Does the Child Penalty Strike Twice*

Mette Gørtz[1], Sarah Sander[1,2], and Almudena Sevilla[2]

[1]University of Copenhagen and CEBI

[3]University College London - Institute of Education

December 31, 2021

Abstract

This paper studies the relative labor market outcomes of grandmothers in comparison to grandfathers before and after the arrival of the first grandchild using Danish administrative data and an event study approach. We find that women's labor market outcomes decline at a steeper rate than men's after the arrival of the first grandchild. We find gender gaps in earnings of four and ten percent five and ten years after the arrival of the first grandchild, which is driven by women's labor supply on both the intensive and extensive margin.

JEL codes: J13, J14, J16, J22

Keywords: grandchildren, female labor supply, gender, inequality, retirement

*Gørtz: Department of Economics and CEBI, University of Copenhagen, Øster Farimagsgade 5, 1353 Copenhagen K, (email: m.gortz@econ.ku.dk); Sevilla: Social Research Institute, Institute of Education, University College London, Gordon Square 55-59, London WC1H 0NU, (email: a.sevilla@ucl.ac.uk); Sander: Department of Economics and CEBI, University of Copenhagen, Øster Farimagsgade 5, 1353 Copenhagen K and Social Research Institute, Institute of Education, University College London, Gordon Square 55-59, London WC1H 0NU, (email: s.sander@ucl.ac.uk). We thank the Danish National Research Foundation for funding through its grant (DNRF-134) to Center of Economic Behavior and Inequality (CEBI), and the European Research Council Consolidator Grant (CoG), SH3, ERC-2017-COG for funding through the PARENTIME project. We are grateful to Paul Bingley, Martin Browning, Maria Juul Hansen, Henrik Kleven, Søren Leth-Petersen, Jakob Egholt Søgaard, participants at the Copenhagen Education Network (CEN) workshop, CEBI lunch seminar, SEHO conference, ESPE conference, EEA conference, Zeuthen workshop and EALE conference for discussions and helpful comments.

1 Introduction

The narrowing gaps in education and labor market outcomes between men and women have been one of the major economic achievements of the last century. Yet convergence in earnings remains stalled. Whereas women's relative earnings are in the 90 percent range of men's earnings at the beginning of employment, it soon declines below the 70 percent level (Goldin, 2014). The arrival of children plays an important role in explaining the persistence of the gender earnings gap. Recent evidence from several developed countries shows that a 20 percent drop in earnings for women after the birth of the first child can last well into the 50s (Kleven et al., 2019a,b; Sieppi and Pehkonen, 2019). This paper uses a quasi-experimental approach using rich administrative data for Denmark to document that the persistence in gender inequality in earnings can be reinforced by the arrival of grandchildren and persist into retirement age. While the recent literature has documented a "child penalty" that contributes to gender inequality, we document that this gap is further extended into old age in the form of a "grandchild penalty".

In many societies, care for children and the elderly is provided through intra-generational exchange of time and money.[1] In Denmark, about 14 percent of grandparents report spending time in child care activities during weekdays, and those who provide care spend on average 1.3 hours a day according to the 1987, 2001 and 2008 Danish time use surveys. Research on the organization of care for children within the extended family has mostly focused on one direction of this exchange, namely how child care provided by grandparents affect parental (mainly maternal) labor supply (Posadas and Vidal-Fernandez, 2013; Bratti et al., 2018). The underlying assumption is that grandparents (mainly grandmothers) can be a source of support for female labor supply in motherhood, thus taking for granted that grandmothers' time is an unused and readily available resource.

[1]The intergenerational transfer literature has identified several motives for transfers of time and money within the family. First, parents may be altruistic and care about their children's wellbeing (Becker, 1991). Second, parents may simply gain utility of giving, which is sometimes referred to as the warm glow motive (Andreoni, 1989). Third, parents may have an exchange motive and transfer money to their children in expectation of old age care from their children (Pezzin and Schone, 1999).

Grandparents usually enjoy spending time with their grandchildren (Triadó et al., 2014; Zanella, 2017). Yet, due to intra-household specialization of work in the household and the market (Becker, 1991), grandparenthood may impact labor market outcomes of women and men in different ways. As female labor supply has been increasing over the last 50 years across the Western world, working women are now increasingly approaching the age of grandparenthood. Moreover, pension reforms intended to postpone retirement age in order to secure financing of welfare and health services in old age imply that grandparents face a growing trade-off between working in the market versus taking care of grandchildren. Increasing the retirement age may increase grandmothers' labor supply, but lower maternal labor supply. Understanding the trade-offs are crucial because of the cost of grandchildren to grandmothers.

We employ a quasi-experimental approach that closely follows the literature estimating causal effects of the birth of the first child (Kleven et al., 2019b). In particular, we adopt an event study approach to study the dynamic effects of having a grandchild on a wide range of outcomes such as earnings, wage rate, labor force participation, full time employment, hours of work, and disposable income. To that end, we use multi-generational high-quality Danish register data containing yearly information in the period 1980–2017 on families in which a person became a grandparent for the first time between 1985 and 2012.

As a preview of our results, we find that the arrival of the first grandchild reduces grandmothers' earnings by 3.4 percent relative to grandfathers' earnings which remains largely unaffected five years after the arrival of the first grandchild. Grandmothers' and grandfathers' labor market outcomes continue to diverge, such that ten years after the first grandchild is born the "grandchild penalty" in earnings is 8.6 percent. The reduction in earnings for grandmothers are primarily driven by grandmothers moving out of full time employment and not by shifts to lower payed jobs. Labor force participation start to decline after the arrival of the first grandchild for both men and women, however, the decline is steeper for women. Pre-trends are parallel before the arrival of the first grandchild. Ten years after the arrival of

the first grandchild grandmothers' labor force participation has fallen 13.5 percent compared to the year before the first grandchild was born. We furthermore find that the "grandchild penalty" for grandmothers, who had their first grandchild in periods, in which options for early retirement were more generous, parental leave longer, and daycare coverage higher, is larger than the "grandchild penalty" for those who had their first grandchild in periods with less generous retirement options and more generous family policies.

As an identification check, we study the effect of having grandchildren per se, by using a Difference-in-Differences (DiD) event study design including men and women who do not (yet) have grandchildren as controls in the analysis. Using men and women without grandchildren as controls confirms that grandmothers adjust their labor supply more than grandfathers upon the arrival of a grandchild.

To shed light on some potential mechanisms, we investigate heterogeneous effects across 1) two main cohorts (corresponding to two time periods with different pension regimes and family policies), 2) socioeconomic group of grandparents, 3) gender of the child (the parent of the grandchild), 4) socioeconomic group of child, 5) commuting time and distance to child, 6) daycare availability in the municipality where the grandchild was born.

We contribute to the recent strand of research aimed at understanding how fertility can explain the persistent nature of gender inequality in the labor market (Adda et al., 2017; Angelov et al., 2016; Blau and Kahn, 2017; Goldin, 2014; Kleven et al., 2019b,a; Sieppi and Pehkonen, 2019). This literature has mostly focus on the case of motherhood. Recent evidence for a variety of countries suggests that women experience a large, immediate and persistent drop in earnings after the birth of their first child, while men are essentially unaffected. This change is quite persistent. Ten years after childbirth, women have not recovered and at this point the series have plateaued (Kleven et al., 2019a).[2]

In this paper, we focus on how the arrival of grandchildren may further aggravate gender inequality. Given that the women in our sample on average become a grandmother at age 53—

[2]Kleven et al. (2019a) find child penalties in earnings in the United States (31%), United Kingdom (44%), Austria (51%), Germany (61%), Sweden (26%), and Denmark (21%).

on average 24 years after having their last child—our findings suggests that the "grandchild penalty" strikes well before women have had time to recuperate after the birth of their last child. We show that the effects of a grandchild can last up to—and well into—retirement.

Only a few other papers look at the effect of grandchildren using causality approaches. Rupert and Zanella (2018) use data from the Panel Study of Income Dynamics (PSID) to examine how having a grandchild affects grandparents' labor supply. Estimating a structural labor supply model while instrumenting for grandparenthood with the gender of the firstborn child, they find that employed grandmothers reduce hours of work by 30 percent. Frimmel et al. (2020) also look at grandparents' labor supply. Modeling the duration until having a grandchild and the duration until labor market exit jointly using Austrian register data, they find that having a first grandchild increases the probability of early retirement for women by 8.5 percent. Asquith (2017) exploits state-year variation in access to various contraceptives to instrument fertility patterns in the US and finds that grandmothers are 8.5 percent more likely to be retired in response to a grandchild. Backhaus and Barslund (2021) use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) and an instrumental variables (IV) strategy based on gender of the first-born child to estimate the causal effect of grandparenthood on the labor supply of working-age grandparents in ten European countries. They find a large negative impact of grandparenthood on the labor supply of women aged 55 to 64. Using UK data, Zanasi et al. (2020) find that the birth of the first grandchild increases the probability of retirement for women aged 50-65 who have previously been active at the labor market by 8 percentage point.

While these papers investigate how becoming a grandparent affects different facets of labor supply, we broaden our understanding by considering six important labor market outcomes: earnings, participation, wage rates, full-time employment, hours worked, and disposable income. Furthermore, we extend previous analyses by using as identification strategy an event study methodology. The event study framework approach has several advantages compared to e.g. an IV strategy, which has been used in previous studies. First, we base our analysis

on within-person variation as opposed to purely cross-sectional variation. This allows us to net out time invariant unobserved factors such as productivity or preferences for work, leisure or family. Second, we avoid exclusion restrictions, which might not hold if grandparents' labor market outcomes were affected directly by the gender of their first-born child. Third, our estimates are not local average treatment effects, but all pertain to the arrival of the first grandchild, which implies that our estimates are comparable across our different estimation strategies. Fourth, the event study methodology allows us to follow the dynamics of the development in labor market outcomes after the arrival of the first grandchild. As in Kleven et al. (2019b), we estimate the gender gap in labor market outcomes by comparing the trajectories of men versus women after the birth of the first grandchild. We compare these estimates with a DiD estimate where we compare labor market outcomes of grandparents with a control group of comparable individuals who are parents but did not become grandparents in the observed time period.

The paper is organized as follows. Section 2 describes the Danish institutional background and the data used in our analysis. Section 3 outlines our empirical strategy, and Section 4 presents the results. Section 5 concludes.

2 Institutional Background and Data

2.1 Institutional Background

Scandinavian countries provide attractive opportunities for women to participate in the labor market while having a family. Institutions to promote female participation such as parental leave and public provision of highly subsidized universal daycare contribute to this picture.[3]

By international standards, female labor force participation is high in Denmark, and has

[3]Universal daycare was rolled out from the 1960s. In the mid-1980s more than half of all children aged 0–6 were in daycare, increasing to almost 80 percent today, and more than 90 percent in the age group 3–6 attend preschool. As in the rest of Scandinavia, the tax pressure is relatively high (around 50 percent on average) in Denmark as the tax returns are used to finance public expenditure such as childcare, healthcare, education, and pensions.

been so over the three decades that we observe in our study. Two in three women participated in the labor force around the mid-80s; today this number is around 80 percent on average. With younger generations of women increasingly pursuing a full-time career in the labor market, the need for support from grandparents is evident. However, with high participation rates also among grandmothers, this option may be limited. Today, there is practically no informal childcare sector in Denmark (OECD, 2019), indicating that the role for grandparents to provide care may be limited. However, daycare institutions were not accessible for the youngest children in the entire period we observe.[4] Moreover, children may also need care when they are sick and outside the opening hours of the daycare institutions.

Despite seemingly high gender equality and the availability of institutions to support working families, the gender gap is still substantial (20 percent in 1980 and 15 percent in 2015) in Denmark, as documented in Kleven et al. (2019b), who ascribe the main part of this gap to the arrival of children, the "child penalty".

As the median age of a first-time grandmother is 53 years and 55 for a first-time grandfather, most grandparents will still have around 10 years in the labor market after the arrival of their first grandchildren. While research generally finds a positive association between grandparents spending time with their grandchildren and life satisfaction, some studies have also documented that grandmothers providing regular care reported high subjective time pressure compared to non-regular-caring grandmothers (Craig and Jenkins, 2016), that a positive association between providing childcare to grandchildren could primarily be explained when looking at cross-sectional variation (Danielsbacka et al., 2019; Di Gessa et al., 2016), and that grandparents providing higher hours of childcare were more likely to develop depression (Brunello and Rocco, 2019). This suggests that while grandparents often have a desire to support their offspring in caring for a new grandchild, they may sometimes also feel a pressure

[4]Local municipalities have the responsibility of providing sufficient capacity and offer child care slots in center-based daycare institutions or slots in family-based care. Family-based care is the slightly cheaper alternative of care for children younger than three, but there is also evidence that the quality is lower (Datta Gupta and Simonsen, 2010). Both center-based care and family-based care are heavily subsidized; on average, parents pay around EUR 300 per month for a slot (Statistics Denmark, 2017).

to offer their help.

As noted by Kanji (2018), the care grandparents provide is largely unrecognized and gendered. Moreover, grandmothers and -fathers seem to be taking on different roles in caring for grandchildren (Sear and Coall, 2011), they provide different hours of child care, and a gender gap in norms about grandparenting is seen across European countries, including Denmark (Hank and Buber, 2009). As female labor supply is now high also among women aged 50+, grandmothers are trying to balance their careers with demand from children for grandparent care (Zamarro, 2020). Nevertheless, for grandparents nearing retirement age, retirement is an obvious exit strategy (Backhaus and Barslund, 2021). For the period we study, an early retirement scheme, Voluntary Early Retirement Pension (VERP) has been available from age 60.[5]

2.2 Data

The analysis is based on administrative register data on the full population in Denmark covering the years 1980–2017. The unique Danish register data combines several administrative registers, which are linked via personal identification numbers.[6] The data contains information on socioeconomic characteristics such as family size, employment, labor market earnings, income, and education. Important for our study, individuals can be linked to family members even if they are not a part of the same household. This allows us to study intergenerational links. We use data on three generations—children, parents, and grandparents—and we are able to distinguish between grandparents on the mother's and the father's side of the family.

[5]The Danish pension system consists of a mix of public, occupational and private pensions. A universal public old age pension (OAP, *"Folkepension"*) scheme has been available for people over age 67 for the entire observed period. In 1999, the OAP pension age was reduced to 65 for all individuals born after 1939. Moreover, an early retirement scheme (VERP, *"Efterløn"*) enabled workers to retire at age 60. Participating in VERP requires making modest contributions to qualified unemployment insurance funds during working life. Benefits are flat-rate, and result in a fixed amount paid to all workers equal to roughly $27,000 annually (in 2010 USD). And until 1996, it was even possible to retire already from age 50 following a short period of unemployment (*"Overgangsydelse"*). For a review of changes to the Danish pension system, see Garcıa-Miralles and Leganza (2020) or Bingley and Lanot (2007).

[6]Danish register data is accessible in anonymized form for researchers based in Danish universities and research institutions through a secured access to Statistics Denmark.

