Demand for informal caregiving and human capital accumulation: Evidence from elderly deaths in Senegal

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September 9, 2025

Abstract. This paper uses original panel data from Senegal to evaluate the effect of elderly household members' deaths on the educational attainment of female children. Using a triple-difference strategy with child fixed-effects, I show that the death of a co-resident aged 60 or older is associated with 20% additional education completed over a period of 4 years by affected girls. I present evidence that changes in demand for informal caregiving among adolescent girls within the household are one of the mechanisms at play. These results highlight the central role of female teenagers in caregiving activities and suggest that policies that increase the availability of formal care for the elderly could reduce gender inequalities in education in contexts similar to Senegal.

Journal of Economic Literature Classification Nos.: I15, J14, J22.

Keywords: child labor, aging, gender inequalities, education, Senegal, Africa.

Data availability: The data used in this article will be made available online prior to publication.

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1 Introduction

More and more Africans live long enough to experience the burden of chronic illness and physical impairment. The available projections suggest that the African population above working age will exceed 150 million by 2050, a three-fold increase compared to its 2020 level (Duhon et al. 2023). Few African countries are equipped with the health care and social protection system required to care for a large dependent population. In Senegal, the focus of this paper, there were only two retirement homes for a total population of 12 million in 2010 (Hane 2011). As a result, most elderly people rely on their family network to care for them in their old days. In a context where households are large and often include members of the extended family (De Vreyer and Nilsson 2019), this means that children often end up residing with elderly relatives and attending to their needs (Antoine and Gning 2014).

There is evidence in the qualitative literature on Senegal that girls in particular are expected to help their dependent elders accomplish basic health and personal activities such as bathing, eating, dressing up, using the toilet or taking medications for instance (Evans 2010; Evans et al. 2016). This raises the question of how female children cope with the workload and with the constant attention required by such caregiving responsibilities. Indeed, if informal caregiving claims a significant share of the time of the girls who reside with young children, elderly adults or chronically ill relatives, it might displace other activities such as schooling. Even for those who dedicate small amounts of time to informal care, the surveillance required by dependent relatives might constrain the time spent outside of home and result in a higher rate of school absenteeism relative to children who are not involved in caregiving. The stress induced by such responsibilities, and the associated cognitive load, are another channel through which the school progression of young caregivers could be impacted (Mani et al. 2013; Lichand and Mani 2020).

This paper evaluates the effect of elderly household members' deaths on the educational attainment of female children. To do so, I use longitudinal data on a sample of 1,005 children who were enrolled in school and resided with an elderly individual at the beginning of the study period. I exploit the deaths of elderly co-residents which occurred between the baseline survey conducted in 2006-2007 and a follow-up survey conducted approximately four years later. The assumption motivating this analysis is that old age individuals are net positive consumers of informal caregiving, i.e they consume on average more informal caregiving than they provide to their co-residents. I discuss the plausibility of this assumption later in the paper. As such, the death of an elderly household member should result in a negative shock of informal caregiving demand for the remaining members of the household. My testable prediction is that this shock will result in better educational attainment for treated children relative to other children with elderly co-residents. I expect this effect to exist mainly for girls since very few boys have caregiving responsibilities: 5% of them do any caregiving work in the baseline sample of interest.

21% of the Senegalese schoolgirls who resided with adults aged 60 or more in 2007 experienced the death of an elderly household member during the period under consideration. To evaluate the effects of this death shock (the treatment) I use a triple difference strategy (DDD) which compares treated and untreated children across time and gender. The econometric model includes individual fixed-effects which address potential sources of bias from unobserved time-invariant differences between children who lost an elderly co-resident during the study period and children who were not exposed to the shock. I add boys to the analysis to account for differential trends along non-sex-specific time-varying variables between treated and untreated children. This approach follows Jayachandran and Lleras-Muney (2009) and relies on a specific form of the parallel trends assumption in which *relative* outcomes in the treatment and control groups are assumed to trend similarly in the pre-treatment period (Olden and Møen 2022). I provide evidence showing that this assumption is likely to be satisfied in the present study.

