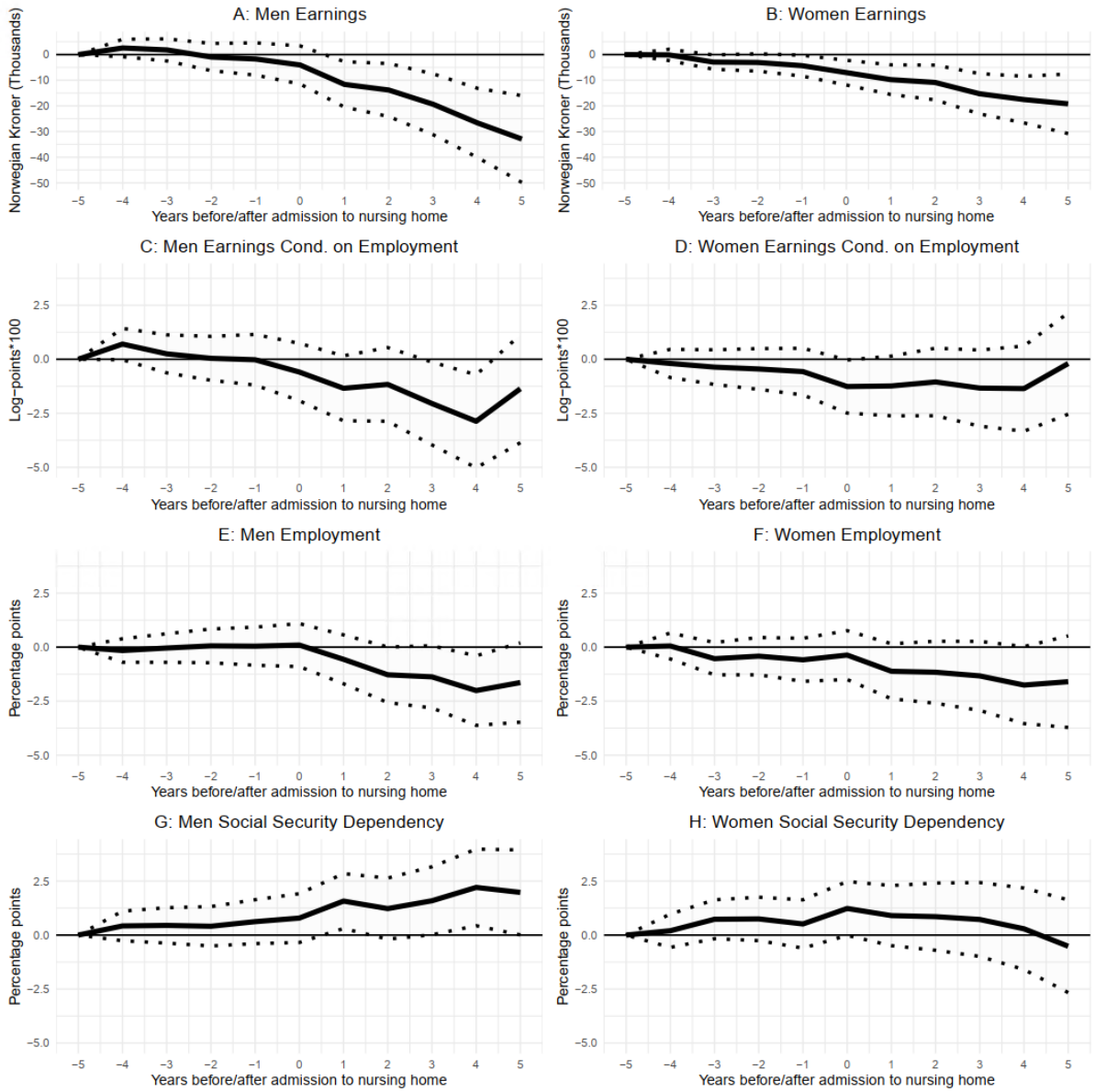


**Figure 4:** *Labor market outcomes around the time of nursing home admission*
Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on our nursing home sample in Table 2 and indicate effects of years until/after the admission to a nursing home of a lone parent relative to more than 4 years before.

In general, these results are similar to those in the parental death sample, pointing toward a role for inheritance also in relation to nursing home admission. Advances in the inheritance often takes place around the time of nursing home admission, as the parent can no longer live in his/her own house and because the return to any wealth held by the parent will increase the deductible for long-term stays in nursing homes. Given the strict admission requirements, it is also the case that the expected remaining lifetime at the time of admission is short. Parents entering nursing homes tend to live on average around two years, meaning that many of the estimates reported in Figure 4 will, to some extent reflect a direct response to the death of a parent and/or different inheritance expectations. To investigate this further, Figure 5 shows the estimates based on the different inheritance groups as shown in our parental death sample. Again, the estimates indicate considerably larger negative labor supply effects for offspring with an outlook to a large inheritance, particularly at the extensive margin.

Although the evidence for strong labor supply responses caused by parental care requirements is weak, we cannot rule out that the situation with a care-needing parent does cause considerable stress and makes it difficult to perform a regular job as usual. One way to examine this more closely is to study sick leave around the time of the parent's admission to a nursing home for employed offspring. As sick leave data are available at a monthly frequency, we can then zoom in on the behavior just before and just after admission, which interacts with the provision of more intensive formal services, such as short-term visits to nursing homes as shown in Figure 1. We focus this analysis on the period from one year before to one year after parental admission and consider adult children who remain employed during these months; see Figure 6. Given the short time period, this analysis is purely descriptive and shows, for each month around the time of admission, the fraction of employees having any absence spell (panel A) and the average number of days absent (panel B). We observe that in the three months before admission, daughters show a clear increase both in the use of sickness absences and number of days absent from work. After the parent has been admitted to a nursing home, the level of sick leave falls back again. For men, we do not observe any changes in sickness absence around the time of the parent's admission, perhaps indicating a gendered norm regarding the responsibility for a care-needing parent. Based on the theoretical model, this can be explained by a higher degree of altruism for women than for men.

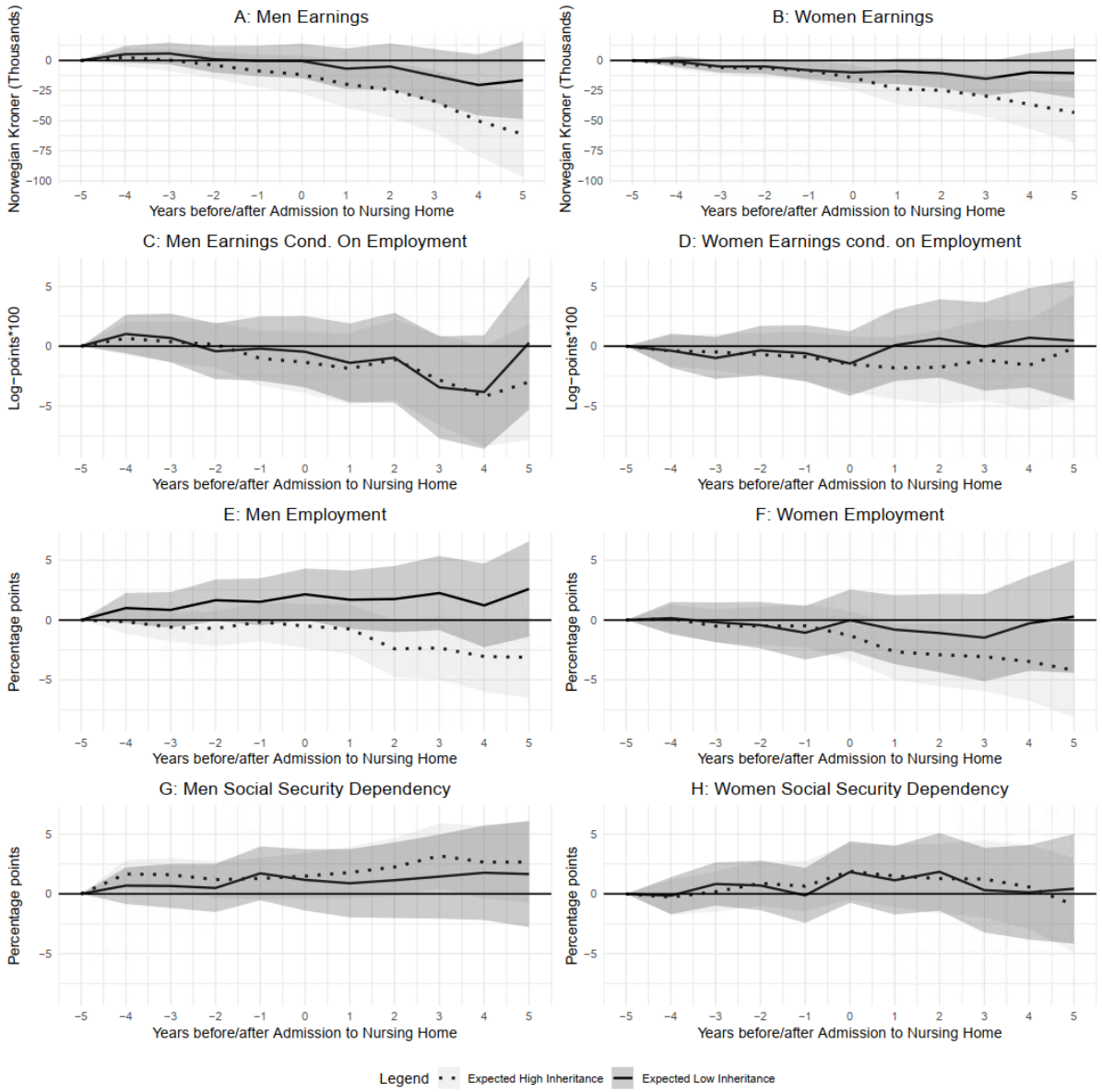


**Figure 5:** *Labor market outcomes around the time of nursing home admission by expected wealth*

Note: These figures present estimates based on Equation (1) with 95% confidence intervals (grey bands). All estimates are based on a subsample of our nursing home sample in Table 2 divided by the size of expected inheritance as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the high inheritance group; the solid line and dark-grey confidence intervals correspond to the low inheritance groups. Point estimates indicate effects of years until/after the admission to a nursing home of a lone parent relative to more than 4 years before.

As pointed out above, many of the parents die relatively quickly after having been admitted to a nursing home. To disentangle the influences of admission (relief) from the influence of the parent's demise (grief and support through the final stages of life), we show in Figure 7 the sickness absence patterns for sons and daughters separately by the time from admission until the parent's demise. In particular, we separate those whose parents died within five months, between 6 months and a year, after a year, and those who remained alive during our observed period.