We draw our sample of grandparents from this data set. We base our analysis on a balanced panel and thus restrict the sample to include only those who are alive and resident five years before through five years after the first grandchild is born. From the register data on demographic characteristics, we use information on the birth year of the first grandchild for each grandparent. The event studied is the birth of an individual's first grandchild. For each event, we observe calendar year and age of the grandparent, the grandparents spouse, and their child (the parent of the grandchild). We trim the sample to people who become grandparents between age 35 and 80 (cf. Appendix Figure A1). Our final sample consists of 1,193,748 individuals who become grandparents to 556,503 grandchildren during 1985–2012.

Table 1: Summary Statistics of Background Characteristics for Grandmothers and Grandfathers

	(1) Grandfathers	(2) Grandmothers	(3) Diff.
Grandparent			
Age at first child's birth	26.96	24.39	2.566***
	(4.834)	(4.518)	(299.55)
Age at last child's birth	31.53	28.85	2.680***
	(5.312)	(4.813)	(289.17)
Age at first grandchild's birth	55.80	53.43	2.370***
	(6.817)	(6.816)	(189.46)
Year of birth	1942.5	1944.8	-2.283***
	(9.999)	(9.902)	(-125.05)
Single-headed household	0.146	0.213	-0.0678***
	(0.353)	(0.410)	(-96.10)
Child (parent of grandchild)			
Age at first child's birth	27.77	27.95	-0.181***
	(4.173)	(4.288)	(-23.31)
Year of birth	1970.5	1970.3	0.268***
	(8.245)	(8.333)	(17.63)
Grandchild			
Year of birth	1998.3	1998.2	0.0872***
	(8.020)	(8.024)	(5.92)
Observations	554,870	638,878	1,193,748

Note— The table shows mean and standard deviation in parenthesis of the background characteristics separately for grandmothers and grandfathers. The headline *Child (parent of grandchild)* refers to the parent of the first born grandchild and the headline *Grandchild* refers to the first born grandchild.

Table 1 shows, separately for grandfathers and grandmothers, the mean and standard deviation of a number of characteristics for the three generations. The grandmothers in our sample were on average two years younger when they had their first child than the grandfathers in our sample. Women are also on average younger than men when becoming a grandparent.

For each individual we use register information on annual earnings and labor market status between 1980 and 2017 for a ten year window before and after the arrival of their first grandchild. Annual labor earnings are measured before tax and excludes unemployment insurance benefits and other public transfers. Earnings are reported directly from employers to the tax authorities, so bias/measurement error stemming from self-reporting is not an issue. We construct a dummy variable for labor force participation taking the value one for individuals with positive earnings and zero for those with no earnings. We use register information on work hours in bins. This measure is based on information from employer contributions to a mandatory pension scheme, ATP.[7] This allows us to construct a measure of hours of work capturing weekly hours of work averaged across the year. Thus we are not able to distinguish between people who work part time throughout the year and people who for example work full time half the year and quit working the rest of the year. Nevertheless, our measure of hours of work allows us to capture labor adjustments on the intensive margin. We calculate wage rates simply by scaling the annual earnings with 52 weeks and diving with our measure of weekly hours of work. As the hours based on ATP information is capped at the top, work hours may be underestimated, and thus the imputed hourly wage rate may be overestimated for full-time employed working more than the top cap.

We construct a full time dummy taking the value one if the grandparent work full time full year and zero otherwise (including if the grandparent retires, works part time, or has never worked). This variable captures people who switch from working more than 27 hours per

[7]The ATP scheme (*"Arbejdsmarkedets Tillægspension"*) requires all employers to make contributions for each employee based on their individual work hours, aggregated in bins (0–8, 9–17, 18–26, 27+, if paid per week, or 0–38, 39–77, 78–116, 117+, if paid monthly).

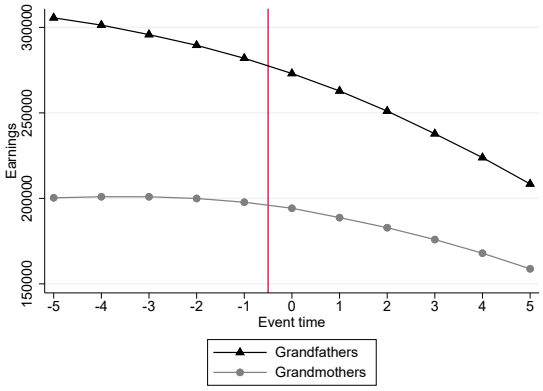
week (or more than 177 per month) through out the year to working less. Additionally, we collect information on disposable income net of tax and dividends. We reflate all monetary outcome variables to reflect 2018-prices and top code at 1 million DKK.

Figure 1 plots the average of all the outcomes variables five years before through five years after the arrival of the first grandchild separately for grandmothers and grandfathers. On average grandfathers have higher earnings than grandmothers, but grandfather's earnings decrease more than grandmother's earnings across the ten year window around the arrival of the first grandchild. The faster decrease of grandfathers is expected, as grandfathers are older than grandmothers when they have their first grandchild and thus closer to retirement age. We control non-parametrically for this in our event study design by including age fixed effects.

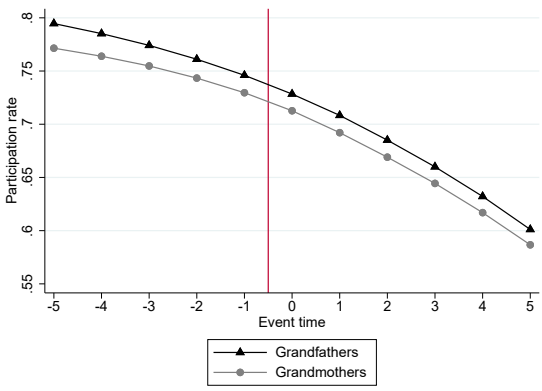
In order to investigate heterogeneity across our sample of individuals who become grandparents between 1985–2012, we exploit register information on civil status and households to investigate if the grandchild penalties vary between single-headed households and coupled grandparents. We use information in the registers on the municipality of residence for both grandchild and grandparent in the year the first grandchild was born coupled with data on travel time and distance between municipalities to investigate if proximity between grandparents and grandchildren plays a role. In addition, we collect information on the average enrollment rate in formal child care for children aged 0–6 for all municipalities in the period 1985–2012. We use this data to construct an indicator variable taking the value one for municipalities with an enrollment above the mean enrollment rate for each year, we link the information on formal child care enrollment to the individuals in our sample based on the municipality of residence and birth year of the first grandchild.

Figure 1: Mean of Outcome Variables

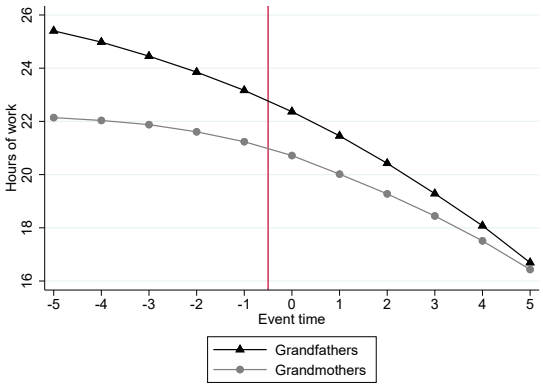
(a) Earnings



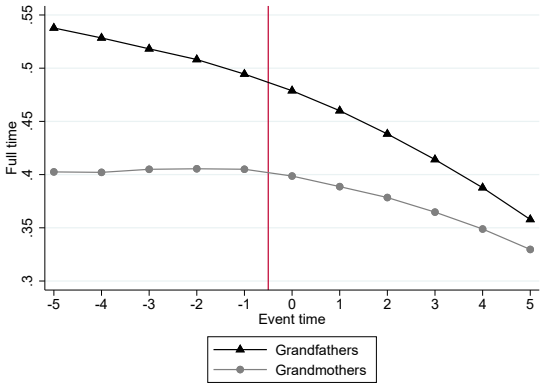
(b) Labor force participation



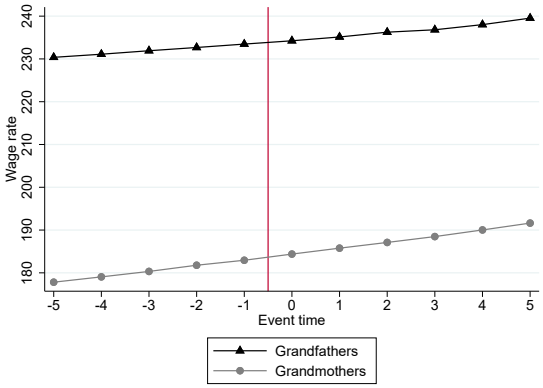
(c) Hours of work



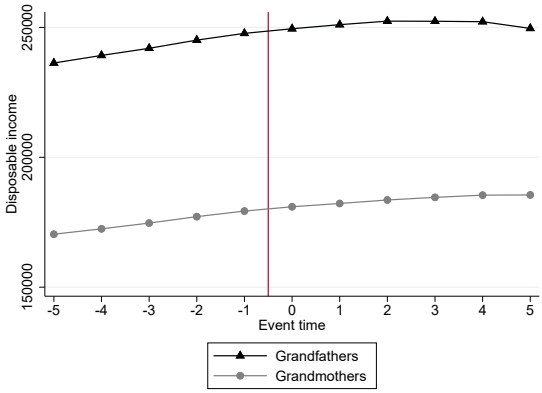
(d) Full time employment



(e) Wage rate



(f) Disposable income



NOTE— The figure shows means of the outcome variables across the event time window separately for grandmothers and grandfathers.

3 Empirical Strategies

The goal in this paper is to estimate the dynamic causal effects of grandparenthood on grandparents labor supply and earnings. The empirical challenge is that individuals who have a grandchild may be different from those that do not have grandchildren in relation to work. For example, if individuals who have grandchildren are more family oriented and less ambitious at work, they would have had lower earnings regardless of whether they ever actually have grandchildren or not. The ideal experiment would be to randomly assign grandchildren to people and examine their labor responses over time. Given the infeasibility of randomly assigning grandchildren, we employ as our preferred empirical strategy an event study methodology. We compare the results from this approach with a difference-in-differences (DiD) strategy.

3.1 Event Study Methodology

The event study approach relies on sharp changes around the birth of the first grandchild for grandmothers relative to grandfathers. The event study methodology has been used previously in the context of parental child penalties (Kleven et al., 2019b). As in similar event studies, the idea is that although becoming a grandparent is not exogenous, the event of having a grandchild may generate sharp changes in labor market outcomes that are orthogonal to unobserved factors that affect the smooth development of those outcomes. We estimate the following regression separately for grandmothers and grandfathers:

$$Y_{ist}^{gp} = \sum_{j \neq -1,-2} \alpha_j^{gp} \cdot \mathbb{1}[j = t] + \sum_k \beta_k^{gp} \cdot \mathbb{1}[k = age_{is}] + \sum_\lambda \gamma_\lambda^{gp} \cdot \mathbb{1}[\lambda = s] + v_i^{gp} + \mu_{ist}^{gp} \quad (1)$$

where Y_{ist}^{gp} is the labor market outcome of interest for individual i in year s at event time t. The superscript gp refers flexibly to the type of grandparent (e.g. grandmothers and grandfathers or, more specifically, maternal and paternal grandmothers and grandfathers, respectively). We include a full set of age dummies and year dummies. Age dummies

control nonparametrically for underlying life-cycle trends, which is important in this context because women become grandmothers about two years earlier than men become grandfathers. Moreover, age dummies take account of age-related rules for e.g. retirement eligibility. Year dummies take into account in a nonparametrical way any time trends during this period, which may result for example from business cycle effects or changes in pension legislation. Because the age of grandparenthood is an age when labor market outcomes starts descending, controlling for age and year dummies alone is not enough to ensure a flat pre-trend, thus, in addition to the age and year dummies used in previous event studies, we also include an individual fixed effect, v_i^{gp}. We omit the event times $t = -5$ and $t = -1$ so that the estimated event time coefficients α_j^{gp} refer to the trend between the years before the first grandchild is born.

The underlying assumption in Equation (1) is that while changes in individual family and work preferences evolve gradually over an individual's life time, the birth of a grandchild is a more sudden event. As a result, any sharp change in labor market outcomes right around the birth of a first grandchild is likely to be the result of the arrival of the grandchild at that particular point in time, rather than being due to a change in family and labor market preferences. This so-called smoothness assumption is common to all event studies and is likely to hold in our analysis because it focuses on short run effects five years after the birth of a grandchild. An additional advantage of the event study is that it describes the dynamic adjustment to a new situation of being a grandparent.

Following Kleven et al. (2019b), we specify the equation in levels rather than logs to keep those with zero earnings in the data. We convert the estimated effects in levels to percentages by scaling the estimates with the counterfactual outcome absent grandchildren: $P_t^{gp} \equiv \hat{\alpha}_t^{gp} / \mathbb{E}[\tilde{Y}_{ist}^{gp} | t]$, where $\tilde{Y}_{ist}^{gp}$ is the predicted outcome when the event time dummies are omitted from Equation (1). We construct the "grandchild penalty" as the percentage by which grandmothers fall behind relative to grandfathers due to the arrival of a grandchild at

event time t as:

$$P_t \equiv \frac{\hat{\alpha}_t^{gf}}{\mathbb{E}[\tilde{Y}_{ist}^{gf}|t]} - \frac{\hat{\alpha}_t^{gm}}{\mathbb{E}[\tilde{Y}_{ist}^{gm}|t]} \tag{2}$$

The grandchild penalty is thus defined as the gender gap in labor market outcomes associated with having a grandchild. In order to understand the potential long-run labor market implications of having grandchildren, we also estimate long-run grandchild penalties by extending the period to 10 years after the birth of the first grandchild. The long-run effects are estimated on an unbalanced panel, however, we still observe 78 percent of our sample 10 years after the birth of the first grandchild. As the smoothness assumption may not hold in the long run, we additionally use a DiD event study design to validate results from the event study.

3.2 Difference-in-Differences

In order to study the effect of having grandchildren per se, we use a DiD event study design using men and women who do not (yet) have grandchildren as controls. To include non-grandparents in an event study design where the event analyzed is having one's first grandchild, we assign "placebo" grandchildren to individuals born 1930–1977 who have at least one child above age 19 but no grandchildren. To achieve a suitable control group, we mimic the distribution of age at first grandchild observed among the sample of grandparents within each birth cohort. As before, we base our analysis on a balanced panel of 1,550,960 individuals, adding 357,214 people without grandchildren to our sample of grandparents. Thus we use a DiD design to compare individuals observed in a ten year window around the birth of their first grandchild to individuals observed in a ten year window around the placebo assignment of a grandchild, as outlined in Equation (3):

$$E[Y_{i,t>0} - Y_{i,t<0}|gc_i > 0] - E[Y_{i,t>0} - Y_{i,t<0}|gc_i = 0], \tag{3}$$

where t denotes the year the grandchild (or placebo grandchild) arrives. $gc_i > 0$ for individuals i who have at least one grandchild, and $gc_i = 0$ for people who have been assigned a placebo grandchild. Identification of Equation (3) relies on the usual parallel trends assumption, which we validate in our event study design by estimating the pre-trend.