The results suggest that co-residing with an elderly relative significantly constrains the ability of young girls to maximize their educational attainment. I find that being exposed to the death of an elderly household member results in approximately 0.6 years of extra education completed by the treated girls during the study period, a 20% gain compared to the mean educational attainment in the control group at baseline. I also find a direct effect of death shocks on the intensive margin of caregiving work, and in particular on the probability of dedicating a very large number of hours (more than 15 hours per week) to caregiving activities.

I show that the effects of the treatment on both schooling and caregiving outcomes are concentrated among girls aged 12-17 at baseline. This points to the fact that female teenagers in particular are in charge of attending to the needs of their elders. This is in line with the literature on informal caregiving in sub-Saharan Africa (Edmonds, Mammen, and Miller 2005; Evans et al. 2016) which highlights the role of female adolescents in caring for dependent relatives. I also present evidence that the effects on educational attainment are driven by girls whose co-residing elderly relative had a low level of economic productivity, a proxy variable used to account for the level of functional autonomy of deceased individuals.

The primary contribution of this paper is to provide novel evidence of the impact of grandparents and other old relatives' deaths on the educational attainment of female children in the African context. The analysis builds on a substantial body of literature examining the effects of death shocks on the well-being of children and women (Ainsworth, Beegle, and Koda 2005; Beegle, De Weerdt, and Dercon 2006; Evans and Miguel 2007; De Vreyer and Nilsson 2019; Villar 2021; Khanna and Pandey 2024). Beyond this, it also advances three main strands of the literature.

First, it complements the literature on dependency and informal caregiving which already highlights the role of women as primary caregivers (Charmes 2019), documents the negative effect of these caregiving responsibilities on their ability to participate in the labor market (Ettner 1995; Carmichael and Charles 1998, 2003; Heitmueller 2007; Bolin, Lindgren, and Lundborg 2008; Schmitz and Westphal 2017), and shows that women caregivers suffer a salary penalty due to the constraint that caregiving exerts on the organization of their time (Heitmueller and Inglis 2007; Van Houtven, Coe, and Skira 2013; Schmitz and Westphal 2017). This literature has so far been largely focused on developed countries with the exception of a few recent contributions examining the role of female adolescents in household childcare in developing countries (Jakiela et al. 2020; Attanasio et al. 2022; Biscaye, Egger, and Pape 2025). In addition to presenting empirical evidence on the impacts of elderly death shocks on the accumulation of human capital by girls, this article also extends the literature on caregiving and development by presenting some new evidence on the involvement of female teenagers in informal *elderly* care activities.

Second, the paper also contributes to the literature on the interaction between household investment decisions, gender norms, and inequalities in access to education (Thomas 1994; Garg and Morduch 1998; Morduch 2000; Duflo 2003; Lundberg 2005; Qian 2008; Akresh, Walque, and Kazianga 2016; Benhassine et al. 2015; Ringdal and Sjursen 2021; Dhar, Jain, and Jayachandran 2022; Dizon-Ross and Jayachandran 2023). My results show that gender norms in domestic work have implications for gender inequalities in education. They call for additional research on the effectiveness of interventions aimed at reshaping these norms from an early age[1].

Finally, this article fits in more generally with the rich empirical literature on the impacts of child labor on education (Ravallion and Wodon 2000; Heady 2003; Canals-Cerda and Ridao-Cano 2004; Gunnarsson, Orazem, and Sánchez 2006; Beegle et al. 2008; Beegle, Dehejia, and Gatti 2009; Bezerra, Kassouf, and Arends-Kuenning 2009; Assaad, Levison, and Zibani 2010;

1. See Dhar, Jain, and Jayachandran (2022) for a recent example.

Buonomo Zabaleta 2011; Dumas 2012; Emerson, Ponczek, and Souza 2017; Kassouf, Tiberti, and Garcias 2020). It is one of the rare contributions to document the impacts of domestic work as opposed to market work on schooling outcomes[2], and it extends the literature on this specific topic by highlighting the impacts of caregiving as a particular type of domestic work.