For daughters whose parents died within 5 months after admission, we observe a sharp increase in sickness absence use that starts around four months before admission. After this initial increase, which peaks around the time of parental death, both the sickness absence rate and days absent from work return to levels similar to those well before admission. In contrast, those who die between six months and one year after admission show more mixed patterns, with no clear changes before admission to a nursing home and sporadic peaks between months five and eleven where deaths occur. For children with parents who survive over a year or throughout our observation period, we see a stable pattern both in sickness absence rates and in days absent from work, although they start at a slightly higher level. One way of explaining this based on the theoretical model, is that formal care and informal care are not perfect substitutes. Even if a nursing home is in charge of a large share of the total burden, the family may still be responsible for emotional support, social contact and practical matters due to the change in residence of the parent.

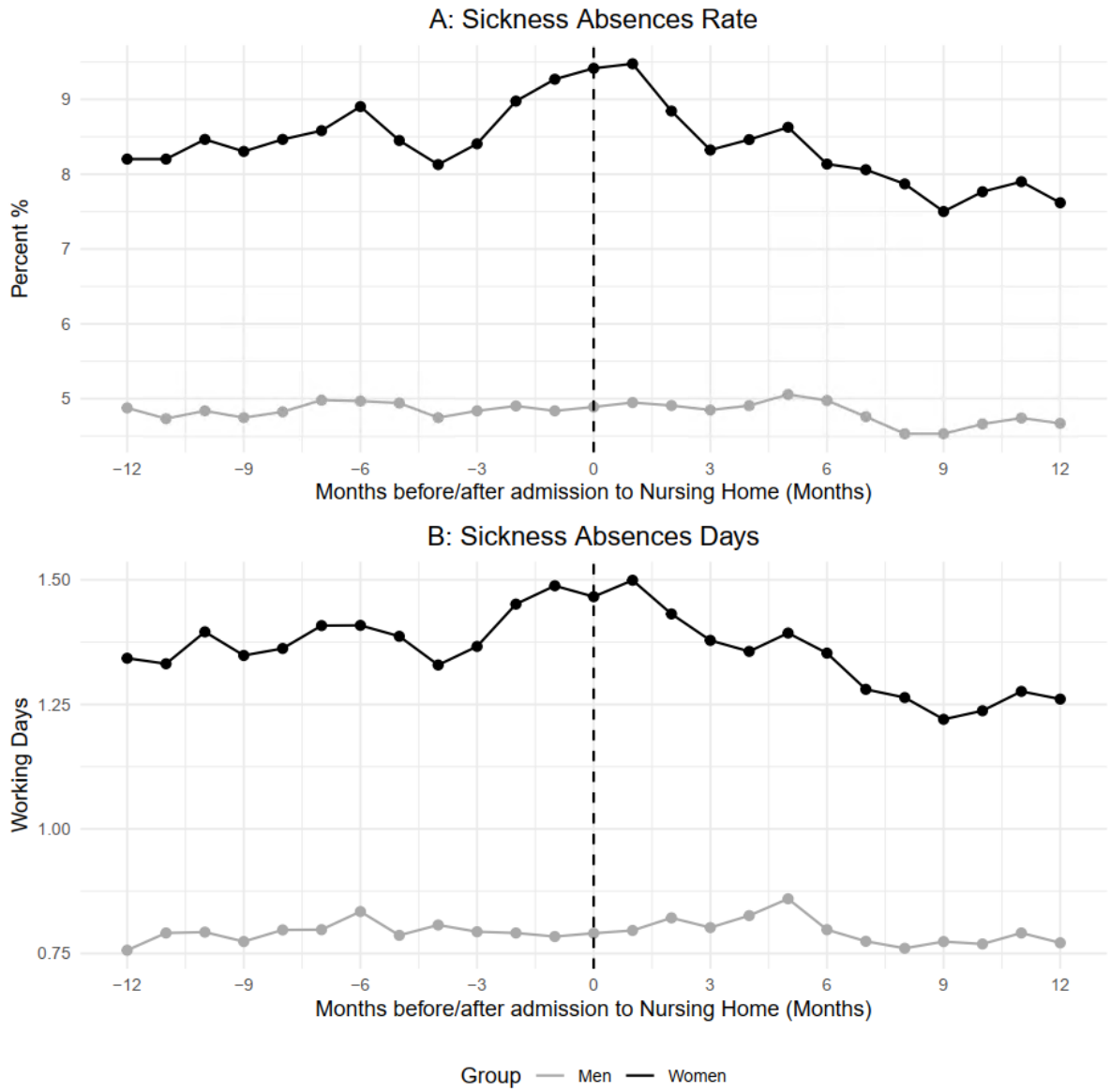


**Figure 6:** *Sickness Absence Rates Around the Time of Nursing Home Admission*
Note: These figures present average sickness absence rate (Panel A) and mean working days lost to own sickness (Panel B). Both are based on our nursing home sample in Table 2. The dotted line indicate the evolution of the outcomes twelve month until/after the admission to a nursing home of a lone parent.

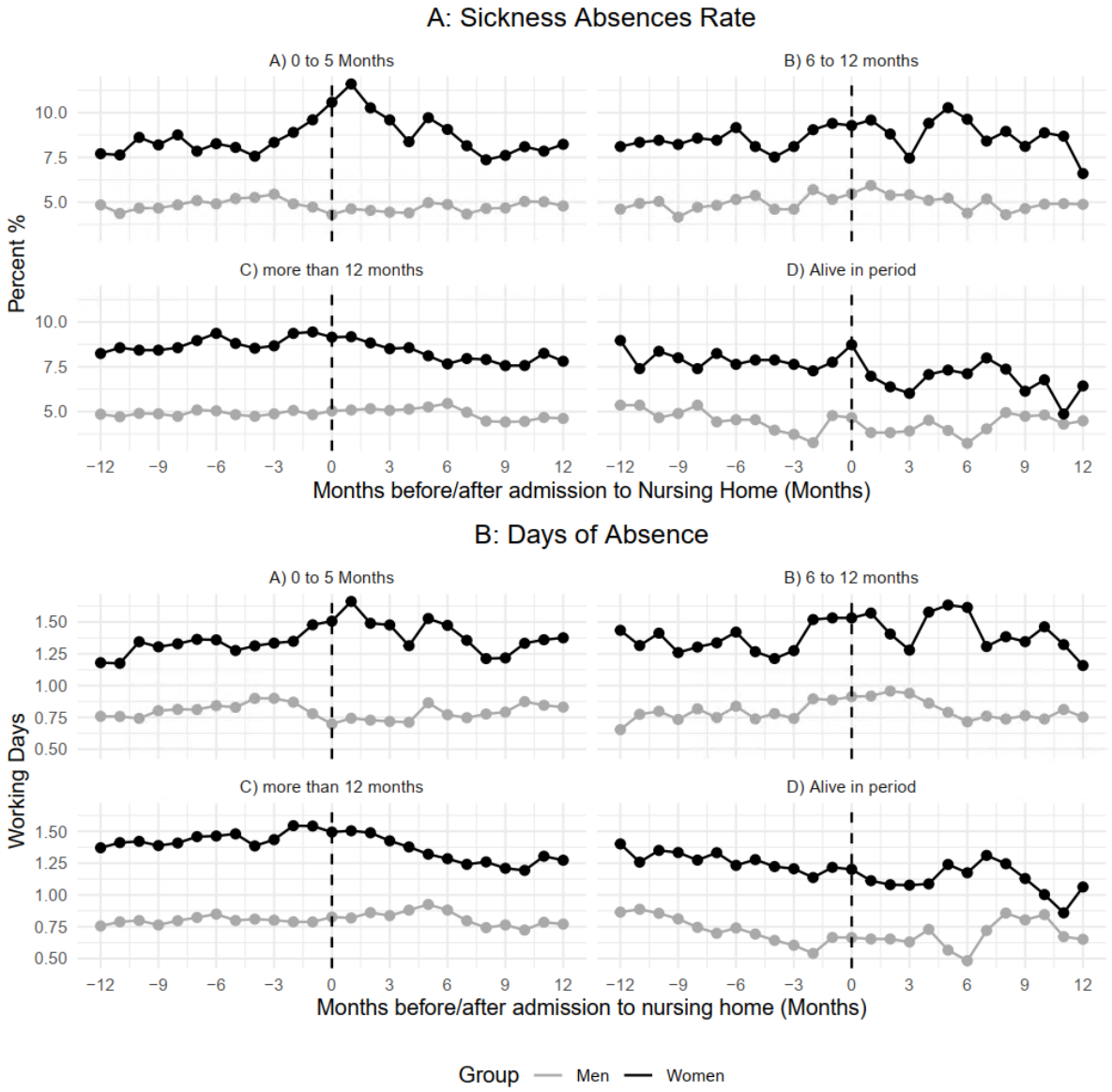


**Figure 7:** *Sickness Absences Around the Time of Nursing Home Admission by Survival Time*
Note: These figures present average sickness absence rate (Panel A) and mean working days lost to own sickness (Panel B). Both are based on our nursing home sample in Table 2. The dotted line indicate the evolution of the outcomes twelve month until/after the admission to a nursing home of a lone parent

# 7 Conclusion

In this study, we have used administrative data from Norway to evaluate the impact of having a lone parent in the terminal phase of life on offspring's labor market participation. We study effects on both the extensive and intensive margins and compare the empirical results with theoretical predictions. The time of death as well as the time of admission to a nursing home are the reference points in our analysis, and we study effects before and after these reference points.

We find that having a lone parent in the terminal phase of life has small negative effects on the offspring's labor supply both before and after the demise of the parent. While the effects on the intensive margin are reversed after death, we find small, persistent effects on the extensive margin. Results using admission to nursing homes find similar effects.

Our study indicates that the negative effects on offspring's labor supply identified prior to a lone parent's death or admission to long-term care are not primarily caused by the provision of care, but rather by the income effect associated with a realized or forthcoming inheritance. In many cases, admission to a nursing home entails an advance on inheritance. Hence, this income effect is present both when using the time of death and the admission to a nursing home as a reference point.

Based on our study, we can draw the conclusion that as the impacts on children's labor supply are relatively small, the publicly provided care in Norway, both home care and institutional care, is in most cases sufficient to avoid large effects on the labor supply. However, we see increased sickness absence around the events of parent's nursing home admission, especially for daughters, indicating that the combination of informal care and work can be especially stressful before the admission happens. Thus, the threshold for admission to a nursing home may have an impact on the children's sick leave and work hours, which is in line with previous studies.

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## Appendix 1: The model

Symbols:

$X$ = consumption of goods
$L$ = leisure
$E$ = level of education
$N$ = total care received by the parent
$Z$ = informal care given by the child
$\bar{Z}$ = care supported by others
$T$ = available time
$LS$ = labor supply
$Y$ = income
$w$ = wage rate
$a$ = travel time
$M$ = inheritance
$P$ = price on goods
$c$ = cost of providing care

The model is solved for three periods $t = 0,1,2$. $t = 0$ is the period where there is no need for care, $t = 1$ is the period where the parent needs care, while the parent is dead when $t = 2$.