Including a control group allows us to construct a "grandchild penalty" as the percentage by which grandmothers (grandfathers) fall behind relative to non-grandmothers (non-grandfathers) due to the arrival of a grandchild at event time t as:

$$P_t \equiv \frac{\hat{\alpha}_t^{ngp}}{\mathbb{E}[\tilde{Y}_{ist}^{ngp}|t]} - \frac{\hat{\alpha}_t^{gp}}{\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]}, \tag{4}$$

where ngp refers to non-grandparents and gp refers to grandparents.

3.3 Intergenerational Transmission of Child Penalties

To investigate if the child penalties mothers experience in their labor market outcomes upon the birth of their first child is related to the grandchild penalties for grandmothers, we .... Equation (5) shows the specification:

$$\begin{aligned} Y_{ist}^{gp} = \theta_{pre}^{gp} \cdot t + \sum_q \alpha_q^{gp} \cdot \mathbb{1}[after_t] \cdot \mathbb{1}[quin_{iq}^m] + \sum_k \beta_k^{gp} \cdot \mathbb{1}[k = age_{is}] \\ + \sum_\lambda \gamma_\lambda^{gp} \cdot \mathbb{1}[\lambda = s] + \sum_q \delta_q^{gp} \cdot \mathbb{1}[quin_{iq}^m] + \sigma^{gp} \cdot \mathbb{1}[after_t] + \mu_{ist}^{gp}, \end{aligned} \tag{5}$$

where $\mathbb{1}[after_t]$ is an indicator for data observations after the arrival of the first grandchild i.e., $t \geq 0$ and $\mathbb{1}[quin_{iq}^m]$ is an indicator for the mother (m) of the grandchild (daughter or daughter-in-law) being in quintile q of the pre-child earnings distribution. In line with our previous approach we use levels and calculate the impact of grandchildren on grandparents with daughters/daughter-in-laws in the qth quintile of the pre-child earnings distributions as $P_q^{gp} \equiv \hat{\alpha}_q^{gp} / \mathbb{E}[\tilde{Y}_{is}^{gp}]$.

4 Results

Figure 2 shows the percentage change in labor market outcomes at a given event time t relative to the year before the first grandchild is born five years before and after the birth of the first grandchild using event time estimates of Equation (1). For all estimated event coefficients we also include 95 percent confidence intervals. Results are presented separately for grandmothers and grandfathers.

Panel (a) in Figure 2 shows the event time estimates of earnings separately for grandmothers and grandfathers. Whereas earnings evolve in parallel before the arrival of the first grandchild, they start to diverge right after the first grandchild is born and continue to diverge thereafter. In particular, grandmothers experience a drop in earnings of 1.6 percent the year immediately after the birth of the first grandchild, whereas the earnings of grandfathers do not decrease. Grandmothers' earnings continue to decline thereafter at a much steeper rate than the decline in earnings for grandfathers. As a result, the grandchild penalty as defined in Equation (2) amounts to 3.8 percent five years after the arrival of the first grandchild.

Panels (b)–(e) in Figure 2 show that the relative decline in earnings experienced by grandmothers after the birth of the first grandchild is primarily driven by declines in hours of work and full time employment, and to a much lesser extent to declines in labor force participation and wage rates. The pre-trend trajectories for each of these outcomes are parallel prior to the arrival of the first grandchild.

A qualitatively similar pattern is observed in Panel (b) and Panel (c) showing declines in labor market attachments in terms of participation and hours after the birth of the first grandchild for grandmothers, indicating that both the extensive and intensive margins are partly responsible for the widening of the earnings gaps after the first grandchild. In particular, Panel (c) shows that grandmothers' hours of work start a steep decline immediately after the birth of the first grandchild. There is no sign of recovery in hours of work five years after the arrival of the first grandchild. Whereas grandfathers' hours of work also decline during the five years after the birth of the first grandchild, they do so at a less steeper way so that

by the end of the five years after the arrival of the first grandchild the grandchild penalty in hours worked amounts to 2.7 percent. Specifically, Panel (d) shows a sharp and continuing fall in full time employment for grandmothers and not for grandfathers after the birth of the first grandchild so that five years after the birth of the first grandchild grandmothers are 4.2 percent less likely to work full time than grandfathers, which further indicates that grandmothers react on the intensive margin. Panel (e) shows a constant wage rate pre and post the event for grandmothers and grandfathers. Finally, Panel (f) shows a modest effect on disposable income and virtually no gender difference in the impact of the first grandchild.

Most other studies on the effect of grandchildren on grandparents' labor market outcomes analyze the effect of the arrival of the first grandchild on the probability of retirement or labor market exit. Most estimates using different estimation strategies and representative samples from several countries lie around an 8 percent increase in the retirement probability. Notable exceptions are results from the PSID, suggesting reductions in hours of work as high as 30 percent (Rupert and Zanella, 2018), and zero effects found in Kridahl (2017), who find no strong evidence that grandmothers are more likely to retire than grandfathers, and argues that it is because grandmothers in Sweden are not the primary caregiver of their grandchildren.

By international comparison, the childcare provided by grandparents is fairly low in Denmark, compared to countries with much higher reliance on intergenerational provision of care. As such, our estimates are probably a lower estimate of what would be in other countries with non-public provision of child care such as the US. We find drops in labor force participation of 4.3 and 13.5 percent for grandmothers in our sample, and 2.8 and 9.0 percent for grandfathers respectively five and 10 years after the birth of the first grandchild (cf. Figure 3).

Comparing our results to the long-run child penalties in Kleven et al. (2019b), the grandchild penalties found in our paper are of a considerable size. Kleven et al. (2019b) find a child penalty in earnings for parents of around 20 percent on average—we find a grandchild

penalty of 3.8 percent five years after the first grandchild, corresponding to about 1/5 of the child penalty incurred by the next generation. While grandchild penalties on hours worked and participation rates are both substantial, there is no grandchild penalty on wage rates, indicating that grandparents do not adjust by selecting into other occupations, sectors or firms scarifying wage premium for flexibility at this point in their career.

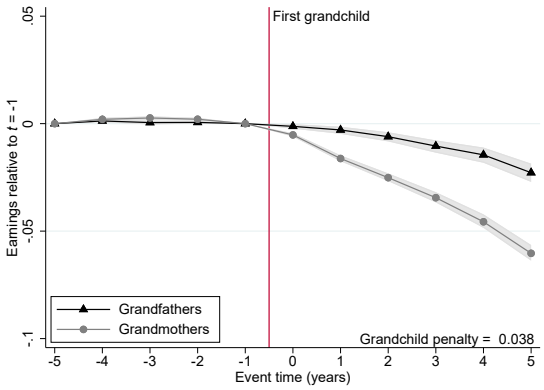
While Kleven et al. (2019b) base their main estimates on a balanced panel of parents who have their first child between 1985–2003, they also expand their sample to an unbalanced panel of parents who have their first child between 1970–2013, allowing them to estimate child penalties 20 years after the arrival of the first child. They find that hours worked start to converge between 10 and 20 years after the first child. However, the child penalty in hours worked is still present 20 years after the first child arrives in the sense that women work 6.5 percent less hours per week 20 years after the first child.

Figure 3 shows the long-run effects measured up to 10 years after the arrival of the first grandchild.[8] In general, the gender gap measured 10 years after the arrival of the first grandchild expands and often more than doubles compared to the 5-year gap. The earnings gap, for example, increases from 3.8 percent after 5 years to 10 after 10 years. Specifically, 10 years after the birth of the first grandchild, grandmothers earn 17.5 percent less than the year before the first grandchild was born. Whereas grandfathers earnings only decrease by 7.5 percent. The labor force participation for both grandmothers and grandfathers decrease gradually after the birth of the first grandchild, such that grandmothers' participation is reduced by 13.5 percent and grandfathers' by 9 percent 10 years after the birth of the first grandchild.

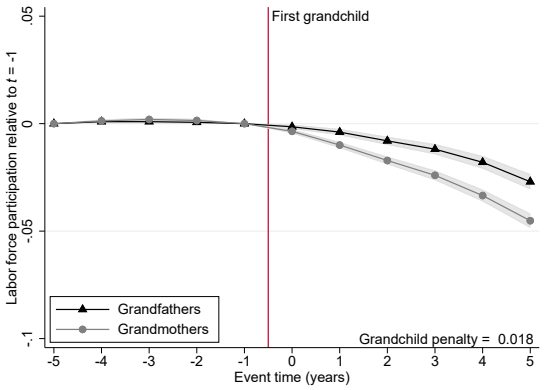
[8]Given that our sample of grandparents are older and nearing retirement, we think of long-term effects as effects measured 10 years after the first grandchild is born. Following up on labor supply effects 20 years after grandparenthood would be difficult due to retirement and attrition due to mortality. The 10-year follow-up is based on our balanced panel of individuals observed 5 years before and 5 years after the birth of their first grandchild.

Figure 2: The Impact of Grandchildren

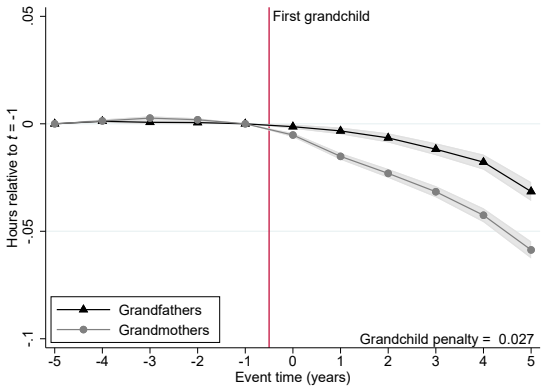
(a) Earnings



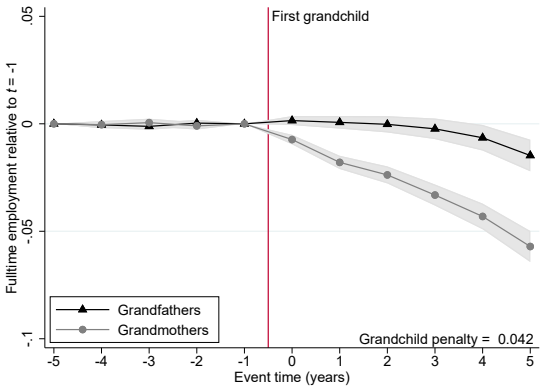
(b) Labor force participation



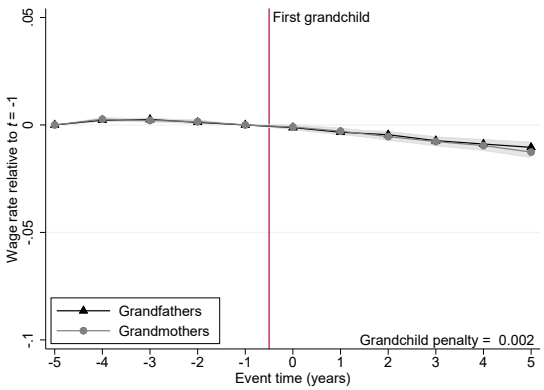
(c) Hours of work



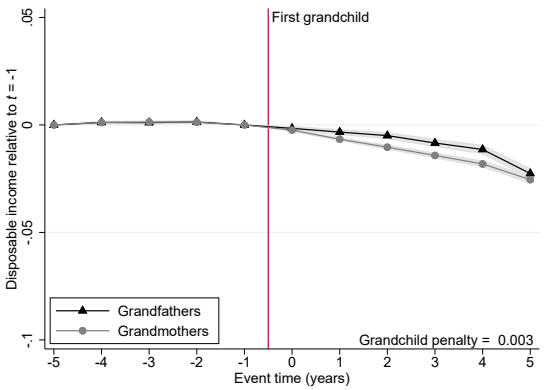
(d) Full time employment



(e) Wage rate



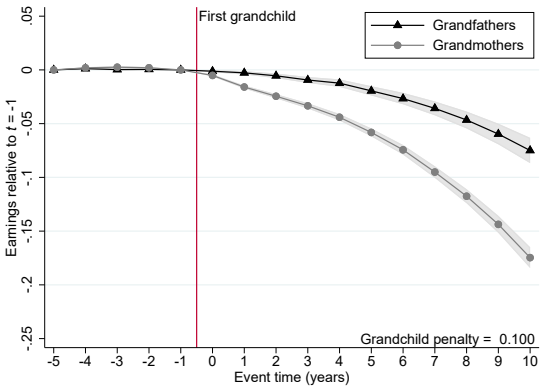
(f) Disposable income



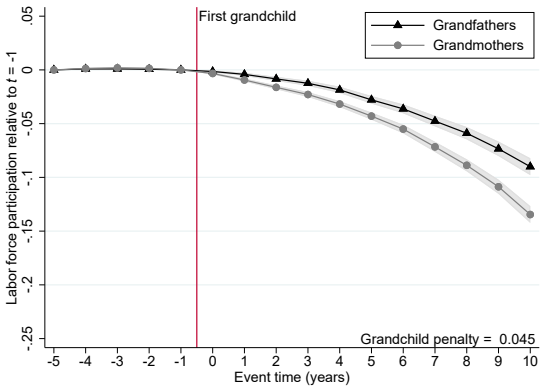
NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp} / \mathbb{E}[\tilde{Y}_{ist}^{gp} | t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on bootstrapped standard errors.