The remainder of this paper is organized as follows. The next section reviews the literature on informal caregiving in sub-Saharan Africa and on the relationship between child labor and education more broadly. Section 3 describes the data and provides some descriptive statistics for elderly adults and for the sample of children under study. Section 4 discusses the econometric specifications used in the analysis and presents the results. Section 5 presents some robustness checks. Section 6 concludes.

2 Related literature

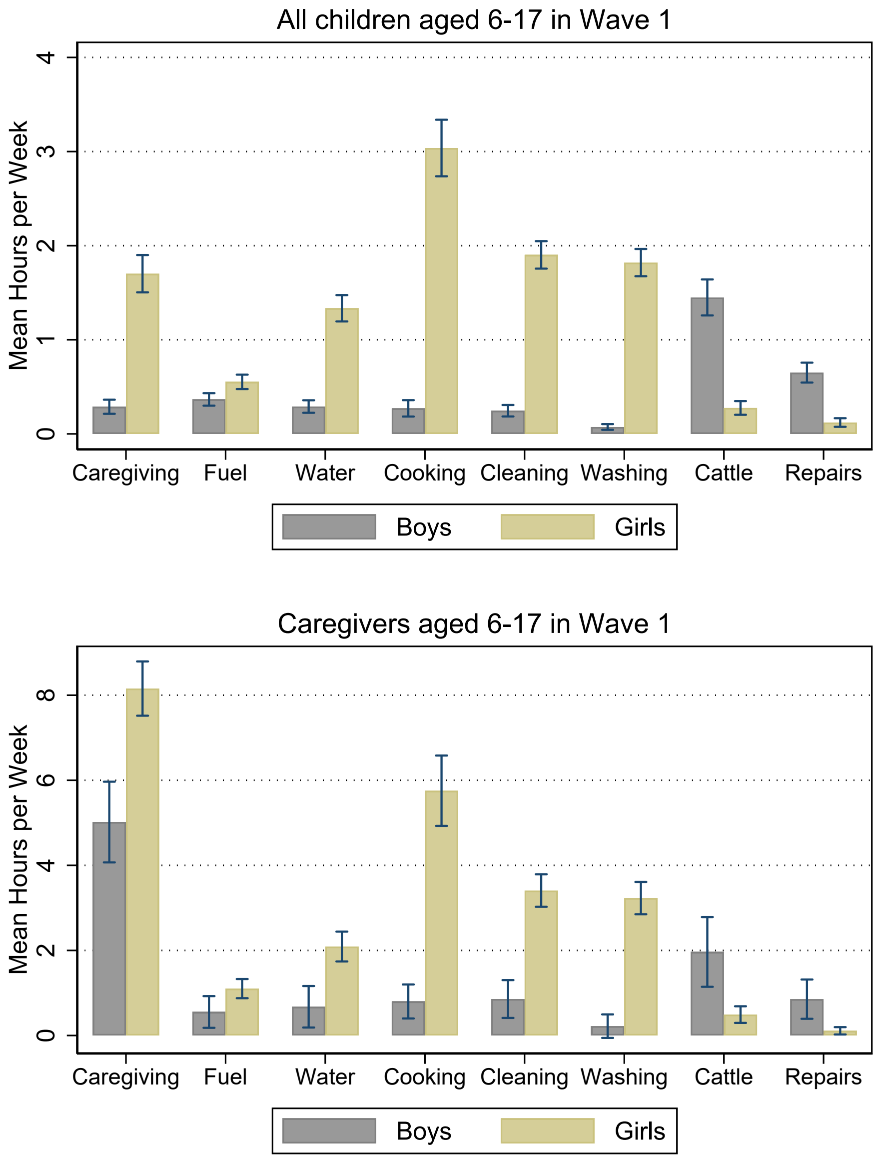
2.1 Children's caregiving roles in sub-Saharan Africa