The utility function

We assume that the child has altruistic preferences and cares about the welfare of the parent. The welfare of the parent is dependent on the level of care received:

$$U_1 = v(C_1) + \beta V(N), \quad 0 < \beta < 1, \quad V' > 0, \quad V'' < 0$$
$$U_t = v(C_t), t = 0,2$$

Consumption is a household production function of goods and leisure, where the productivity depends positively on the education level: $C_t = C(X_t, L_t; E)$. The utility function can, therefore, be written as $u(X_t, L_t; E) = v(C(X_t, L_t; E))$.

The utility function in three periods is therefore:

(1) $U_0 = u(X_0, L_0; E)$
(2) $U_1 = u(X_1, L_1; E) + \beta V(N)$
(3) $U_2 = u(X_2, L_2; E)$

The function is concave in $X$ and $L$. We also have $u_X > 0$, $u_{XX} < 0$, $u_L > 0$ and $u_{LL} < 0$, and assume $u_{XE} > 0$, $u_{LE} > 0$, $u_{XL} > 0$. Thus, the marginal utility of $X$ and $L$ increase in $E$.

Care is a function of the informal care provided by the child and care provided by others, where we assume that the two types of care are perfect substitutes:

(4) $N = Z + \bar{Z}$

The time budget

Available time can be used for work, leisure and caregiving:

(5) $T_0 = LS_0 + L_0$

(6) $T_1 = LS_1 + L_1 + (1+a)Z$
(7) $T_2 = LS_2 + L_2$

Income

Labor income is the wage rate multiplied by the labor supply:

(8) $Y_0 = w(T_0 - L_0)$
(9) $Y_1 = w(T_1 - L_1 - (1+a)Z)$
(10) $Y_2 = w(T_2 - L_2) + M$

The monetary budget

The budget with credit constraints:

(11) $PX_0 = Y_0$
(12) $PX_1 + cZ = Y_1$
(13) $PX_2 = Y_2$

The budget with perfect credit markets where we have disregarded discounting:

(14) $pX_0 + pX_1 + cZ + pX_2 = w(T_0 - L_0) + w(T_1 - L_1 - (1+a)Z) + w(T_2 - L_2) + M$

The optimization problem

If credit constraints exist, the child wants to maximize the utility in each period given the time budget and the monetary budget in the same period.

It there are perfect credit markets, the child will maximize intertemporal utility: $U = \sum_{t=0}^{2} U_t$, given the time budgets and the intertemporal monetary budget constraint.

## Appendix 2: Solving the model

**The optimisation problem**

***1. Imperfect credit market***

Period 1

The child wants to maximise

(A1) $U_1 = u(X_1, L_1; E) + \beta V(Z + \bar{Z}) U_1 = u(X_1, L_1; E) + \beta V(Z + \bar{Z})$

given

(A2) $PX_1 + cZ = w(T_1 - L_1 - (1+a)Z)$

This gives the following Lagrangian:

(A3) $L_{per1} = u(X_1, L_1; E) + \beta V(Z + \bar{Z}) + \lambda_1(w(T_1 - L_1 - (1+a)Z) - PX_1 - cZ)$

First order conditions are:

(A4) $\frac{\partial L_{per1}}{\partial X_1} = u_X^{'} - \lambda_1 P = 0$

(A5) $\frac{\partial L_{per1}}{\partial L_1} = u_L^{'} - \lambda_1 w = 0$

(A6) $\frac{\partial L_{per1}}{\partial Z} = \beta V_N^{'} - \lambda_1(w(1+a)+c) = 0$

(A7) $\frac{\partial L_{per1}}{\partial \lambda_1} = w(T_1 - L_1 - (1+a)Z) - PX_1 - cZ = 0$

This gives:

(A8) $wu_X^{'} = Pu_L^{'} wu_X^{'} = Pu_L^{'}$

(A9) $(w(1+a)+c)u_L^{'} = w\beta V_N^{'}(w(1+a)+c)u_L^{'} = w\beta V_N^{'}$

(A10) $w(T_1 - L_1 - (1+a)Z) - PX_1 - cZ = 0 w(T_1 - L_1 - (1+a)Z) - PX_1 - cZ = 0$

Equations (A8)-(A10) determine $X_1$, $L_1$ and $Z$.

The second order conditions can be written as follows (see, e.g., Varian, 1992):

(A11) $-P^2 u_{LL}^{''} - w(wu_{XX}^{''} - 2Pu_{LX}^{''}) \equiv \Lambda > 0$

(A12) $(c + w(1+a))^2[(u_{LX}^{''})^2 - u_{LL}^{''}u_{XX}^{''}] - \beta V_{NN}^{''}(P^2 u_{LL}^{''} - 2Pwu_{LX}^{''} + w^2 u_{XX}^{''}) \equiv \Delta < 0$

While (A11) is fulfilled, (A12) requires

$$(c + w(1+a))^2[(u_{LX}^{''})^2 - u_{LL}^{''}u_{XX}^{''}] < \beta V_{NN}^{''}(P^2 u_{LL}^{''} - 2Pwu_{LX}^{''} + w^2 u_{XX}^{''})$$

<u>Period 2</u>

The child wants to maximise

(A13) $U_2 = u(X_2, L_2; E)$

given

(A14) $PX_2 = w(T_2 - L_2) + M$

This gives the following Lagrangian:

(A15) $L_{per2} = u(X_2, L_2; E) + \lambda_2(w(T_2 - L_2) + M - PX_2)$

First order conditions are:

(A16) $\frac{\partial L_{per2}}{\partial X_2} = u_X^{'} - \lambda_2 P = 0$

(A17) $\frac{\partial L_{per2}}{\partial L_2} = u_L^{'} - \lambda_2 w = 0$

(A18) $\frac{\partial L_{per2}}{\partial \lambda_2} = w(T_2 - L_2) + M - PX_2 = 0$

This gives:

(A19) $wu_X^{'} = Pu_L^{'}$

(A20) $w(T_2 - L_2) + M - PX_2 = 0$

Equations (A19) and (A20) determine $X_2$ and $L_2$.

The second order condition can be written as follows (note that this is the same as (A11)):

(A21) $-P^2 u_{LL}^{''} - w(wu_{XX}^{''} - 2Pu_{LX}^{''}) \equiv \Lambda > 0$

**Total differentiation**

***1. Imperfect credit market – period 1***

In period 1, the following system of equations based on (A8)-(A10) gives the optimal variables $X_1^*$, $L_1^*$ and $Z^*$ given exogenous values of $E, \overline{Z}, T_1, w, P, a$ and $c$:

(B1) $wu_X^{'} - Pu_L^{'} = 0$

(B2) $(w(1+a)+c)u_L^{'} - w\beta V_N^{'} = 0$

(B3) $PX_1 + cZ - w(T_1 - L_1 - (1+a)Z) = 0$

A total differentiation of the system (B1)-(B3) gives:

(B4) $u_X^{'}dw + w(u_{XX}^{''}dX_1 + u_{XL}^{''}dL_1 + u_{XE}^{''}dE) - u_L^{'}dP - P(u_{LX}^{''}dX_1 + u_{LL}^{''}dL_1 + u_{LE}^{''}dE) = 0$

(B5) $u_L^{'}(dw(1+a) + wda + dc) + (w(1+a)+c)(u_{LX}^{''}dX_1 + u_{LL}^{''}dL_1 + u_{LE}^{''}dE) - \beta V_N^{'}dw - w\beta V_{NN}^{''}(dZ + d\bar{Z}) = 0$

(B6) $X_1dP + PdX_1 + cdZ + Zdc - (T_1 - L_1 - (1+a)Z)dw - w(dT_1 - dL_1 - (1+a)dZ - Zda) = 0$

This can be written in the following way:

(B7) $u_X^{'}dw - u_L^{'}dP + (wu_{XX}^{''} - Pu_{LX}^{''})dX_1 + (wu_{XL}^{''} - Pu_{LL}^{''})dL_1 + (wu_{XE}^{''} - Pu_{LE}^{''})dE = 0$

(B8) $(u_L^{'}(1+a) - \beta V_N^{'})dw + u_L^{'}dc + (w(1+a)+c)u_{LX}^{''}dX_1 + (w(1+a)+c)u_{LL}^{''}dL_1 + (w(1+a)+c)u_{LE}^{''}dE + u_L^{'}wda - w\beta V_{NN}^{''}dZ - w\beta V_{NN}^{''}d\bar{Z} = 0$

(B9) $X_1dP + PdX_1 + Zdc - (T_1 - L_1 - Z(1+a))dw - wdT_1 + wdL_1 + (w(1+a)+c)dZ + Zwda = 0$

<u>A. dE > 0, d$\overline{Z}$ = $dT_1$ = $dw$ = $dP$ = $dc$ = $da$ = 0</u>

(B7)-(B9) reduce to:

(B10) $(wu_{XX}^{''} - Pu_{LX}^{''})dX_1 + (wu_{XL}^{''} - Pu_{LL}^{''})dL_1 + (wu_{XE}^{''} - Pu_{LE}^{''})dE = 0$

(B11) $(w(1+a)+c)u_{LX}^{''}dX_1 + (w(1+a)+c)u_{LL}^{''}dL_1 + (w(1+a)+c)u_{LE}^{''}dE - w\beta V_{NN}^{''}dZ = 0$

(B12) $PdX_1 + wdL_1 + (w(1+a)+c)dZ = 0$

This gives:

(B13) $\frac{dX_1}{dE} = \frac{K_1}{\Delta}$

$K_1 = -(c + w(1+a))^2[u_{LE}^{''}u_{LX}^{''} - u_{LL}^{''}u_{XE}^{''}] + w\beta V_{NN}^{''}(wu_{XE}^{''} - Pu_{LE}^{''})$

Note that $\Delta < 0$, see (A12).

We know from the first order condition (B1) that $wU_X^{'} = PU_L^{'}$. Assume that the curvature of the marginal utility of consumed goods and leisure is not very different. In this case, we can for simplicity set

(B14) $wU_{XE}^{''} = PU_{LE}^{''}$.