Figure 3: The Long-run Impact of Grandchildren

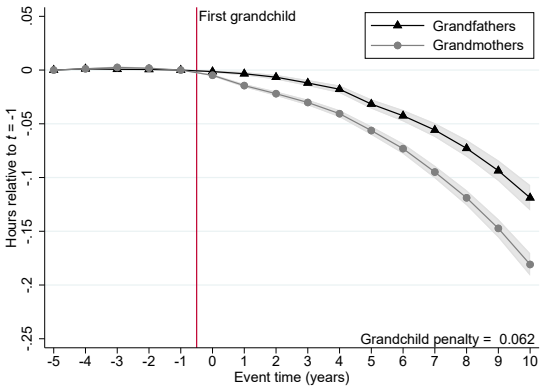
(a) Earnings



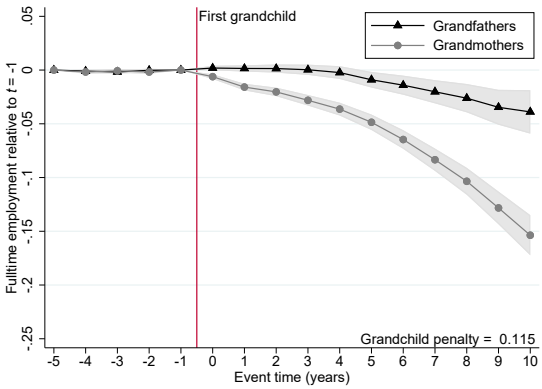
(b) Labor force participation



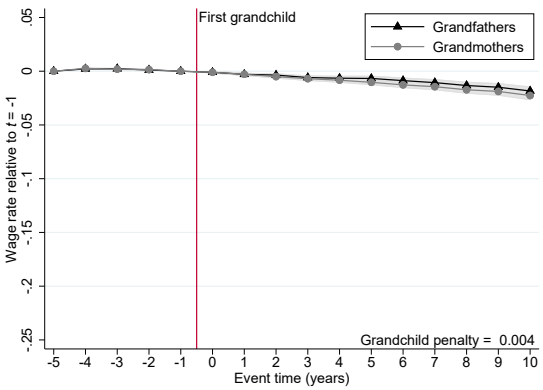
(c) Hours of work



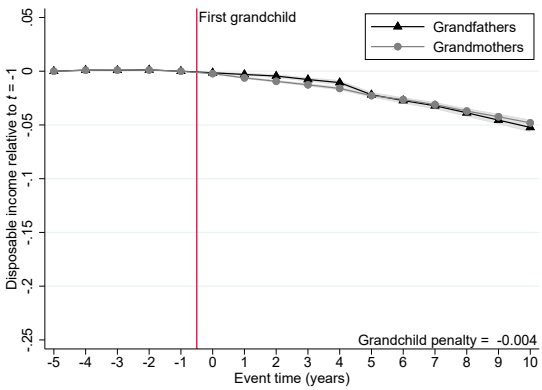
(d) Full time employment



(e) Wage rate



(f) Disposable income



NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 10. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

4.1 Heterogeneous Results and Mechanisms

This section investigates heterogeneous responses across our sample. We explore whether the grandchild penalty varies across six dimensions: Whether the grandchild lived in a municipality with high or low availability of daycare at birth, whether grandparents live more or less than a 20 minutes commute from grandchild, grandparents are single or married/cohabiting, whether the child (parent of grandchildren) is a daughter or a son of the grandparent, and whether the grandchild is born in an early or later part of the time period.

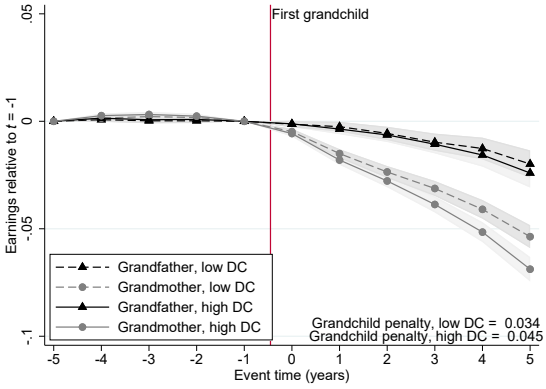
Differences between low and high daycare enrollment areas

Starting in the 1960s, Danish municipalities initiated a roll-out of daycare institutions for preschool children, and this effort was intensified from the 1990s with municipal policies to ensure that all children were guaranteed a childcare slot and after-school care. Today, the majority of Danish children enroll in center-based daycare before they start school, nevertheless, regional differences in the availability of daycare may affect the choices new grandparents make regarding their labor supply following the birth of their first grandchild. To investigate this channel, we stratify the sample based on the mean daycare coverage for children aged 0-2 in the municipality where the firstborn grandchild lives at birth, distinguishing between municipalities with high and low daycare coverage.

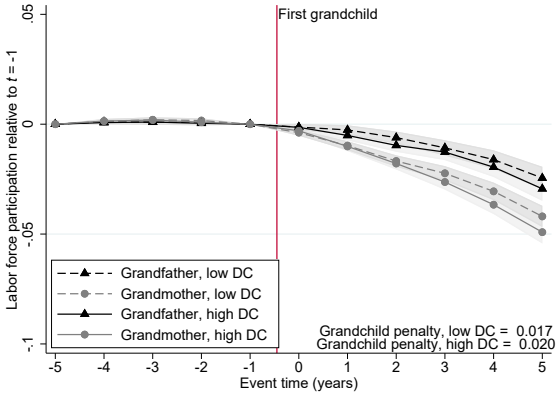
Panels (a)–(f) in Figure 4 show the event study coefficients for the two groups with low and high daycare coverage, respectively. The drops in grandmothers' labor market outcomes are somewhat larger for the families with high daycare coverage. Thus, in line with research from Sweden and OECD statistics (Kridahl, 2017; OECD, 2019), this results hints that grandmothers are not the primary caregivers of their grandchildren. If anything, our results show that grandmothers, whose grandchild live in a municipality with high daycare coverage, experience a larger drop in both earnings and hours of work than grandmothers, whose grandchild live in a municipality with low daycare coverage. Suggesting that grandmothers may work as a complementing care option rather than a substitute for formal daycare.

Figure 4: The Impact of Grandchildren by Daycare Enrollment

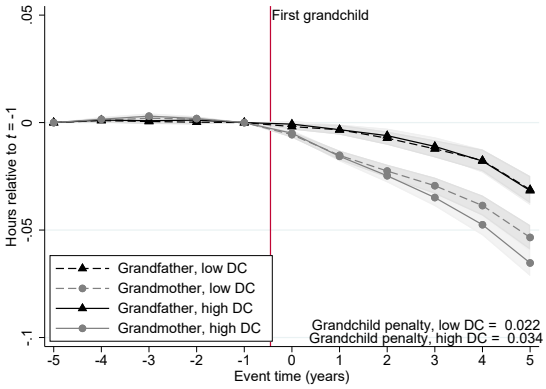
(a) Earnings



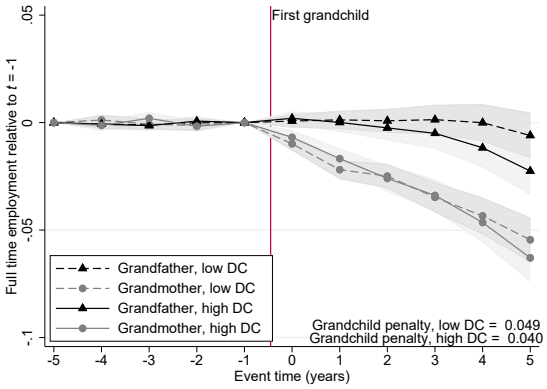
(b) Labor force participation



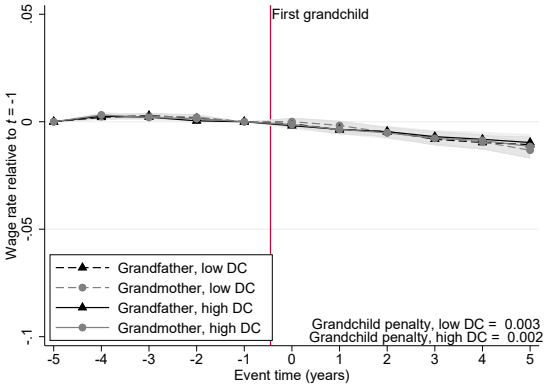
(c) Hours of work



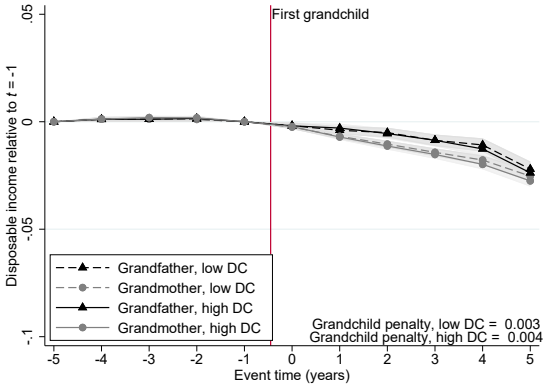
(d) Full time employment



(e) Wage rate



(f) Disposable income



NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

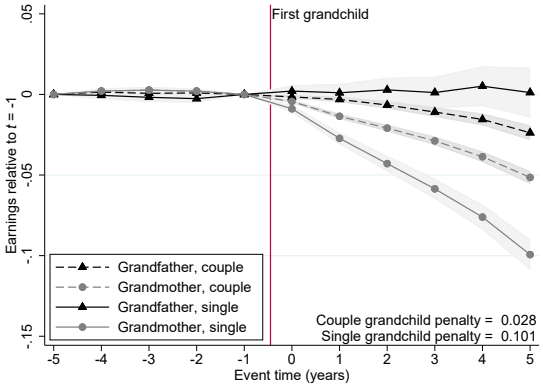
Single and coupled grandparents

Figure 5 shows the event time estimates of our outcome variables separately for grandmothers and grandfathers, depending on whether a grandparent lives in a single-headed household or in a couple. Panel (a) shows that single grandmothers experience the largest grandchild penalty, in terms of a drop in earnings of 10.1 percent compared to single grandfathers. The grandchild penalty in earnings for coupled grandparents is much lower than the penalty for single grandparents, at 2.8 percent.

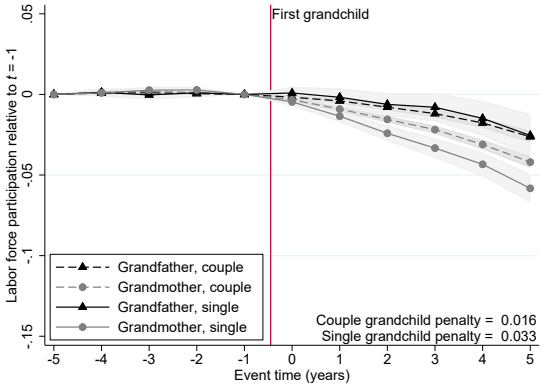
Panels (c) and (d) show that the earnings patterns in Panel (a) are driven by reductions in hours of work and in full time employment. Panel (c) hints that the birth of a grandchild reduces hours of work for grandfathers living in a couple, whereas it has no effect on grandfathers who live alone. Overall our findings suggest that single grandfathers contribute towards the younger generation by transferring money, while single grandmothers and grandparents in a couple contribute time. The coordinated reaction of married/cohabiting grandmothers and grandfathers is in accordance with a vast literature showing that spouses generally value joint leisure (Browning et al., 2021) and coordinate their retirement patterns in old age (Bingley and Lanot, 2007; Garcıa-Miralles and Leganza, 2020).

Figure 5: The Impact of Grandchildren by Household Type

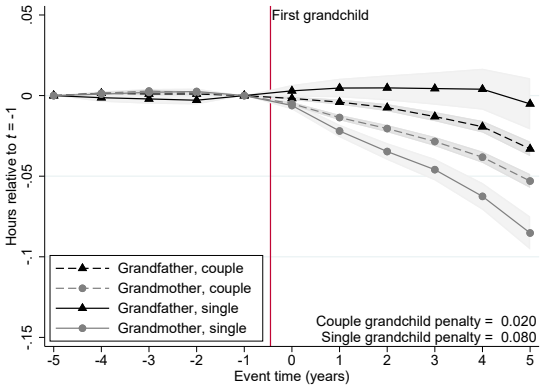
(a) Earnings



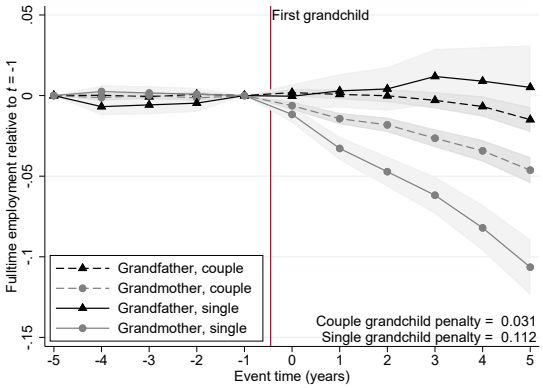
(b) Labor force participation



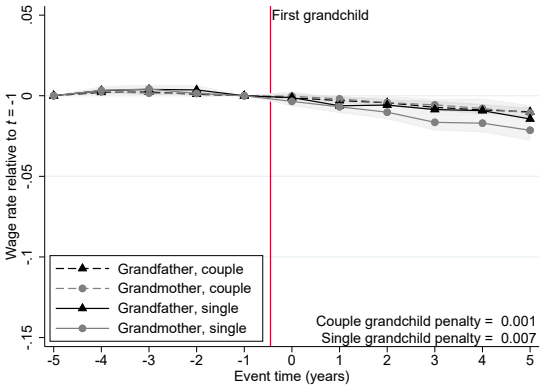
(c) Hours of work



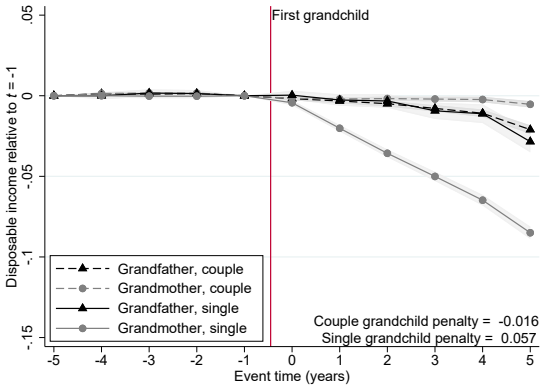
(d) Full time employment



(e) Wage rate



(f) Disposable income



NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Differences across time periods

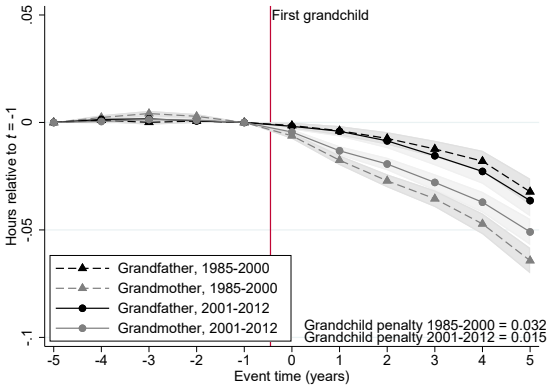
Figure 6 shows the event study estimates separately for grandmothers and grandfathers who become grandparents between 1985–2000 and 2001–2012. Panel (a) shows that the grandchild penalty is largest for women who become grandmothers between 1985 and 2000, as they experience a drop in earnings of 4.2 percent compared to men who become grandfathers in the same period. Whereas the grandchild penalty in earnings is 3 percent for women who become grandmothers between 2001 and 2012. Specifically, we see that the gender divergence in hours of work and full time employment is larger for grandparents, who have their first grandchild between 1985 and 2000 than for grandparents, who have their first grandchild after 2001.

Figure 6: The Impact of Grandchildren by Different Time Periods

(a) Earnings

(b) Labor force participation

(c) Hours of work



(d) Full time employment

(e) Wage rate

(f) Disposable income

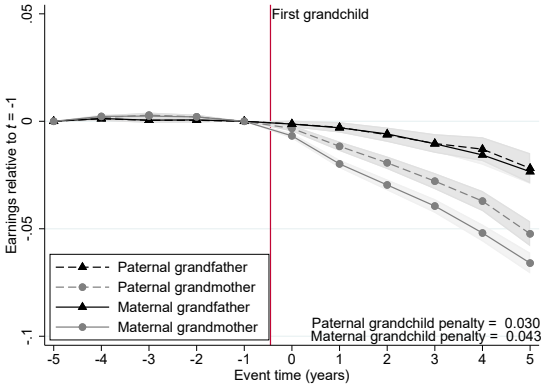
NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp} / \mathbb{E}[\tilde{Y}_{ist}^{gp} | t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2000 or 2001–2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Differences between daughters and sons

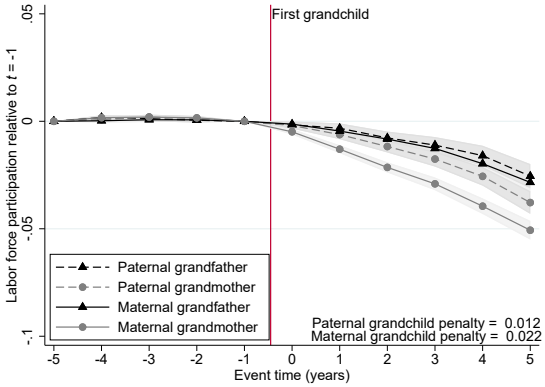
We next investigate whether grandparents' labor market adjustments depend on whether their first grandchild is by a daughter or a son. Figure 7 shows the event time estimates separately for grandmothers and grandfathers depending on whether a son or a daughter provided the first grandchild. Defining the maternal (paternal) grandchild penalty as the percentage grandmothers on the mother's (father's) side of the family fall behind grandfather's on the mother's (father's) side of the family due to grandchildren. Panels (a)–(f) show that maternal grandchild penalties are larger than the paternal grandchild penalties across all outcomes. This confirms Frimmel et al. (2020), who find that labor market exits are three percent higher in the case of a daughter's child compared to a son's child.

Figure 7: The Impact of Grandchildren by Gender of Child

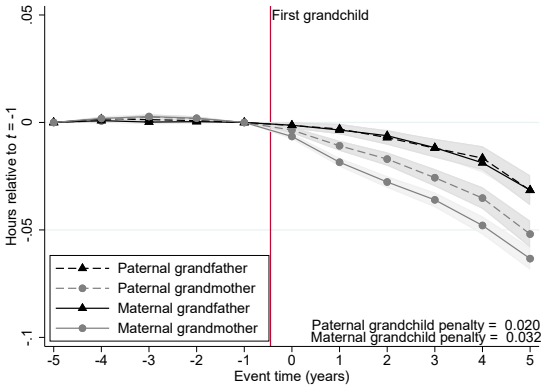
(a) Earnings



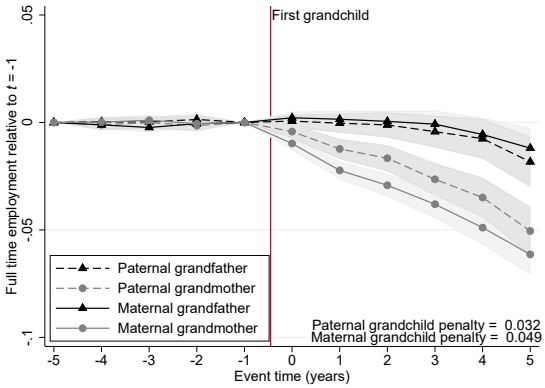
(b) Labor force participation



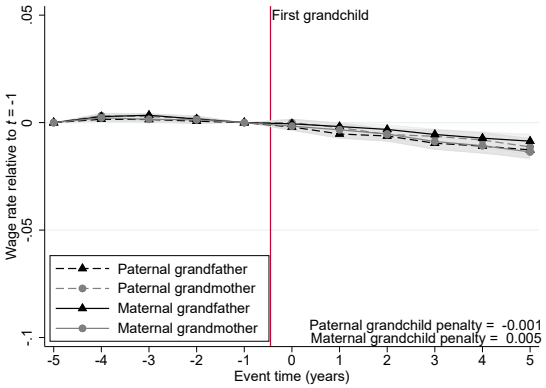
(c) Hours of work



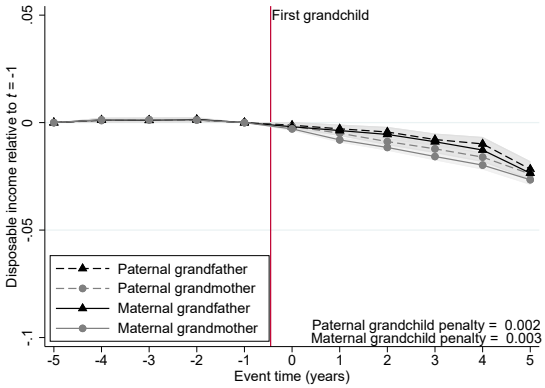
(d) Full time employment



(e) Wage rate



(f) Disposable income



NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Grandparents' proximity

While there are many reasons why grandparents spend time with their grandchildren, including caring for them when they are sick and cannot attend daycare, grandparents who live closer to their grandchildren experience lower costs in terms of time and transport when going to see their grandchildren and as a result may be more likely to provide childcare. Indeed, Compton and Pollak (2014) combine US Census data and the National Survey of Families and Households to show that residential proximity to grandmothers (a distance less than 25 miles) increases labor force participation of women with children younger than 12 by about 10 percentage point. Here we examine if grandparents proximity affects the grandchild penalty by stratifying the sample according to the commuting time between the municipality where the grandparents live and the municipality where the firstborn grandchild lives in the first year of life is more or less than 20 minutes.[9]

Figure 8 shows the event time estimates of our outcome variables separately for grandmothers and grandfathers who live more than 20 minutes and less than 20 minutes away from their firstborn grandchild. Grandparents who live less than 20 minutes away from their grandchild have a lower cost of commuting, may be perceived more easily available, or may have preferences for being close to their family. While we find larger drops in earnings, labor force participation, hours of work and full time employment for grandmothers who live less than 20 minutes away from their firstborn grandchild than grandmothers who live more than 20 minutes away, we find no difference in labor market outcomes for grandfathers according to whether they live more or less than 20 minutes away from their firstborn grandchild.

While Figure 7 shows larger penalties for maternal grandmothers and Figure 8 shows that proximity to the grandchild affects grandmothers' labor market outcomes after the birth of the first grandchild, we do not know if grandparents and parents preferences for living closer to each other change with the birth of a first grandchild.

[9]There are currently 98 municipalities in Denmark. The median municipality has around 43,000 inhabitants. Municipalities range in size from a few very small islands with around 2,000 inhabitants to Copenhagen with more than 600,000 inhabitants in recent years. The average commuting time between parents and grandparents is 54 minutes and 40 percent of our sample lives less than 20 minutes away from each other.

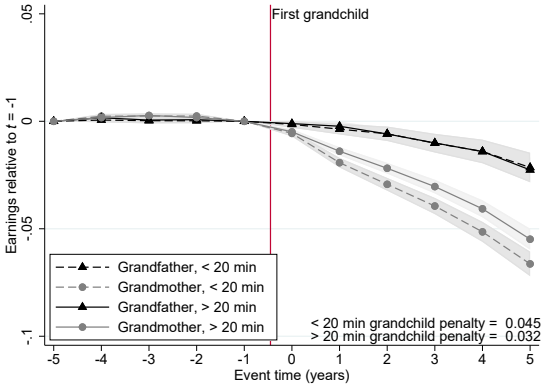
To investigate if the arrival of a grandchild influences grandparents and parents preferences for living closer to each other, we collect a panel of commuting time and commuting distance between grandparents and parents in a ten year window around the arrival of the first grandchild and repeat our event time analysis on this data separately for maternal and paternal grandparents in Figure 9.

As one would expect, there is no evidence of gender differences in the commuting time or distance between parents and grandparents before or after the arrival of the first grandchild. However, Figure 9 shows a small decrease in both commuting time and commuting distance for maternal grandparents of around 2 percent, whereas there is little change in proximity for paternal grandparents. This suggest that grandparents (or parents) on the mothers' side of the family move to be closer to each other after the birth of the first grandchild.

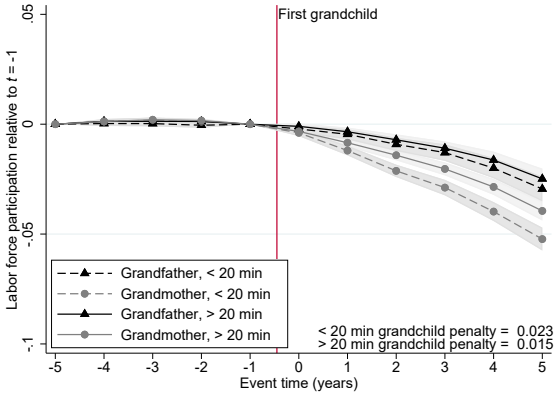
Bütikofer et al. (2021) use a panel of commuting data between parents' work place and home address in Norway in an event study design similar to our design to show that there exist a gender divergence in commuting patterns after the arrival of the first child. They find that women commute less after the birth of the first child and argue that decrease in commuting time explain part of the child penalty in earnings.

Figure 8: The Impact of Grandchildren by Commuting Time

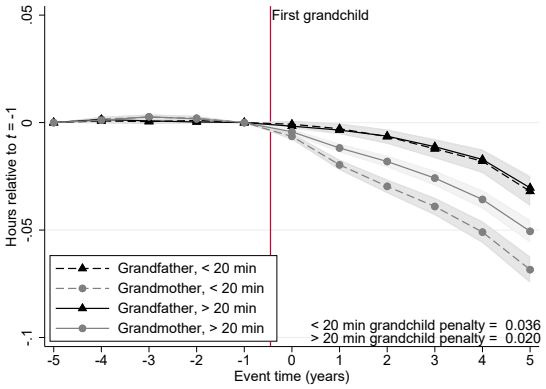
(a) Earnings



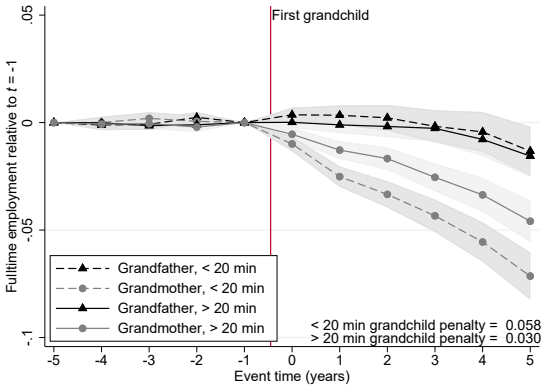
(b) Labor force participation



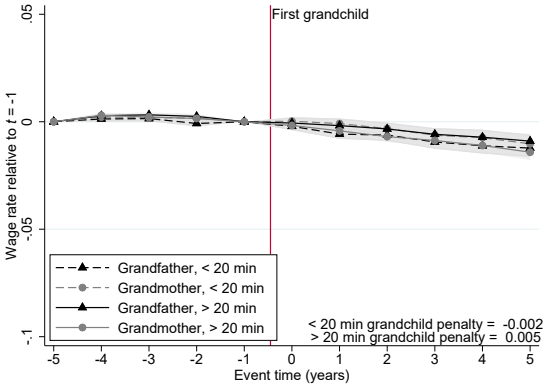
(c) Hours of work



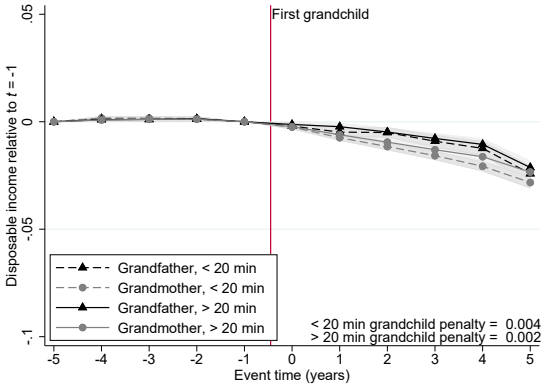
(d) Full time employment



(e) Wage rate



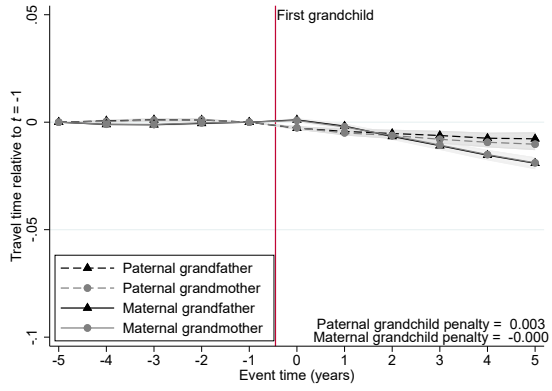
(f) Disposable income



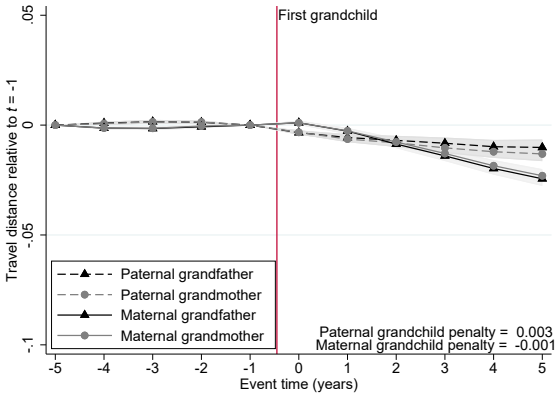
NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for grandfathers and grandmothers separately and for different outcomes. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Figure 9: The Impact of Grandchildren on Commuting Time and Distance between Parents and Grandparents

(a) Commuting time



(b) Commuting distance



NOTE— The figure shows event time coefficients estimated from Equation (1) for maternal and paternal grandfathers and grandmothers separately and for two different outcomes; log commuting time and log commuting distance. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. All of these statistics are estimated on a balanced sample of grandparents who have their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Time use data

In many time use surveys, grandparents report spending time in child care activities although they are not primary caregivers. Because the Danish time use surveys can be linked to our register data, we are able to investigate if there are any differences in the amount of time grandparents spend doing childcare depending on the characteristics of the family. Utilizing the time use surveys in 1987, 2001 and 2008, we have diary data for 5,111 of the grandparents in our main sample.[10] Among these grandparents, 14 percent report spending time in child care activities on the dairy day. Table 2 shows that grandfathers spend significantly less time with their grandchildren, both on the maternal and paternal side of the family. Grandmothers who live alone spend most time with their grandchildren, while grandfathers who live alone spend the least time with their grandchildren.

Figure 10, Panel (a) shows minutes per day spent in childcare activities for grandmothers and grandfathers across the age of the firstborn grandchild including those grandparents who report spending zero minutes doing child care activities. While grandmothers spend more time doing child care when their firstborn grandchild is 3–5 years, both grandmothers and grandfathers spend about 10 minutes per day when their first born grandchild is 6–8 years. That grandmothers spend more time with their grandchildren when the oldest grandchild is 3–5 could signal that grandmothers assist parents with picking up children in daycare. Panel (b) show time spent in child care activities separately for maternal and paternal grandmothers and grandfathers. Again, bot maternal and paternal grandmothers spend more time with their grandchildren, when the oldest grandchild is 3–5 years, than grandfathers. Panel (c) shows that grandmothers who live alone spend more time doing child care when their first grandchild is 3–5 years and panel (d) shows that grandmothers do more child care on weekend days than grandfathers, whereas the time spend doing child care on week days is more equal between grandmothers and grandfathers.