Using this, we find:

(B15) $K_1 = -(c + w(1+a))^2[u''_{LE}u''_{LX} - u''_{LL}u''_{XE}] < 0$

Thus, $\frac{dX_1}{dE} = \frac{K_1}{\Delta} > 0$

The effect on L

(B16) $\frac{dL_1}{dE} = \frac{K_2}{\Delta}$

$K_2 = -(c + w(1+a))^2[u''_{LX}u''_{XE} - u''_{LE}u''_{XX}] + P\beta V''_{NN}(Pu''_{LE} - wu''_{XE})$

Using (B14), we find

(B17) $K_2 = -(c + w(1+a))^2[u''_{LX}u''_{XE} - u''_{LE}u''_{XX}] < 0$

Thus, $\frac{dL_1}{dE} = \frac{K_2}{\Delta} > 0$

Finally, the effect on Z is

(B18) $\frac{dZ}{dE} = \frac{K_3}{\Delta}$

$K_3 = (c + w(1+a))[Pu''_{LE}u''_{LX} - Pu''_{LL}u''_{XE} + wu''_{LX}u''_{XE} - wu''_{LE}u''_{XX}) > 0$

Thus, $\frac{dZ}{dE} = \frac{K_3}{\Delta} < 0$

B. dw > 0, $dE = d\overline{Z} = dT_1 = dP = dc = da = 0$

(B7)-(B9) reduce to:

(B19) $u'_X dw + (wu''_{XX} - Pu''_{LX})dX_1 + (wu''_{XL} - Pu''_{LL})dL_1 = 0$

(B20) $(u'_L(1+a) - \beta V'_N)dw + (w(1+a)+c)u''_{LX}dX_1 + (w(1+a)+c)u''_{LL}dL_1 - w\beta V''_{NN}dZ = 0$

(B21) $PdX_1 - (T_1 - L_1 - Z(1+a))dw + wdL_1 + (w(1+a)+c)dZ = 0$

This gives:

(B22) $\frac{dX_1}{dw} = \frac{K_4}{\Delta}$

$$K_4 = \frac{1}{w}\{c^2U''_{LL}U'_X + (1+a)c\left(PU'_LU''_{LL} - wU'_LU''_{LX} + 2wU''_{LL}U'_X\right) + c\beta V'_N(wU''_{LX} - PU''_{LL})\}$$
$$+PU''_{LL}\left((1+a)^2U'_L + \beta[V''_{NN}(Z(1+a) + L_1 - T_1) - (1+a)V'_N]\right)$$
$$+w\left((1+a)^2U''_{LL}U'_X - (1+a)^2U'_LU''_{LX}\right.$$
$$\left. + \beta\left[U'_XV''_{NN} + U''_{LX}\left((1+a)V'_N - V''_{NN}(Z(1+a) + L_1 - T_1)\right)\right]\right)$$

(B23) $\frac{dL_1}{dw} = \frac{-K_5}{\Delta}$

$$K_5 = \frac{1}{w}\{c^2U''_{LX}U'_X + (1+a)c\left(PU'_LU''_{LX} - wU'_LU''_{XX} + 2wU''_{LX}U'_X\right) + c\beta V'_N(wU''_{XX} - PU''_{LX})\}$$
$$+P\left((1+a)^2U'_LU''_{LX} + \beta\left[U'_XV''_{NN} + U''_{LX}\left(V''_{NN}(Z(1+a) + L_1 - T_1) - (1+a)V'_N\right)\right]\right)$$
$$+w\left((1+a)^2U''_{LX}U'_X - U''_{XX}\left[(1+a)^2U'_L + \beta\left[V''_{NN}(Z(1+a) + L_1 - T_1) - (1+a)V'_N\right]\right]\right)$$

(B24) $\frac{dZ}{dw} = \frac{-K_6}{\Delta}$

$$K_6 = \frac{1}{w}\{P^2U''_{LL}\left((1+a)U'_L - \beta V'_N\right)$$
$$+ P\left(U'_XU''_{LL}(c + w(1+a)) - 2w(1+a)U'_LU''_{LX} + 2w\beta U''_{LX}V'_N\right)\}$$
$$+(w(1+a)+c)\left((U''_{LX})^2(L_1 + (1+a)Z - T_1) - U''_{XX}U''_{LL}(L_1 + (1+a)Z - T_1) - U''_{LX}U'_X\right)$$
$$+w(1+a)U''_{XX}U'_L - w\beta V'_NU''_{XX}$$

$K_4$, $K_5$ and $K_6$ are indeterminate.

C. $d\bar{Z} > 0$, $dE = dT_l = dw = dP = dc = da = 0$
(B7)-(B9) reduce to:

(B25) $(wu''_{XX} - Pu''_{LX})dX_1 + (wu''_{XL} - Pu''_{LL})dL_1 = 0$
(B26) $(w(1+a)+c)u''_{LX}dX_1 + (w(1+a)+c)u''_{LL}dL_1 - w\beta V''_{NN}dZ - w\beta V''_{NN}d\bar{Z} = 0$
(B27) $PdX_1 + wdL_1 + (w(1+a)+c)dZ = 0$

This gives

(B28) $\frac{dX_1}{d\bar{Z}} = \frac{K_7}{\Delta}$

$K_7 = -((1+a)w + c)\beta V''_{NN}(PU''_{LL} - wU''_{LX}) < 0$
Thus, $\frac{dX_1}{d\bar{Z}} = \frac{K_7}{\Delta} > 0$

(B29) $\frac{dL_1}{d\bar{Z}} = \frac{K_8}{\Delta}$

$K_8 = -(w(1+a)+c)\beta V''_{NN}(wU''_{XX} - PU''_{LX}) < 0$

Thus, $\frac{dL_1}{d\bar{Z}} = \frac{K_8}{\Delta} > 0$

(B30) $\frac{dZ}{d\bar{Z}} = \frac{K_9}{\Delta}$

$K_9 = \beta V''_{NN}(P^2U''_{LL} - 2wPU''_{LX} + w^2U''_{XX}) > 0$

Thus, $\frac{dZ}{d\overline{Z}} = \frac{K_9}{\Delta} < 0$

D. $dc > 0$, $dE = d\overline{Z} = dT_l = dw = dP = da = 0$
(B7)-(B9) reduce to:

(B31) $(wu''_{XX} - Pu''_{LX})dX_1 + (wu''_{XL} - Pu''_{LL})dL_1 = 0$
(B32) $u'_L dc + (w(1+a)+c)u''_{LX}dX_1 + (w(1+a)+c)u''_{LL}dL_1 - w\beta V''_{NN}dZ = 0$
(B33) $PdX_1 + Zdc_1 + wdL_1 + (w(1+a)+c)dZ = 0$

This gives:

(B34) $\frac{dX_1}{dc} = \frac{K_{10}}{\Delta}$

$K_{10} = (PU''_{LL} - wU''_{LX})\left(U'_L(w(1+a)+c) + Zw\beta V''_{NN}\right)$

(B35) $\frac{dL_1}{dc} = \frac{K_{11}}{\Delta}$

$K_{11} = (wU''_{XX} - PU''_{LX})\left(U'_L(w(1+a)+c) + Zw\beta V''_{NN}\right)$

(B36) $\frac{dZ}{dc} = \frac{K_{12}}{\Delta}$

$$K_{12} = -\left(P^2U'_LU''_{LL} - 2wPU'_LU''_{LX} + w\left(wU'_LU''_{XX} + \left((U''_{LX})^2 - U''_{LL}U''_{XX}\right)(w(1+a)+c)Z\right)\right)$$

$K_{10}$, $K_{11}$ and $K_{12}$ are indeterminate.

E. $da > 0$, $dE = d\overline{Z} = dT_l = dw = dP = dc = 0$
(B7)-(B9) reduce to:

(B37) $(wu''_{XX} - Pu''_{LX})dX_1 + (wu''_{XL} - Pu''_{LL})dL_1 = 0$
(B38) $(w(1+a)+c)u''_{LX}dX_1 + (w(1+a)+c)u''_{LL}dL_1 + u'_L wda - w\beta V''_{NN}dZ = 0$
(B39) $PdX_1 + wdL_1 + (w(1+a)+c)dZ + Zwda = 0$

This gives:

(B40) $\frac{dX_1}{da} = \frac{K_{13}}{\Delta} = -\frac{dX_1}{dc}$

$K_{13} = (PU''_{LL} - wU''_{LX})(U'_L(w(1+a)+c) + Zw\beta V''_{NN}) = K_{10}$

(B41) $\frac{dL_1}{da} = \frac{K_{14}}{\Delta} = \frac{dL_1}{dc}$

$K_{14} = (wU''_{XX} - PU''_{LX})(U'_L(w(1+a)+c) + Zw\beta V''_{NN}) = K_{11}$

(B42) $\frac{dZ}{da} = \frac{K_{15}}{\Delta} = \frac{dZ}{dc}$

$$K_{15} = -(P^2 U_L^{'} U_{LL}^{''} - 2wPU_L^{'} U_{LX}^{''} + w\left(wU_L^{'} U_{XX}^{''} + \left((U_{LX}^{''})^2 - U_{LL}^{''} U_{XX}^{''}\right)(w(1+a)+c)Z\right)$$
$$= K_{12}$$

$K_{13}$, $K_{14}$ and $K_{15}$ are indeterminate.

***2. Imperfect credit market – period 2***

In period 2, the equations (A19) and (A20) give the optimal variables $X_2^*$, $L_2^*$ given exogenous values of $E$, $T_2$, $w$, $P$ and $M$:

(B43) $wu_X^{'} - Pu_L^{'} = 0$
(B44) $PX_2 - w(T_2 - L_2) - M = 0$

A total differentiation of the system (B44) and (B45) gives:
(B45) $u_X^{'} dw - u_L^{'} dP + (wu_{XX}^{''} - Pu_{LX}^{''})dX_2 + (wu_{XL}^{''} - Pu_{LL}^{''})dL_2 + (wu_{XE}^{''} - Pu_{LE}^{''})dE = 0$
(B46) $X_2 dP + PdX_2 - (T_2 - L_2)dw - wdT_2 + wdL_2 - dM = 0$

A. $dM > 0$, $dE = dw = dT_2 = dP = 0$
(B45)-(B46) reduce to:

(B47) $(wu_{XX}^{''} - Pu_{LX}^{''})dX_2 + (wu_{XL}^{''} - Pu_{LL}^{''})dL_2 = 0$
(B48) $PdX_2 + wdL_2 - dM = 0$

This gives
(B49) $\frac{dX_2}{dM} = \frac{wu_{LX}^{''} - Pu_{LL}^{''}}{\Lambda} > 0$
(B50) $\frac{dL_2}{dM} = \frac{Pu_{LX}^{''} - wu_{XX}^{''}}{\Lambda} > 0$

where Λ follows from (A21).

B. $dT_2 > 0$, $dE = dw = dP = dM = 0$
(B45)-(B46) reduce to:

(B51) $(wu_{XX}^{''} - Pu_{LX}^{''})dX_2 + (wu_{XL}^{''} - Pu_{LL}^{''})dL_2 = 0$
(B52) $PdX_2 - wdT_2 + wdL_2 = 0$

This gives
(B53) $\frac{dX_2}{dT_2} = \frac{w(wu_{LX}^{''} - Pu_{LL}^{''})}{\Lambda} > 0$
(B54) $\frac{dL_2}{dT_2} = \frac{w(Pu_{LX}^{''} - wu_{XX}^{''})}{\Lambda} > 0$

## Appendix 3: Additional analysis

The effect of also taking care of own children

Let $B$ be the time a child uses to take care of its own children, and let $B$ be exogenous. The time budgets can then be written as

(15) $T_0 - B = LS_0 + L_0$

(16) $T_1 - B = LS_1 + L_1 + (1+a)Z$

(17) $T_2 - B = LS_2 + L_2$

We can analyze $B > 0$ as a negative shift in $T_i$, $t = 1,2,3$.