As only 14 percent of the sample report doing child care activities on the diary day,

[10]Because the spouse of the respondent also filled in the dairies in 2008, grandparents in single-headed households are underrepresented.

Table 2: Summary Statistics of Time in Child Care Activities

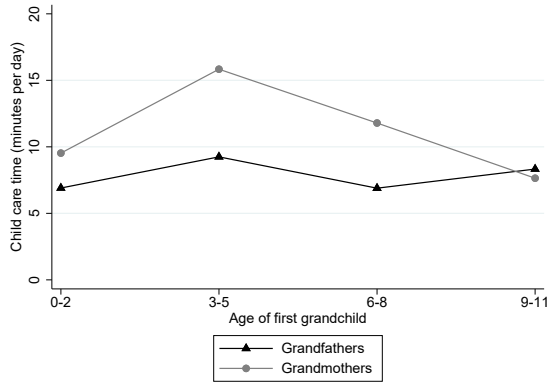
	(1)	(2)	(3)	(4)
	Grandmothers	Grandfathers		
Child care time	10.20	7.416**		
	(54.49)	(40.56)		
Observations	2641	2459		
	Maternal grandmothers	Maternal grandfathers	Paternal grandmothers	Paternal grandfathers
Child care time	11.34	7.416**	8.836	7.416*
	(57.30)	(40.12)	(50.95)	(41.15)
Observations	1434	1393	1207	1066
	Week day	Weekend		
Child care time	8.296	9.427		
	(47.84)	(48.76)		
Observations	2579	2521		
	Grandmothers week day	Grandmothers weekend	Grandfathers week day	Grandfathers weekend
Child care time	8.542	11.89	8.031	6.787
	(50.79)	(58.01)	(44.47)	(36.15)
Observations	1337	1304	1242	1217
	Single	Couple		
Child care time	11.27	8.644		
	(62.20)	(46.89)		
Observations	410	4690		
	Grandmothers single	Grandmothers couple	Grandfathers single	Grandfathers couple
Child care time	15.14	9.671	5.032	7.578**
	(71.27)	(52.39)	(43.30)	(40.37)
Observations	253	2388	157	2302

Note— The table shows mean and standard deviation in parenthesis of time in child care activities. The stars indicate significant t-statistics in relation to the mean reported in column (1), * 10%, ** 5%, and *** 1%.

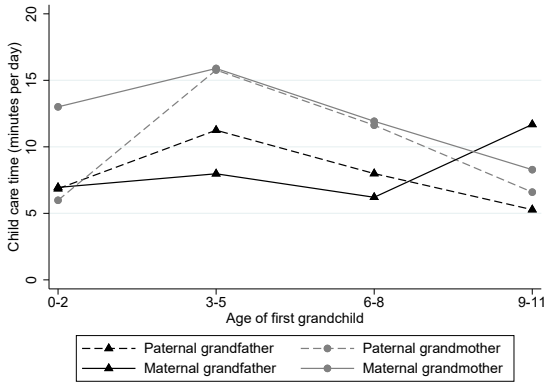
the time use data suggest that grandparental care is a relatively rare event. Data on 3228 grandparents from SHARE, where people are asked how often their care for children, confirms that 15 percent of grandparents with grandchildren aged 1–5 care for children daily or weekly

Figure 10: Time in Childcare Activities by Age of Grandchild

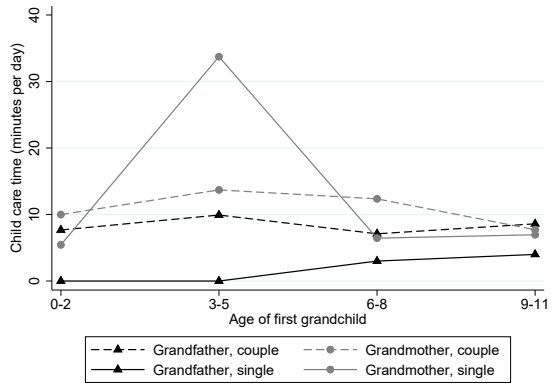
(a) Childcare time by gender



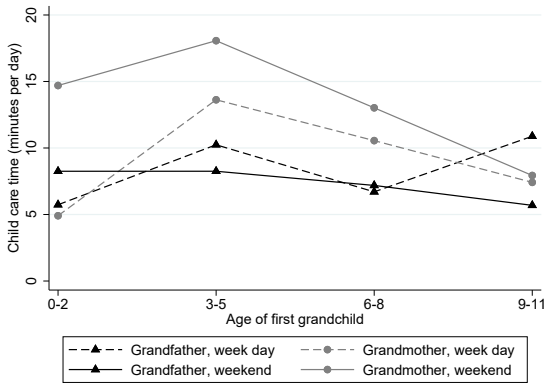
(b) Childcare time by gender and gender of child



(c) Childcare time by household type



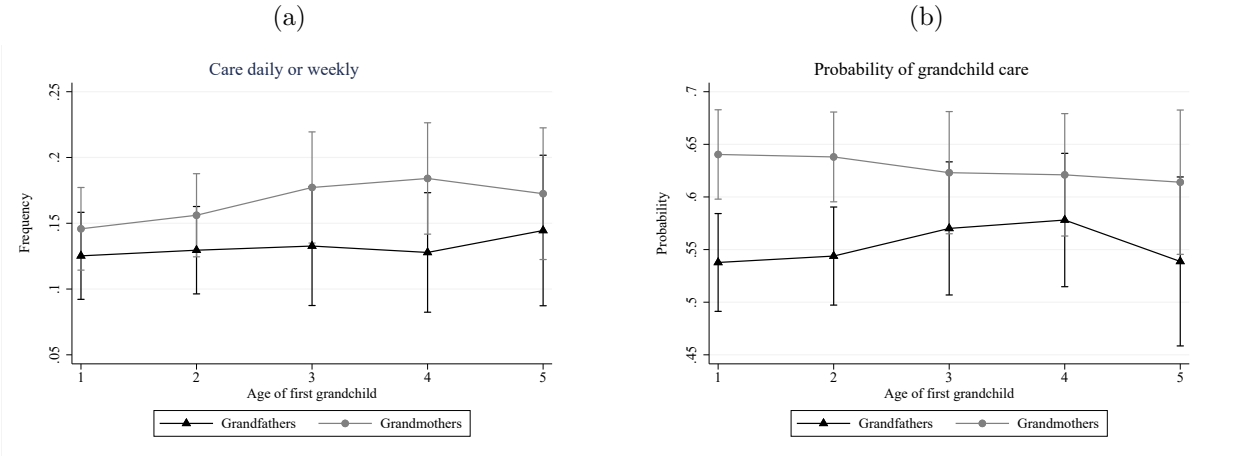
(d) Childcare time by week day or weekend



NOTE— The figure shows the average minutes per day grandparents report spending in childcare activities in the Danish Time Use Surveys from 1987, 2001 and 2008.

(cf. Figure 11). Using this data, also confirms that grandmothers spend more time with their grandchildren than grandfathers.

Figure 11: Grandparents child care time in SHARE



NOTE— The figure shows the frequency on grandparents care for children on a daily or weekly basis separately for men and women in panel (a) and the probability of grandparental care separately form men and women in panel (b). The bars indicate 95 percent confidence intervals from a t-test.

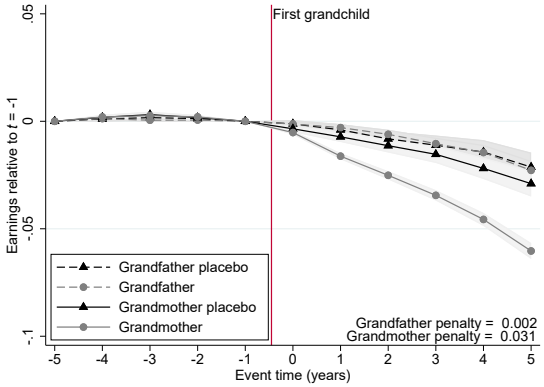
4.2 Robustness Analysis

DiD event study

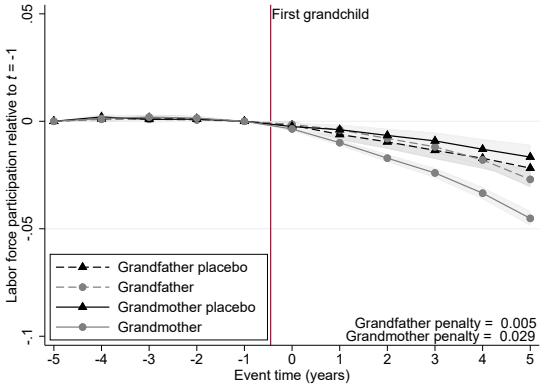
Figure 12 shows event study estimates for individuals who become grandparents between 1985–2012 and for individuals whom have been assigned a placebo grandchildren between 1985–2012. Each panel in Figure 12 reports an overall "grandparent penalty", the percentage by which grandmothers (grandfathers) are falling behind women (men) without grandchildren due to grandchildren, as defined in Equation (4). Thus in the DiD event study, we compare women to women, and we compare men to men, as opposed to our gender gap estimates comparing women to men. The results presented so far have shown that there is also an effect for men once they become grandfathers, the DiD event study allow us to estimate the effect of grandparenthood per se for grandmothers and grandfathers, respectively. Panel (a) shows that the grandmother penalty in earnings is 3.1 percent, while the grandfather penalty in earnings is only 0.2 percent. Panels (b)–(d) suggest that the drop in earnings comes from reductions in both the intensive and extensive margin of labor supply. Panels (e) and (f) confirms the previous results with no effects on wage rates and disposable income.

Figure 12: DiD Event Study of the Impact of Grandchildren

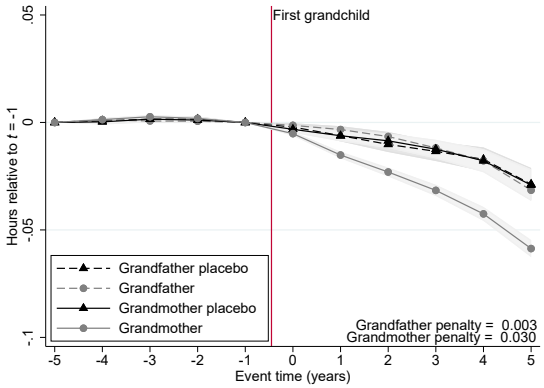
(a) Earnings



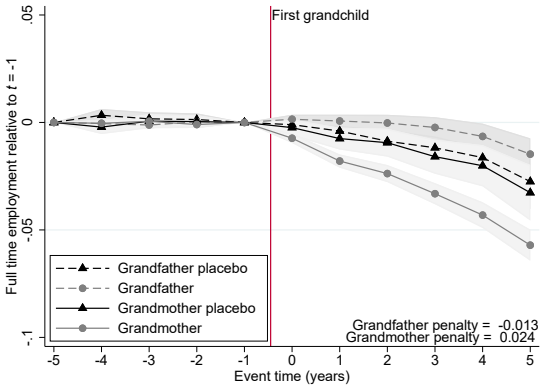
(b) Labor force participation



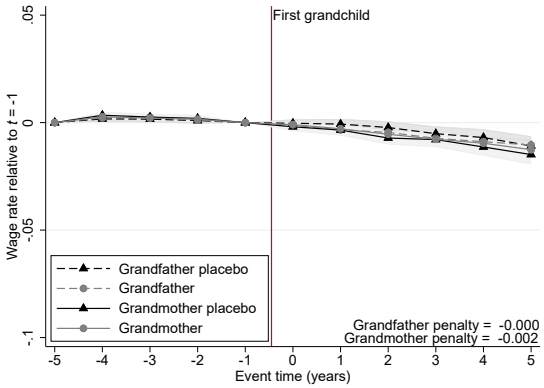
(c) Hours of work



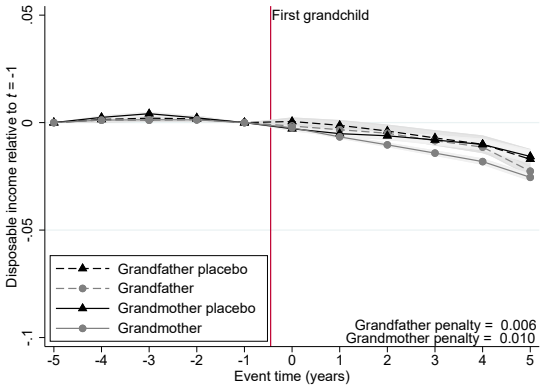
(d) Full time employment



(e) Wage rate



(f) Disposable income



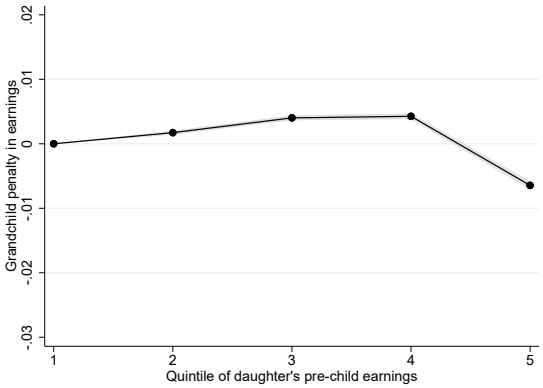
NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp}/\mathbb{E}[\tilde{Y}_{ist}^{gp}|t]$) for men and women with and without grandchildren separately and for different outcomes. Each panel also reports a "grandchild penalty", as defined in Equation (4) measured at event time 5. All of these statistics are estimated on a balanced sample of people who have (been assigned) their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first (placebo) grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

4.3 Intergenerational Transmission and Socioeconomic Status

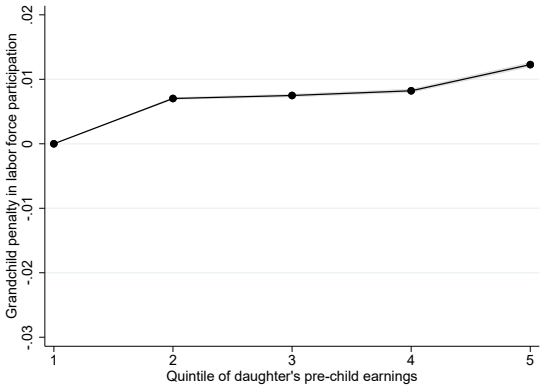
Figure 13 shows the relative grandchild penalties in labor market outcomes at event time 5 against quintiles of the daughter's (i.e., the mother of the firstborn grandchild) pre-child earnings relative to the grandchild penalty for grandparent who's daughter's pre-child earnings was in the lowest quintile using the event time estimates of Equation (5).