Using the total differentiation in Appendix 2, and setting $dT_1 > 0$, $d\overline{Z} = dE = dw = dP = dc = da = 0$, we find the following system of equations for $t = 1$:

(18) $(wu''_{XX} - Pu''_{LX})dX_1 + (wu''_{XL} - Pu''_{LL})dL_1 = 0$

(19) $(w(1+a)+c)u''_{LX}dX_1 + (w(1+a)+c)u''_{LL}dL_1 - w\beta V''_{NN}dZ = 0$

(20) $PdX_1 - wdT_1 + wdL_1 + (w(1+a)+c)dZ = 0$

This gives:

(21) $\frac{dX_1}{dT_1} = \frac{K_{16}}{\Delta} > 0,$

as

(22) $K_{16} = w\beta V''_{NN}(wu''_{LX} - Pu''_{LL}) < 0$

Note that $\Delta < 0$ as it follows from the second order condition, see Appendix 2. Thus, a reduction in $T_1$ reduces $X_1$.[8]

The effect on $L_1$:

(23) $\frac{dL_1}{dT_1} = \frac{K_{17}}{\Delta} > 0$

where

(24) $K_{17} = -w\beta V''_{NN}(wu''_{XX} - Pu''_{LX}) < 0$

Thus, a reduction in in $T_1$ reduces $L_1$.

[8] Labor supply in period 1 is $LS_1 = T_1 - L_1 - (1+a)Z$. As $Y_1 = wLS_1$, we find from using the budget constraint that $X_1 = \frac{wLS_1}{P} + \frac{c}{P}Z$. Thus, for $c = 0$, $X_1$ is a proxy for labor supply.

Finally, the effect on $Z$ is

(25) $\frac{dZ}{dT_1} = \frac{K_{18}}{\Delta}$.

where

(26) $K_{18} = w(c + w(1 + a))[(u''_{LX})^2 - u''_{XX}u''_{LL})$

As $K_{18}$ is indeterminate, the effect on $Z$ is also indeterminate.

Men and women give different types of care

Assume first that the care given by daughters and sons has the same welfare impact on the parent. This means that equation (4) is still valid. In addition, the time budget in equation (6) is also valid, but $a > 0$ for daughters and $a = 0$ for sons.

In this case, the formal analysis is as before, but in the interpretation of care, $(1+a)Z$ must be interpreted as the care given by daughters, even if this does not turn up in equation (4). As the effect on $Z$ of an increase in $a$ (from zero), is indeterminate, the effect on care is indeterminate.

Assume now that the parent values positively the time spent in caregiving. Thus, more time with the parent increases her welfare. In this case, the total care can be written as

(27) $N = (1+a)Z + \bar{Z}$,

where $a > 0$ for daughters and $a = 0$ for sons. The time budget is still described by equation (6).

Let $Z_s = Z$be the care provided by sons and $Z_d = (1 + a)Z$ be the care provided by daughters. Inserting $Z_s$ and $Z_d$ in equations (6), (9), (12) and (27),[9] we see that the optimization problem is identical for sons and daughters. Thus, $Z_s = Z_d$.

Informal and formal care are not perfect substitutes

Assume that formal care is not valued in the same way as informal care by the parent. We can model this as

(28) $N = Z + \kappa\bar{Z}, \quad 0 < \kappa < 1$

This can be studied as a negative shift in $\bar{Z}$as studied in Appendix 2. As shown, this will increase $Z$ and reduce labor supply given by $LS = T_1 - L_1 - (1 + a)Z$.

[9] It may be argued that the extra time spent on care does not have a monetary cost, see (12). On the other hand, the monetary cost of informal care can probably be ignored if we do not consider costs of travelling.

## Appendix 4: Description of Long-term Care in Norway

In Norway, the municipalities have the responsibility for providing and financing long-term care services. The right to receive care is regulated by the Municipal Health Services Act. All residents in Norway have the right to receive services based on their needs. The services are financed by tax revenues and block grants by the state and user copayments for certain services. User payments are regulated by national guidelines («Forskrift om egenandel for kommunale helse- og omsorgstjenester»). The resident themself, a relative or a healthcare professional can communicate the need for health care to the municipality.

The municipal health- and care services can be divided into three main services; 1. Practical assistance, 2. Home nursing and 3. Nursing homes.

Practical assistance includes help with household tasks such as cleaning, linen change, laundry and help with ordering and delivering necessary groceries. Municipalities may charge a user fee on those services. The user fee is calculated based on income and set rates. Home nursing is part of the municipal health- and care service that provides nursing and care services for people who live outside of a health institution. Home nursing is the healthcare part of the municipal assistance schemes for homes. The service may include wound care, personal hygiene assistance, and medication management. Home nursing is free of charge. When living at home a resident may receive both practical assistance and home nursing. The type of, and extent of, services are assigned according to need.

Nursing homes are a facility for people with continuous need for health and care services. The stay can be of longer or shorter duration, called short-term and long-term stays. A *short-term stay* in a nursing home is a temporary placement where someone receives care, rehabilitation, or supervision for a limited period, for example after a hospital stay. The length of the stay varies from a few days to several weeks, but the goal is that the patients should still be able to live at home after a spell. Long-term stay is an offer for those who need 24/7 follow-up and supervision over an extended period of time. A long-term stay is usually permanent, lasting until death. For short-term stay in nursing home the municipality can charge up to 205 NOK per day (2026). For long-term stay in nursing home the municipality can charge up to 75% of disposable income up to the National insurance base amount (130 160 NOK in 2025), and 85% for disposable income above that ceiling.

Home-based services have been the dominant approach in health- and care services since the early 1990s (Grødem, 2018). Through various reforms (Leve hele livet», «Bo trygt hjemme») there is increased focus on ensuring that older people can live at home longer with adapted services from the municipality. An example of this are welfare technologies, which are a series of devices, such as alarms and monitoring sensors that are aimed to support and enforce safety, mobility and independence while ensuring interactions with other welfare services (Helsedirektoratet, 2012).

## Appendix 5: Data sources and variable description

Our analysis is based on Norwegian administrative registry data covering the entire population of Norway from 1993 to 2020. We use encrypted identification personal and family number to follow individuals over time and to link children to their parents and siblings.[10] With these unique numbers we merge several registers containing information about age, gender, municipality, earnings, education, social security transfers, etc. With family ties we are able to identify the exact time (date) of parents' death.

Through GERICA, we have information about all residents in Oslo receiving services provided by the municipality during the period 2009-2020. In this register start- and stop dates for each service are included. We are particularly interested in the date for admission to long-term stay in nursing home, but to describe the extent and type of formal services received in advance other services are also relevant.

### Table A.1: Description of variables

**A. Outcomes (Offspring)**

| Variable | Definition | Source |
|---|---|---|
| Annual wage earnings | Earnings are defined as the sum of wage income and net business income during the calendar year. Sick pay and maternity pay are included. Inflation adjusted using G[11] | Income Registry[12] |
| Log earnings (conditional on employment) | For those who are employed, we use log of annual wage earnings as an additional dependent variable. For the definition of employment, see below | Income Registry |
| Employed | Dummy variable equals 1 if annual wage earnings > 1 G (NOK 130 160 in 2025). | Income Registry |
| Social security dependency | Dummy variable equals 1 if an individual receives any of the following benefits (see below) at least three months in a single calendar year. The benefits include sickness absence benefits, temporary and permanent disability benefits, early retirement, unemployment benefits, and social assistance. | Social Security Registry (FD-Trygd)[13] |
| Physician-certified sickness absence | Use of physician-certified sickness absence during a given year/month. We use a dichotomous variable capturing the use of any sickness absence during a given year or month. | Sick-leave register |

**B. Timing of events**

| Variable | Definition | Source |
|---|---|---|
| Event date (parental death) | Year of death of the parent | Population Registry |
| Event date (nursing home admission) | We use the exact start date of the long-term stay in a nursing home. We treat this as an absorbing state | GERICA. Applies only for Oslo |
| Relative time to the event | Difference between a given calendar year and the year of the event. Negative event-year indicators represent the years before the treatment. Year zero is the year of the event, and positive indicators are the years after the event | |
| Reference period | We use the 9 years before parental death and 4 years before admission to a long-term stay in a nursing home as references. | |

[10] For individuals born before 1953 the family identifiers are incomplete since family ties are often missing for offspring moving out of their home before the 1970 census.

[11] G refers to "Folketrygdens grunnbeløp", which is a standard reference amount used by the Norwegian National Insurance Scheme. It serves as a benchmark for calculating benefits, such as pensions, disability benefits, unemployment benefits, and other social security payments. In 20251G is NOK 130 160

[12] We use the variable «yrkesinntekt» see https://www.ssb.no/data-til-forskning/utlan-av-data-til-forskere/variabellister/inntekt

[13] We use "sykepenger», «Arbeidsavklaringspenger», «Uføretrygd», early retirement pension, «sosialhjelp» and «dagpenger» for more information see https://www.ssb.no/data-til-forskning/utlan-av-data-til-forskere/variabellister/fd-trygd

### C. Demographics and socioeconomic variables

| Variable | Definition | Source |
|---|---|---|
| Sex | Gender registered | Population registry |
| Birth year | | Population registry |
| Education (highest attained) | Highest level of education achieved the year before parental death. University/college includes: first stage of tertiary education, second stage of tertiary education (postgraduate education) Compulsory and secondary school includes the rest; No education and pre-school primary education, lower secondary education, upper secondary education, upper secondary post-secondary non-tertiary education. | National Education Database (NUDB) |
| Immigrant with non-Western background | Dummy equals 1 if the following criteria are achieved:<br>- Born to two migrant parents or are migrants themselves<br>- Not from Denmark, Finland, Iceland, Sweden, Belgium, Ireland, the Netherlands, Liechtenstein, Luxembourg, Monaco, Portugal, the United Kingdom, Switzerland, Germany, Austria, Canada, the United States, Australia and New Zealand. Kingdom, Switzerland, Germany, Austria, Canada, the United States, Australia and New Zealand. | Population registry |
| Parent wealth (baseline) | Amount of taxable gross wealth in the year before the parental death | Income Registry |
| Inheritance quartile group | Low inheritance if their respective parent's wealth is within the bottom quartile of the wealth distribution, the year before the event of interest<br>High inheritance if their affected parent's wealth is within the top quartile of the wealth distribution in the year before the event of interest. | Income Registry |
| Same municipality as parent | A person who resides in the same municipality as the lone parent in the year before parental death/admission to nursing home | Population registry |
| Number of siblings | Number of siblings to the same mother or father using family linkages | Population registry |
| Only-child indicator | Indicator of whether an adult child has a sibling based on the number of siblings | Population registry |
| Own children aged 0-12 | Indicator of whether an adult children has children of their own who are between 0 and 12 years old at the time of parental death | Population registry |
| Same-year both parents died indicator | Binary variable for those who lose both parents in the same year | |
| Years between parents' deaths | For those children that has two lone parents dying, this represents the number of years between the death of the two | |
| Parent age at event | Age at event = Year of event – Year of birth | |
| Parent sex | | Population registry |
| Municipal health- and care services prior to long-term stay in nursing homes | *Short term stay* at nursing home are stays in nursing homes related to health assessments, treatment, rehabilitation and habilitation (codes 8, 18, 19, 20 and 25). *Home nursing* are services that offer medical care and support (code 15). *Practical help* includes care services at home that cover help with daily tasks such as food delivery, house cleaning, laundry, etc (codes 1,2,5). *Welfare technology* includes users of telecare devices such as alarms and sensors provided by the municipality (code 6, 26). For more details, see appendix 4 | Gerica |
| Length of nursing home stay | Difference between the time of death and the start of the nursing home stay. To follow all residents 3 years ahead the numbers presented in table 2 include cohorts from 2009 to the year 2017 | Gerica |

### D. Sample Construction and Restrictions

| Variable | Definition | Source |
|---|---|---|
| Offspring age at event | Offspring must be between 38 and 66 years old at event time. We observe cohorts from 1934 to 1982 for the parental death sample, and 1940 and 1982 for nursing home | Population registry merged with relevant event dates |
| Eligible age range | We include outcomes of offspring that are between 35 and 66 years old during the observed period | |
| Parent identified/linkage | We use parents' encrypted identity number | Population registry |
| Sibling linkage | Siblings are identified through the parents' encrypted identity number. | Population registry |
| Long-term stay in nursing home | A long-term stay in a nursing home means that an individual is admitted to a nursing home at permanent basis. The code for long-term stay in a nursing home is 21. For more details see appendix 4. | GERICA |

## Appendix 6: Figures

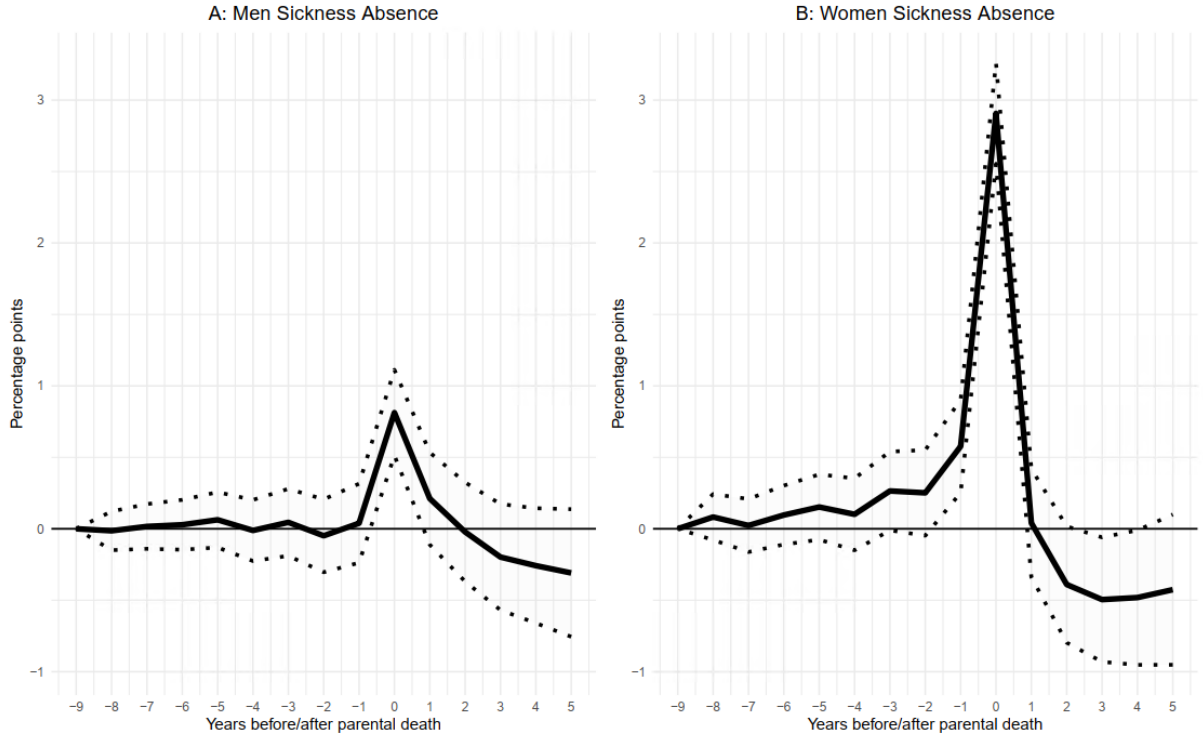


***Figure A1:*** *Sickness Absences around the time of parental death*
Note: This figure present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on our parental death sample in Table 1. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before.

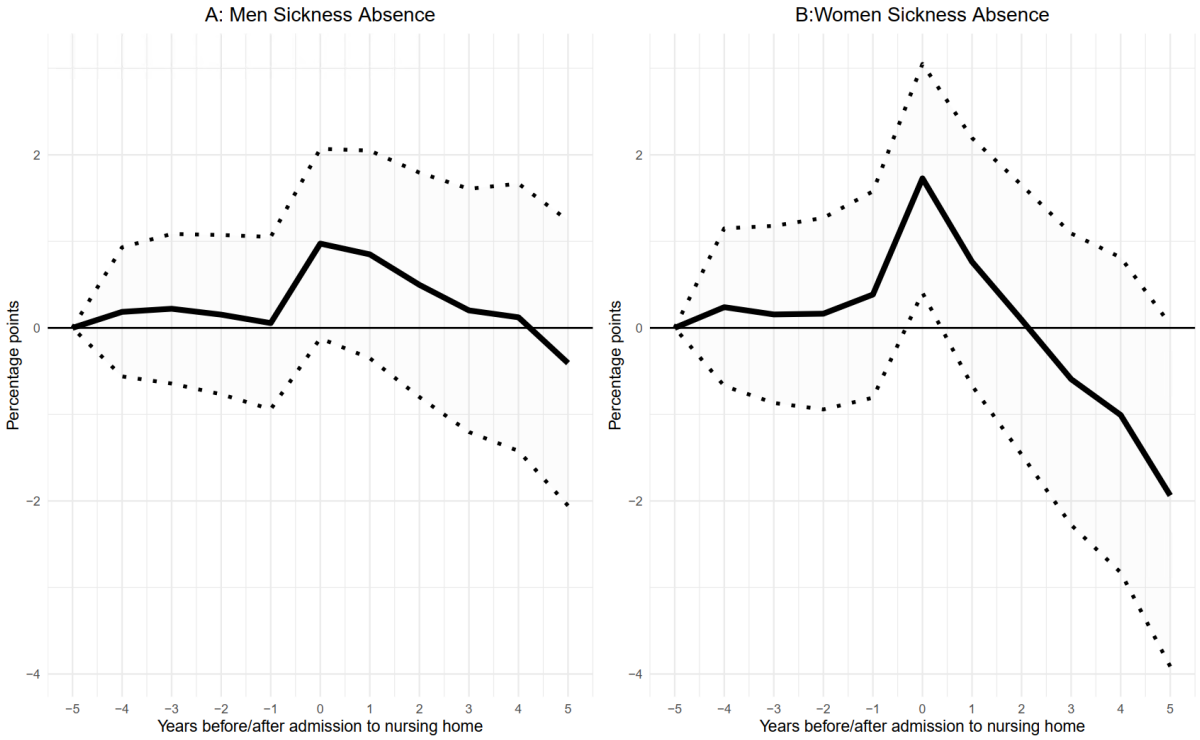


***Figure A2:*** *Sickness Absences around the time of parental admission to nursing home*
Note: This figure present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on the nursing home sample described in Table 2 and indicate effects of years until/after the admission to a nursing home of a lone parent relative to more than 4 years before.

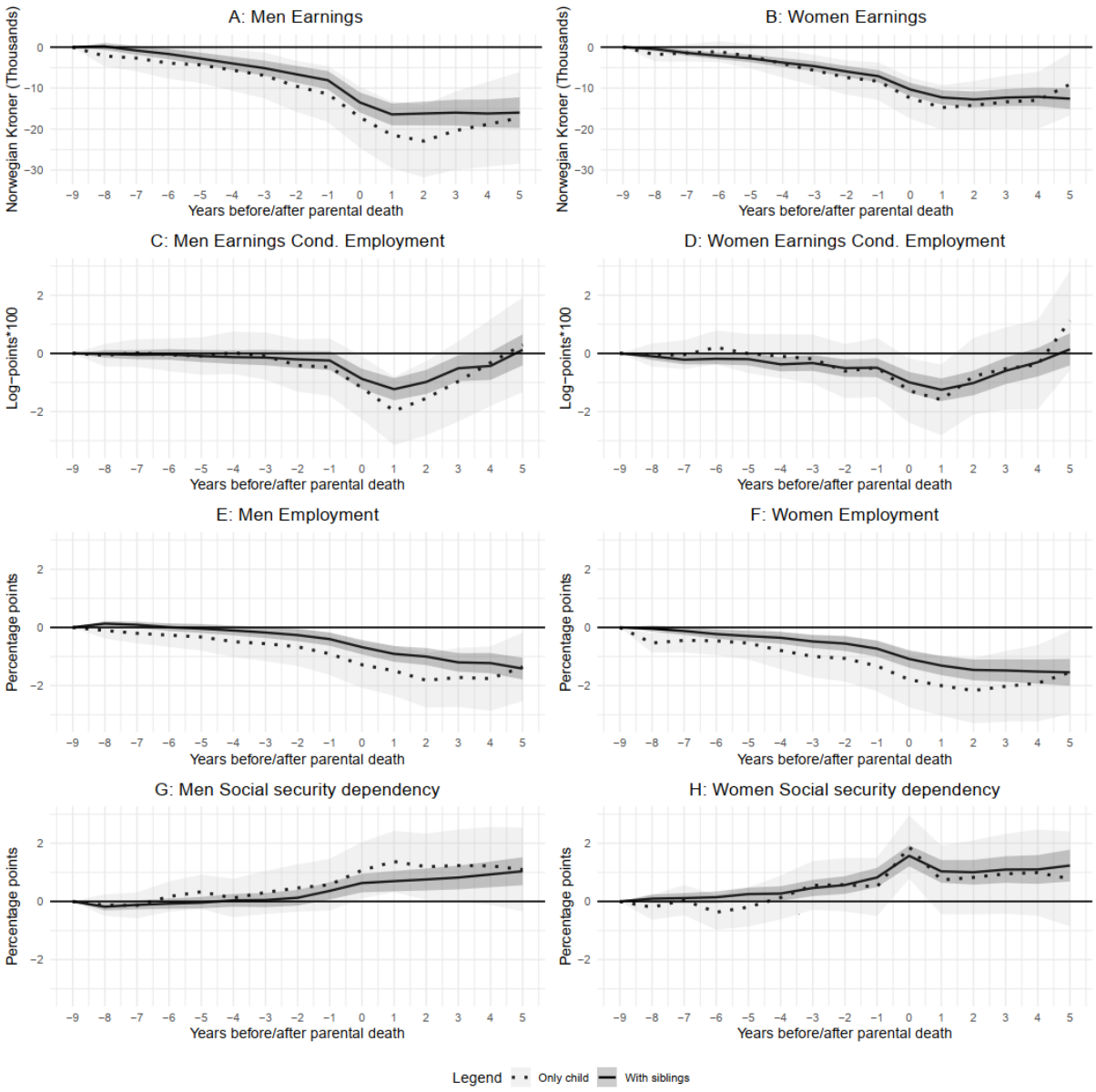


**Figure A3:** *Labor market outcomes by presence of siblings*

Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on a subsample of our main sample in Table 1 divided by the presence of siblings, as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the only child group; the solid line and dark-grey confidence intervals correspond to the offspring with siblings group. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before.