Figure 13: Grandchild Penalties across Quintile of Daughter's Pre-child Earnings

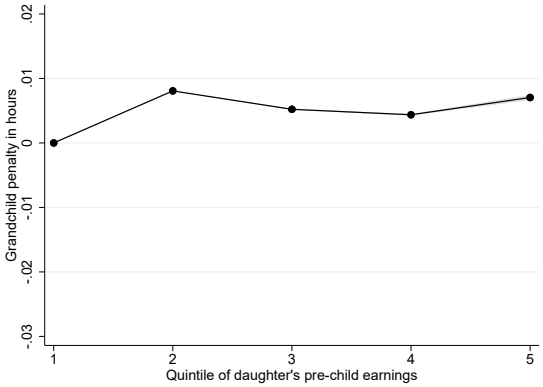
(a) Earnings



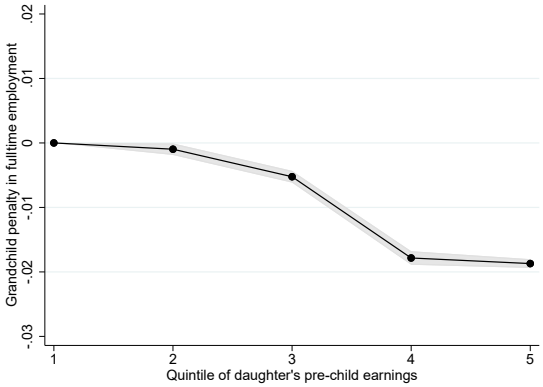
(b) Labor force participation



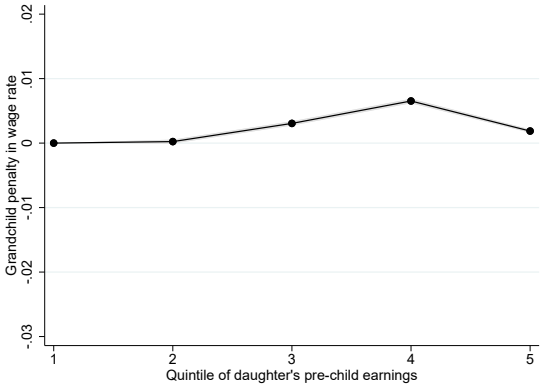
(c) Hours of work



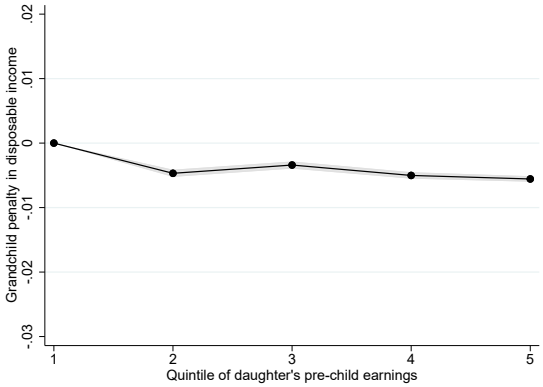
(d) Full time employment



(e) Wage rate



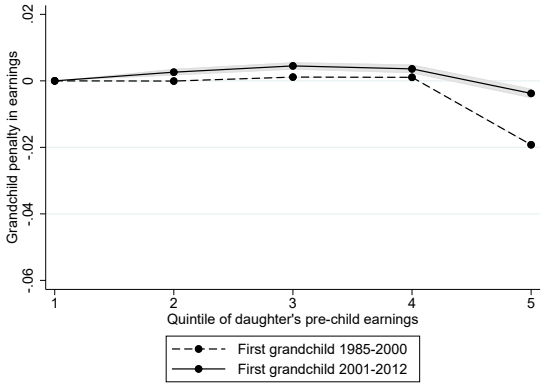
(f) Disposable income



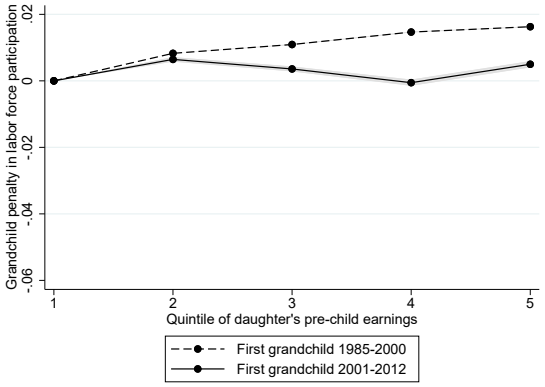
NOTE— The figure shows grandchild penalties in different labor market outcomes against quintiles of the daughter's (the mother of the grandchild) pre-child earnings relative to the grandchild penalty for those in the first quintile. The statistics are estimated on a balanced sample of people who have (been assigned) their first grandchild between 1985—2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

Figure 14: Grandchild Penalties across Quintile of Daughter's Pre-child Earnings by Time Periods

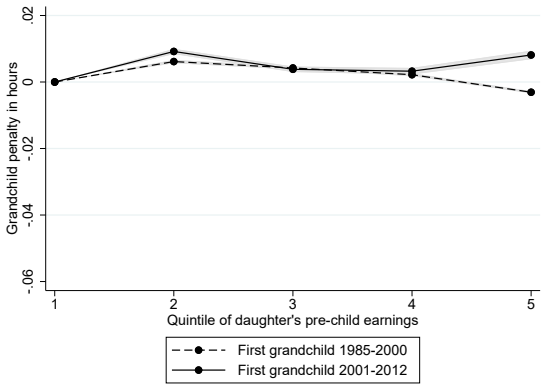
(a) Earnings



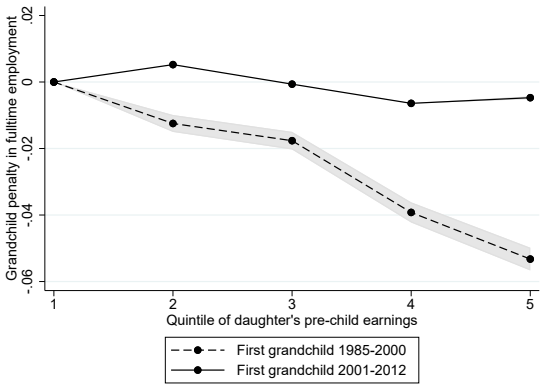
(b) Labor force participation



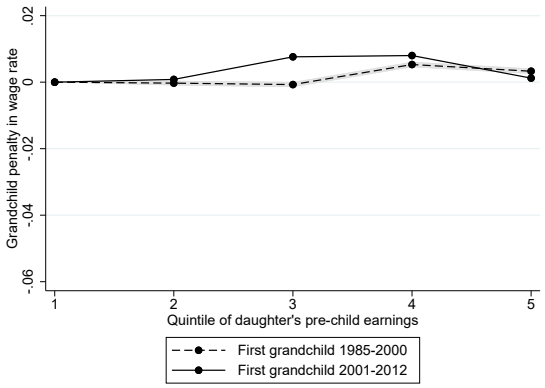
(c) Hours of work



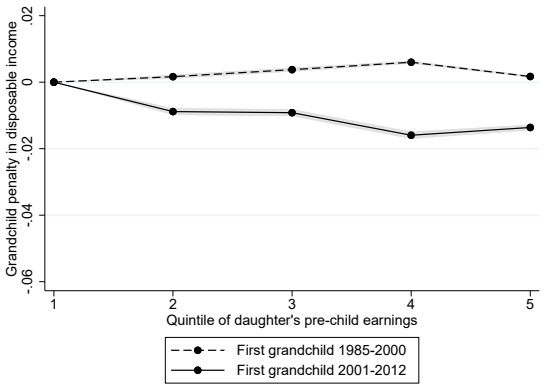
(d) Full time employment



(e) Wage rate



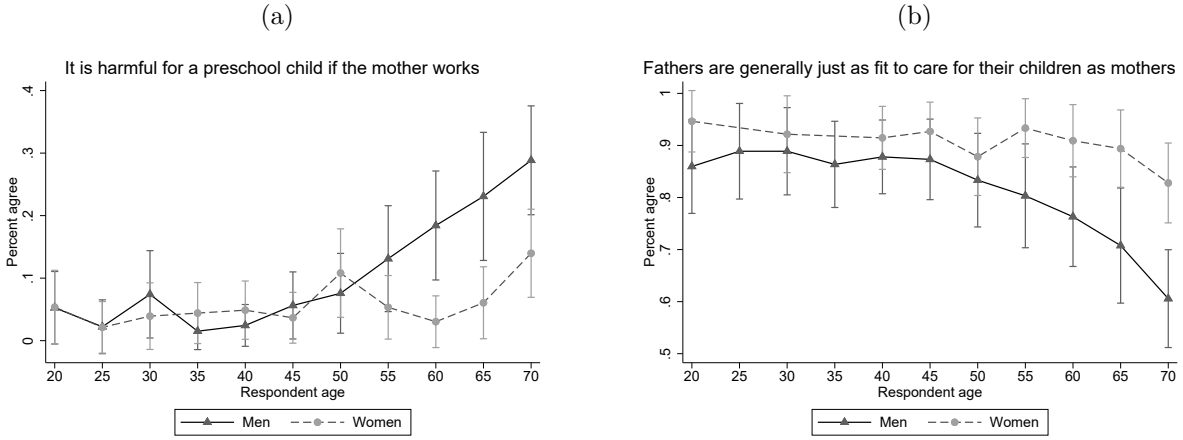
(f) Disposable income



NOTE— The figure shows grandchild penalties in different labor market outcomes against quintiles of the daughter's (the mother of the grandchild) pre-child earnings relative to the grandchild penalty for those in the first quintile. The statistics are estimated on a balanced sample of people who have their first grandchild between 1985—2000 or 2001–2012 and who are observed in the data during the entire period between five years before and five years after the birth of their first grandchild. The effects on wage rates are estimated conditional on participation. The shaded 95 percent confidence intervals are based on cluster robust standard errors.

4.4 Norms

Figure 15: Social norms by age and gender



NOTE— The figure uses data from the European Value Survey 2008. The bars indicate 95 percent confidence intervals from a t-test.

Using data from the European Value Survey 2008, we find that there is a gender difference among older cohorts in their view on fathers' and mothers' responsibilities in terms of parenting. Figure 15 shows the percentage of men and women who agrees with the following two statements: (a) It is harmful for a preschool child if the mother works and (b) Fathers are generally just as fit to care for their children as mothers. While there is little difference in the percentage of men and women below age 50 who agrees with these two statements, the percentage of men above age 50 who agrees with statement (a), claiming that it is harmful for children if their mothers work, is significantly higher than the percentage of women above age 50 who agrees with the statement. Similarly for statement (b), there appears to be a gender divergence opening up after age 50 in the percentage of people who agrees with the statement that fathers are just as good caregivers as mothers.

5 Conclusion

Recent research documents a sizable and persistent child penalty as measured by a drop in earnings for women after the birth of the first child across several developed countries

(Kleven et al., 2019a,b; Sieppi and Pehkonen, 2019). The child penalty contributes to gender inequality over working age. Our paper extends this literature by documenting that this gap is further extended into old age in the form of a grandchild penalty. Using a quasi-experimental approach and exploiting unique and rich administrative data for Denmark, we show that the persistent gender gap is reinforced by the arrival of grandchildren and thus continues into retirement age. Following Kleven et al. (2019b), we employ a quasi-experimental approach to estimate the causal effects of the birth of the first grandchild. Our event study approach allows us to show the dynamic effects of having a grandchild on earnings, wage rate, labor force participation, full time employment, hours of work, and disposable income. We find that the arrival of the first grandchild reduces grandmothers' labor force participation by 1.8 percent in comparison to grandfathers' labor force participation. Thus, we show that the child penalty due to fertility strikes again when women enter grandparenthood, although to a much smaller extent. After the arrival of the first grandchild, female earnings start decreasing in comparison to male earnings, which are unaffected when we control for year, age and individual effects. Five years after the arrival of the first grandchild, the gender gap in earnings has been extended by 3.8 percent due to the arrival of a grandchild. This effect is almost entirely driven by reductions in full time employment. We compare our event study estimates of the gender gap in labor market outcomes to a DiD event study design. This alternative approach generally confirms our results based on the event study strategy comparing grandmothers and grandfathers. To shed light on some potential mechanisms, we furthermore explore the effects across different groups and time periods, leading to several interesting additional insights. First, we investigate the results by two subperiods, 1985–2000 and 2001–2012. We show that the gender earnings gap is stronger for the earlier period, in which options for early retirement were much more generous, parental leave shorter, and daycare availability more scarce than in later periods. At the same time, female labor supply was generally lower and part time work more prevalent for women becoming grandmothers in this period. Second, we find that the effects of becoming a grandparent vary by the gender

of the child (the parent of the grandchild). Thus grandmothers are significantly more likely to reduce their work hours if it is their daughter who gives birth to a grandchild relative to their son. This suggests that the inclination to transfer time across generations is stronger in the mother-daughter relationship than in the mother-son relationship. Third, we find that labor market effects for grandparents are stronger if grandparents and children live closer apart. Fourth, we find very different effects for grandparents who are single compared to grandparents who live in couples. We find the strongest negative effects on labor market outcomes for single grandmothers, while we find some evidence of a positive effect on earnings and hours for single grandfathers. For couples, the labor market outcomes move more closely together, but the grandchild penalty is still larger for women than for men. Fifth, we find slightly larger grandchild penalties for grandmothers who's firstborn grandchild lives in a municipality with relatively high coverage of childcare.

Our results point to several policy relevant insights. We show that it is crucial to take a broader family perspective that recognizes the provision of grandparental childcare in order to reduce gender inequalities in the labor market that open up at first child birth, expand at the arrival of the first grandchild, and persist into retirement. Recent evidence suggests that decades of childcare subsidies and maternity leave policies have achieved little in terms of closing the gender earnings gap (Kleven et al., 2020; Olivetti and Petrongolo, 2017; Rossin-Slater, 2017). Previous research has pointed to the availability of grandparental care as an important factor as especially grandmothers transfer a substantial amount of time resources to their children, and this provision of time positively affects maternal labor supply (Del Boca, 2002; Bratti et al., 2018; Zamarro, 2020).

After decades of reductions in the gender gap in education and increasing female labor supply in Denmark, grandmothers' time is no longer an unused resource to the same extent as it was perhaps 30 years ago. Furthermore, pension reforms intended to postpone retirement contribute to this picture. As such, family policies targeted young families such as childcare subsidies may not lead to increases in maternal supply if mothers use the subsidy to free up

grandmother's childcare provision (Havnes and Mogstad, 2011). Parental leave policies may increase grandmothers labor supply, while doing little to maternal labor supply.

Our research documents that trade-offs between mothers' and grandmothers' labor supply abound. However, previous research also shows that gender norms are correlated across generations (Kleven et al., 2019a). Policies that help grandmothers stay in the labor force while supporting mothers' labor market attachment are desirable.

References

Adda, J., Dustmann, C., and Stevens, K. (2017). The career costs of children. *Journal of Political Economy*, 125(2):293–337.

Andreoni, J. (1989). Giving with impure altruism: Applications to charity and Ricardian equivalence. *Journal of Political Economy*, 97(6):1447–1458.