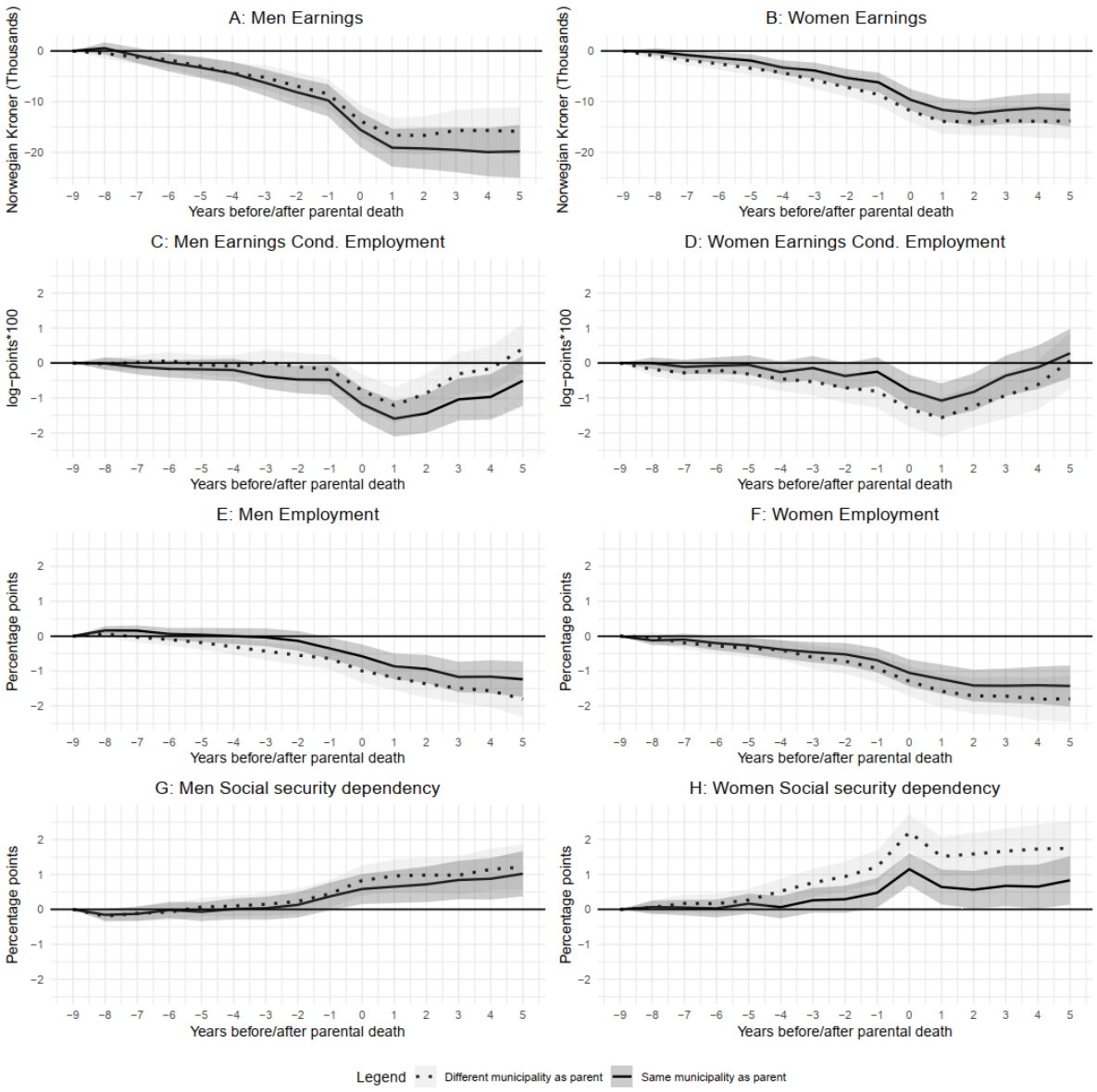


**Figure A4:** *Labor market outcomes by proximity to parent*

Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on a subsample of our main sample in Table 1 divided according to whether adult children live in the same or a different municipality as their lone parent, as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the group living in a different municipality; the solid line and dark-grey confidence intervals correspond to the offspring living in the same municipality as their parent. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before

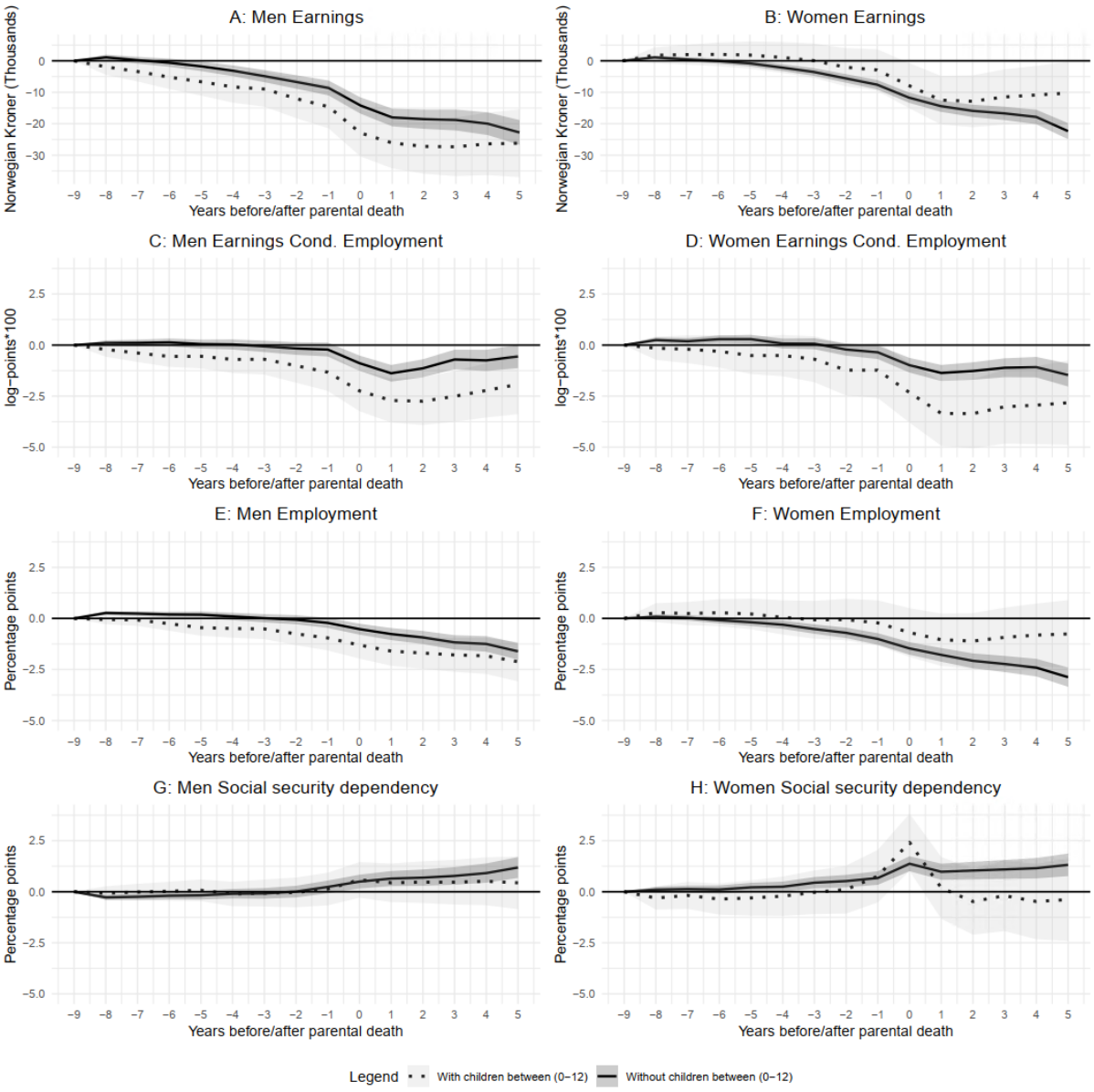


**Figure A5:** *Labor market outcomes by presence of young children*
Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands).All estimates are based on a subsample of our main sample in Table 1 divided according to whether adult children live have younger children of their own (between 0 and 12 years), as described in Section 4.2. For those with young children, In addition to controls described in Equation 1, we also include age-by cohort controls for the youngest child. The dotted line and light grey confidence intervals correspond to the group with young children; the solid line and dark-grey confidence intervals correspond to the group without young children. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before