Angelov, N., Johansson, P., and Lindahl, E. (2016). Parenthood and the gender gap in pay. *Journal of Labor Economics*, 34(3):545–579.

Asquith, B. J. (2017). *Essays in Urban and Labor Economics*. PhD thesis, UC Irvine.

Backhaus, A. and Barslund, M. (2021). The effect of grandchildren on grandparental labour supply: Evidence from Europe. *European Economic Review*, 137:103817.

Becker, G. (1991). Family background and the opportunities of children. *Becker, GS, A Treatise on the Family, Harvard University Press, Cambridge, Mass. Enlarged edition*, pages 179–200.

Bingley, P. and Lanot, G. (2007). Public pension programmes and the retirement of married couples in Denmark. *Journal of Public Economics*, 91(10):1878–1901.

Blau, F. D. and Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *Journal of Economic Literature*, 55(3):789–865.

Bratti, M., Frattini, T., and Scervini, F. (2018). Grandparental availability for child care and maternal labor force participation: Pension reform evidence from Italy. *Journal of Population Economics*, 31(4):1239–1277.

Browning, M., Donni, O., and Gørtz, M. (2021). Do you have time to take a walk together? Private and joint time within the household. *The Economic Journal*, 131(635):1051–1080.

Brunello, G. and Rocco, L. (2019). Grandparents in the blues. The effect of childcare on grandparents' depression. *Review of Economics of the Household*, 17:587–613.

Bütikofer, A., Karadakic, R., and Willén, A. (2021). Mommy is stuck in traffic? Parenthood and the gender gap in commuting. *Unpublished material*.

Compton, J. and Pollak, R. A. (2014). Family proximity, childcare, and women's labor force attachment. *Journal of Urban Economics*, 79:72–90.

Craig, L. and Jenkins, B. (2016). Grandparental childcare in Australia: Gender differences in the correlates of providing regular grandparental care while parents work. *Community, Work & Family*, 19(3):281–301.

Danielsbacka, M., Tanskanen, A. O., Coall, D. A., and Jokela, M. (2019). Grandparental childcare, health and well-being in Europe: A within-individual investigation of longitudinal data. *Social Science & Medicine*, 230:194 – 203.

Datta Gupta, N. and Simonsen, M. (2010). Non-cognitive child outcomes and universal high quality child care. *Journal of Public Economics*, 94(1-2):30–43.

Del Boca, D. (2002). The effect of child care and part time opportunities on participation and fertility decisions in Italy. *Journal of Population Economics*, 15(3):549–573.

Di Gessa, G., Glaser, K., and Tinker, A. (2016). The impact of caring for grandchildren on the health of grandparents in Europe: A lifecourse approach. *Social Science & Medicine*, 152:166 – 175.

Frimmel, W., Halla, M., Schmidpeter, B., and Winter-Ebmer, R. (2020). Grandmothers' labor supply. *Journal of Human Resources*, pages 0419–10144R1.

Garcıa-Miralles, E. and Leganza, J. M. (2020). Joint retirement of couples: Evidence from discontinuities in Denmark. *Unpublished material*.

Goldin, C. (2014). A grand gender convergence: Its last chapter. *American Economic Review*, 104(4):1091–1119.

Hank, K. and Buber, I. (2009). Grandparents caring for their grandchildren: Findings from the 2004 Survey of Health, Ageing, and Retirement in Europe. *Journal of Family Issues*, 30(1):53–73.

Havnes, T. and Mogstad, M. (2011). Money for nothing? Universal child care and maternal employment. *Journal of Public Economics*, 95(11-12):1455–1465.

Kanji, S. (2018). Grandparent care: A key factor in mothers' labour force participation in the UK. *Journal of Social Policy*, 47(3):523–542.

Kleven, H., Landais, C., Posch, J., Steinhauer, A., and Zweimüller, J. (2019a). Child penalties across countries: Evidence and explanations. *AEA Papers and Proceedings*, 109:122–26.

Kleven, H., Landais, C., Posch, J., Steinhauer, A., and Zweimüller, J. (2020). Do family policies reduce gender inequality? Evidence from 60 years of policy experimentation. *NBER Working Paper*, (w28082).

Kleven, H., Landais, C., and Søgaard, J. E. (2019b). Children and gender inequality: Evidence from Denmark. *American Economic Journal: Applied Economics*, 11(4):181–209.

Kridahl, L. (2017). Retirement timing and grandparenthood in Sweden: Evidence from population-based register data. *Demographic Research*, 37:957–994.

OECD (2019). OECD Family Database. PF3.3: Informal childcare arrangement. OECD – Social Policy Division – Directorate of Employment, Labour and Social Affairs. `http://www.oecd.org/els/family/PF3-3-Informal-childcare-arrangements.pdf`, Last accessed on 2020-01-10.

Olivetti, C. and Petrongolo, B. (2017). The economic consequences of family policies: Lessons

from a century of legislation in high-income countries. *Journal of Economic Perspectives*, 31(1):205–30.

Pezzin, L. E. and Schone, B. S. (1999). Intergenerational household formation, female labor supply and informal caregiving: A bargaining approach. *Journal of Human Resources*, pages 475–503.

Posadas, J. and Vidal-Fernandez, M. (2013). Grandparents' childcare and female labor force participation. *IZA Journal of Labor Policy*, 2.

Rossin-Slater, M. (2017). Maternity and family leave policy. Technical report, National Bureau of Economic Research.

Rupert, P. and Zanella, G. (2018). Grandchildren and their grandparents' labor supply. *Journal of Public Economics*, 159:89–103.

Sear, R. and Coall, D. (2011). How much does family matter? Cooperative breeding and the demographic transition. *Population and Development Review*, 37 (Supplement):81–112.

Sieppi, A. and Pehkonen, J. (2019). Parenthood and gender inequality: Population-based evidence on the child penalty in Finland. *Economics Letters*, 182:5–9.

Statistics Denmark (2017). Takster for børnepasning 2017. Nyt fra Danmarks Statistik, nr. 165. `https://www.dst.dk/Site/Dst/Udgivelser/nyt/GetPdf.aspx?cid=24107`, Last accessed on 2020-01-10.

Triadó, C., Villar, F., Celdrán, M., and Solé, C. (2014). Grandparents who provide auxiliary care for their grandchildren: Satisfaction, difficulties, and impact on their health and well-being. *Journal of Intergenerational Relationships*, 12(2):113–127.

Zamarro, G. (2020). Family labor participation and child care decisions: The role of grannies. *SERIEs*, pages 1–26.

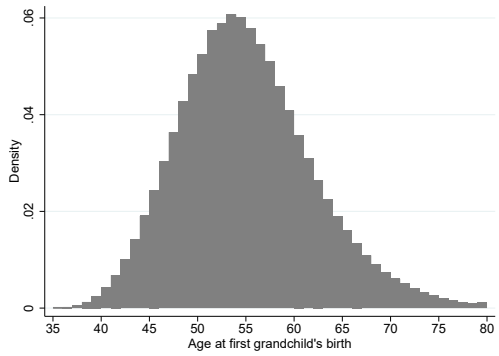
Zanasi, F., Sieben, I., and Uunk, W. (2020). Work history, economic resources, and women's labour market withdrawal after the birth of the first grandchild. *European Journal of Ageing*, 17(1):109–118.

Zanella, G. (2017). How does grandparent childcare affect labor supply? *IZA World of Labor*.

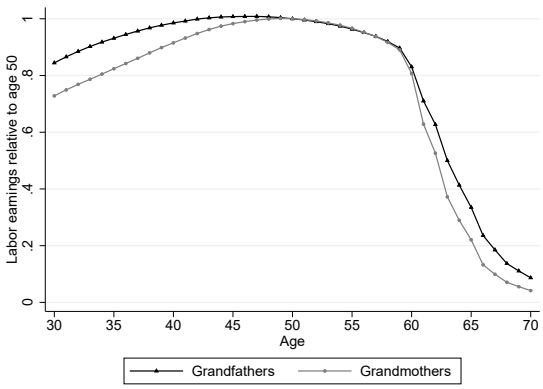
A Appendix

Figure A1: Age at Grandparenthood and Earnings across Age

(a) Age at grandparenthood



(b) Earningsprofile



NOTE— The figure in panel (a) shows the distribution of age at the birth of the first grandchild for all grandparents in Denmark. The figure in panel (b) shows earnings between age 30 and 70 (indexed at age 50) for individuals who at some point in their live become grandparents.

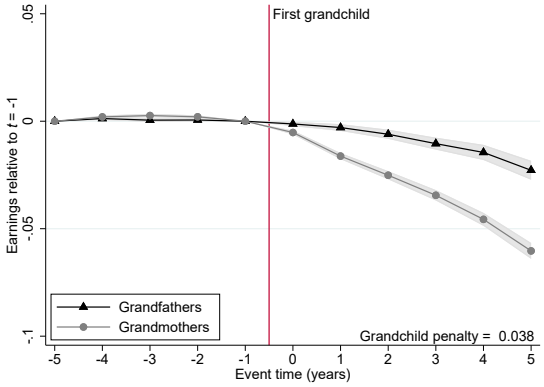
Table A1: Summary Statistics of Background Characteristics for Grandmothers and Grandfathers with Firstborn Sons and Firstborn Daughters

	(1) Grandfathers w. firstborn sons	(2) Grandfathers w. firstborn daughters	(3) Grandmothers w. firstborn sons	(4) Grandmothers w. firstborn daughters
Grandparent				
Age at first child's birth	26.93	26.99	24.37	24.41
	(4.832)	(4.836)	(4.557)	(4.476)
Age at last child's birth	31.67	31.39	28.97	28.72
	(5.343)	(5.274)	(4.842)	(4.778)
Age at first grandchild's birth	56.43	55.12	54.09	52.71
	(6.802)	(6.768)	(6.831)	(6.727)
Year of birth	1941.8	1943.3	1944.0	1945.6
	(10.12)	(9.814)	(10.04)	(9.682)
Single-headed household	0.142	0.150	0.214	0.213
	(0.349)	(0.357)	(0.410)	(0.409)
Child (parent of grandchild)				
Age at first child's birth	28.19	27.31	28.39	27.46
	(4.256)	(4.034)	(4.398)	(4.110)
Year of birth	1970.0	1971.1	1969.7	1970.9
	(8.331)	(8.116)	(8.436)	(8.180)
Grandchild				
Year of birth	1998.2	1998.4	1998.1	1998.3
	(8.047)	(7.990)	(8.045)	(8.000)
Observations	286,477	268,393	331,737	307,141

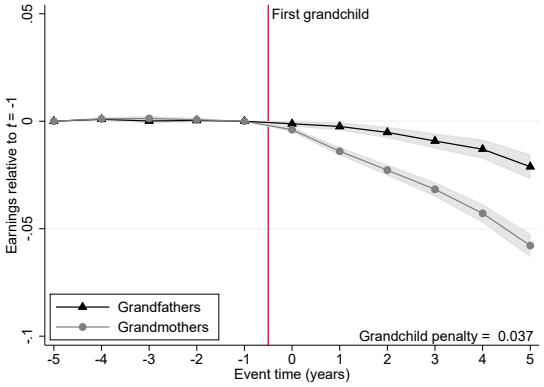
Note— The table shows mean and standard deviation in parenthesis of the background characteristics separately for grandmothers with firstborn sons and daughters and separately for grandfathers with firstborn sons and daughters. The headline *Child (parent of grandchild)* refers to the parent of the first born grandchild and the headline *Grandchild* refers to the first born grandchild.

Figure A2: The Impact of Grandchildren for Different Age Groups

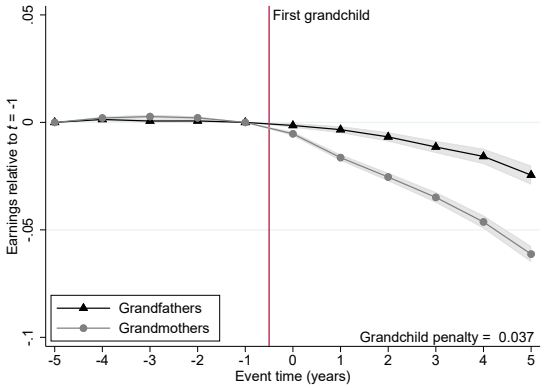
(a) Earnings, age 35-80



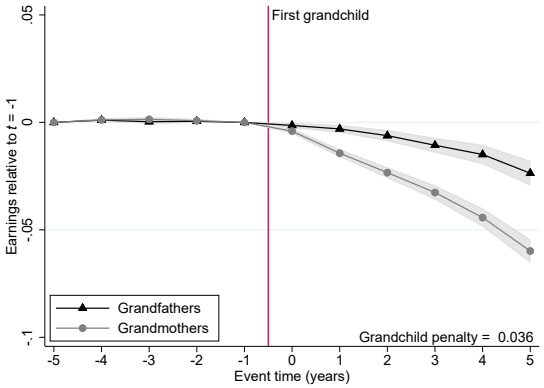
(b) Earnings, age 50-80



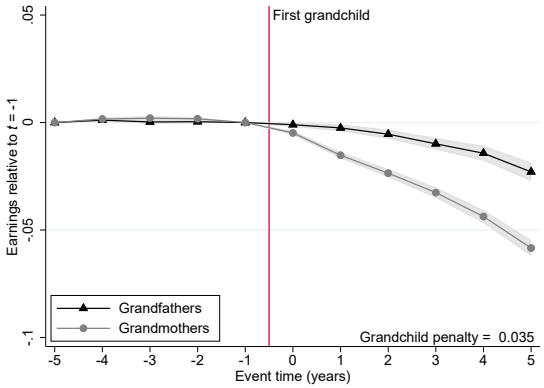
(c) Earnings, age 35-70



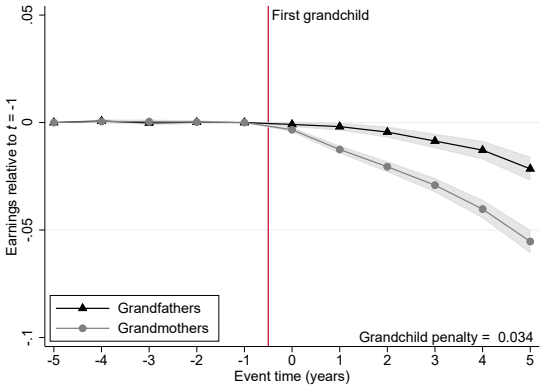
(d) Earnings, age 50-70



(e) Earnings, age 35-65



(f) Earnings, age 50-65



NOTE— The figure shows event time coefficients estimated from Equation (1) as a percentage of the counterfactual outcome, absent grandchildren (i.e., $P_t^{gp} \equiv \hat{\alpha}_t^{gp} / \mathbb{E}[\tilde{Y}_{ist}^{gp} | t]$) for grandfathers and grandmothers separately of different age groups. Each panel also reports a "grandchild penalty", the percentage by which grandmothers are falling behind grandfathers due to grandchildren, as defined in Equation (2). The grandchild penalty is measured at event time 5. The shaded 95 percent confidence intervals are based on robust standard errors.