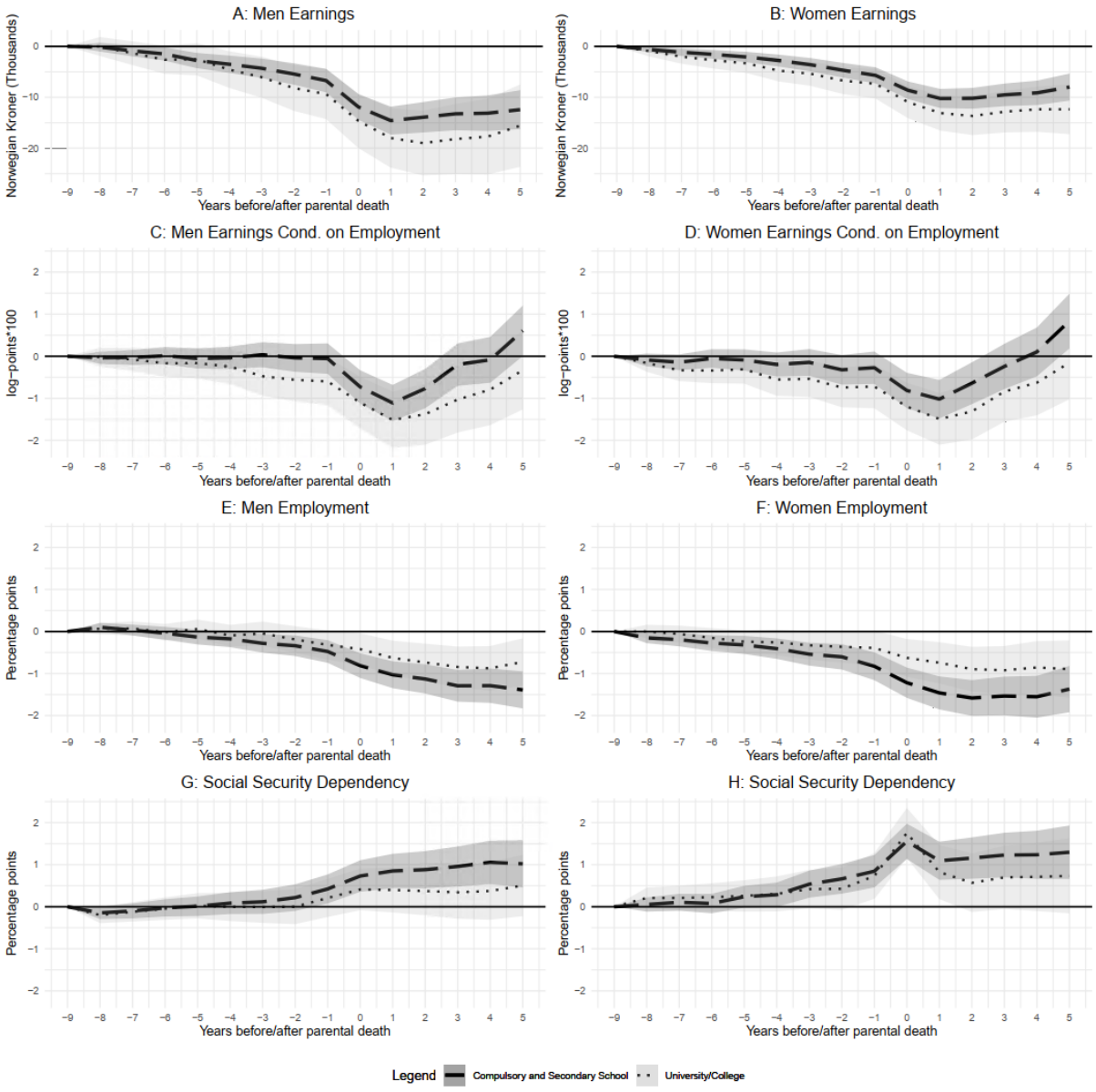


**Figure A6:** *Labor market outcomes by education level*

Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on a subsample of our main sample in Table 1 divided highest level of education obtained by the offspring as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the group with college or university education; the solid line and dark-grey confidence intervals correspond to the group with compulsory and secondary school. Point estimates indicate effects of years until/after the death of a lone parent relative to more than 8 years before.

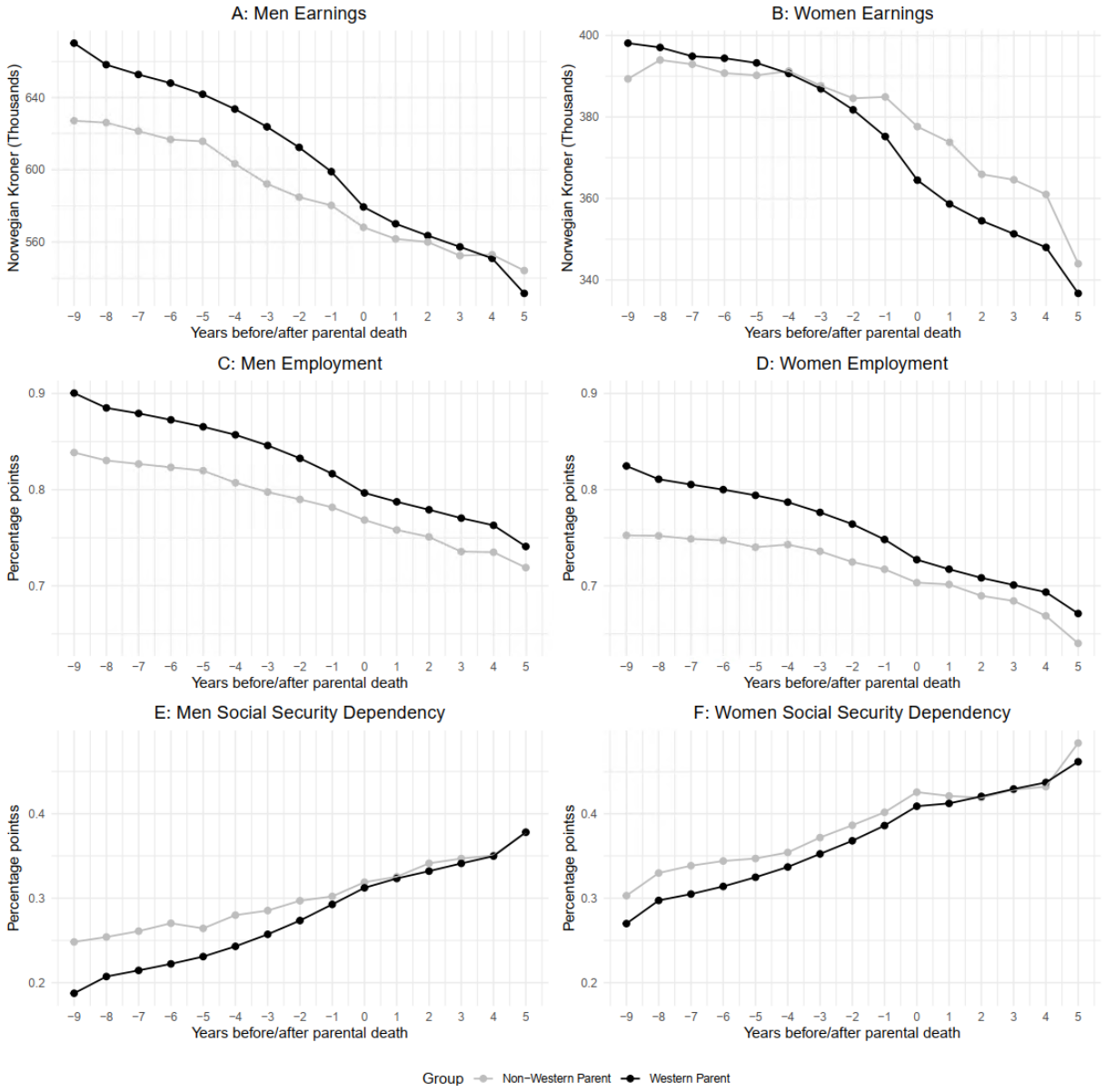


**Figure A7:** *Labor market outcomes by family background*
Note: This figure present average outcomes based on a subsample of our main sample in Table 1 divided by the national background of the parent, as described in Section 4.2.

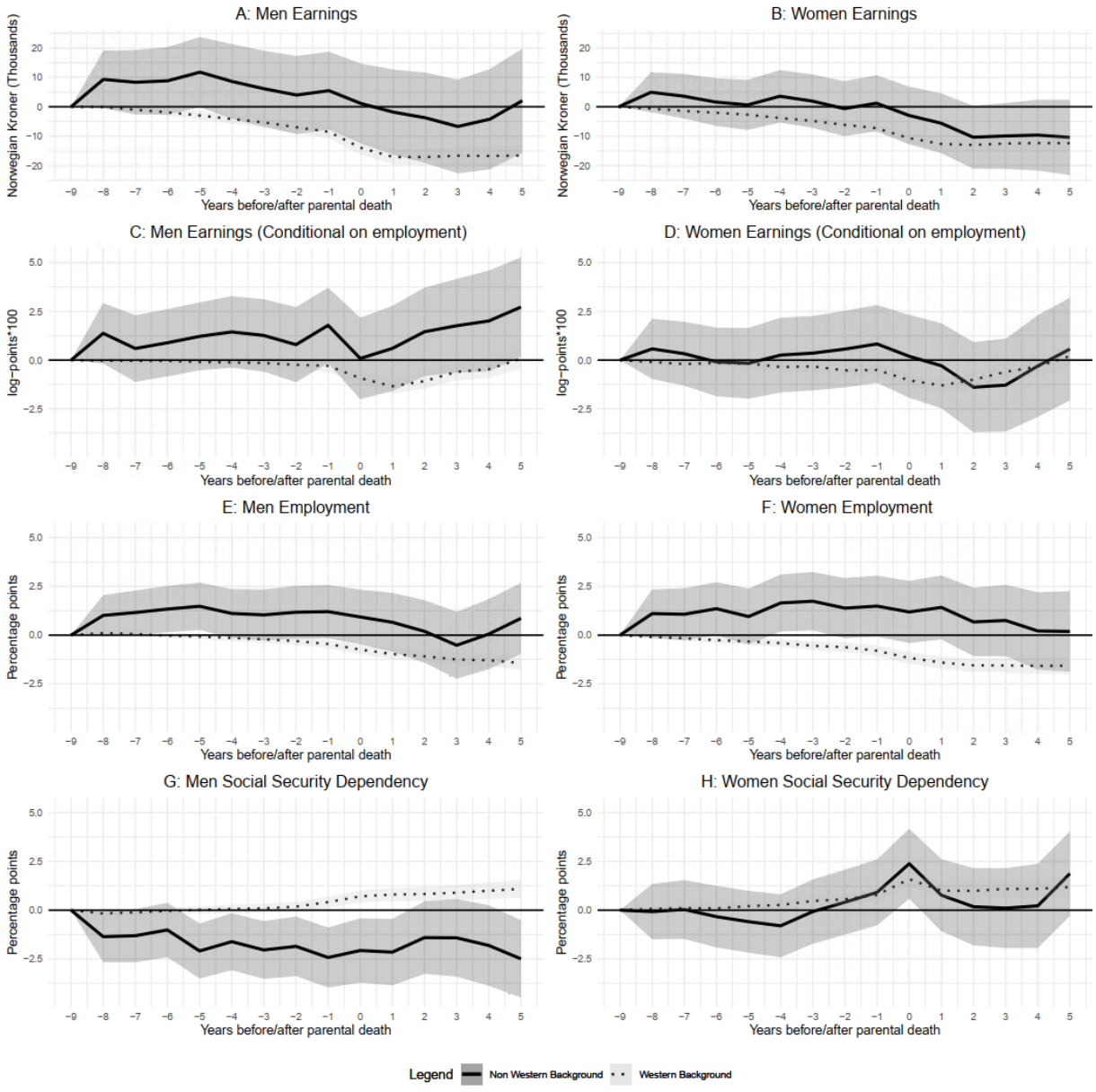


**Figure A8:** *Labor market outcomes by immigrant background*
Note: These figures present estimates based on Equation (1) with 95% confidence intervals (dotted bands). All estimates are based on a subsample of our nursing home sample in Table 2 divided by the national background of the parent, as described in Section 4.2. The dotted line and light grey confidence intervals correspond to the group with a Western background; the solid line and dark-grey confidence intervals correspond to the offspring with a non-Western background. Point estimates indicate effects of years until/after the admission to nursing home of a lone parent relative to more than 4 years before.