Qualitative evidence suggests that children take on a significant share of the burden of caring for dependent relatives in many sub-Saharan African communities (Evans 2010). A rich body of ethnographic research documents the role of young caregivers in supporting HIV-infected parents in several Southern and Eastern African countries which faced high HIV prevalence in the 1990s and 2000s (Robson 2004; Robson et al. 2006; Akintola 2008). This stream of literature also suggests that caregiving roles are highly differentiated by gender with women and girls often in charge of providing personal care and emotional support while men and boys more frequently meet the costs of supporting their sick or elderly relatives financially.

Several evaluations of the impact of parental or adult deaths on primary school participation in the context of the AIDS epidemic have documented the relationship between chronic illness among adult household members and children's education (Ainsworth, Beegle, and Koda 2005; Evans and Miguel 2007). They show that negative effects on school attendance appear before the death of a chronically ill parent and that girls tend to be the most affected (Yamano and Jayne 2005). There are indications in this literature that an increase in the demand for informal caregiving could be one of the mechanisms behind this pre-death absenteeism (Ainsworth, Beegle, and Koda 2005).

2. Previous contributions include Assaad, Levison, and Zibani (2010) and Kassouf, Tiberti, and Garcias (2020).

Figure 1: Time dedicated to caregiving and other domestic work by task



Source: PSF Survey, wave 1. Vertical spikes indicate 95% confidence intervals. A bar graph of time dedicated to caregiving and domestic work by task in wave 2 of PSF is presented in Appendix Figure B.3.

2.2 Informal caregiving to elderly relatives and children's schooling

The literature on children caregivers in AIDS-affected households mainly documents their role in caring for prime-age adults. Unfortunately, much less has been published on children's involvement in caring for their aged relatives but the available evidence suggests that girls, and first-born daughters in particular, have a comparative advantage in caring for elderly family members in the context of sub-Saharan Africa (Edmonds, Mammen, and Miller 2005; Evans et al. 2016). Prior research suggests at least three potential pathways through which caregiving responsibilities may reduce educational attainment, particularly for female children.

First, demand for caregiving within the household could compete with school time and constrain children to drop out of school or miss school frequently as is the case for other types of child labor (Ravallion and Wodon 2000; Assaad, Levison, and Zibani 2010). Furthermore, the relationship between informal caregiving time and schooling hours may not be proportional. The distribution of caregiving hours during the week or their low predictability could result in disproportionate impacts on school attendance. This would be the case if the time at which specific tasks need to be conducted is fixed and coincides with school hours, for example if a child was in charge of helping a grand-parent to bath, to dress up, to eat or to take a medication. In this type of situation, low intensity caregiving work could nevertheless lead to increased absenteeism and affect learning, exam performances and school progression in the medium term.

Second, even in situations where female children were able to conduct caregiving work without missing school, caregiving could still compete with time dedicated to homework and affect learning and educational attainment through this channel. There is evidence in the empirical literature that schoolchildren who work underperform in reading and mathematics tests, even when they mainly supply household work or only work on an occasional basis (Gunnarsson, Orazem, and Sánchez 2006; Kassouf, Tiberti, and Garcias 2020).

Third, the responsibility of caring for a dependent relative requires significant mental attention and can generate stress for a child who suddenly becomes in charge of the life of another person. This implies that caregiving responsibilities can be a source of cognitive load as defined by Mullainathan and Shafir (2013): reduced available attention to matters other than caregiving work in our case. This cognitive load could affect learning and educational attainment through impaired cognitive function and reduced in-class attention among female child caregivers (Mani et al. 2013; Howard et al. 2017; Lichand and Mani 2020). There are thus reasons to believe that learning can be negatively affected even in situations where children caregivers attend school as regularly as other children.

3 Data and descriptive statistics

3.1 Data

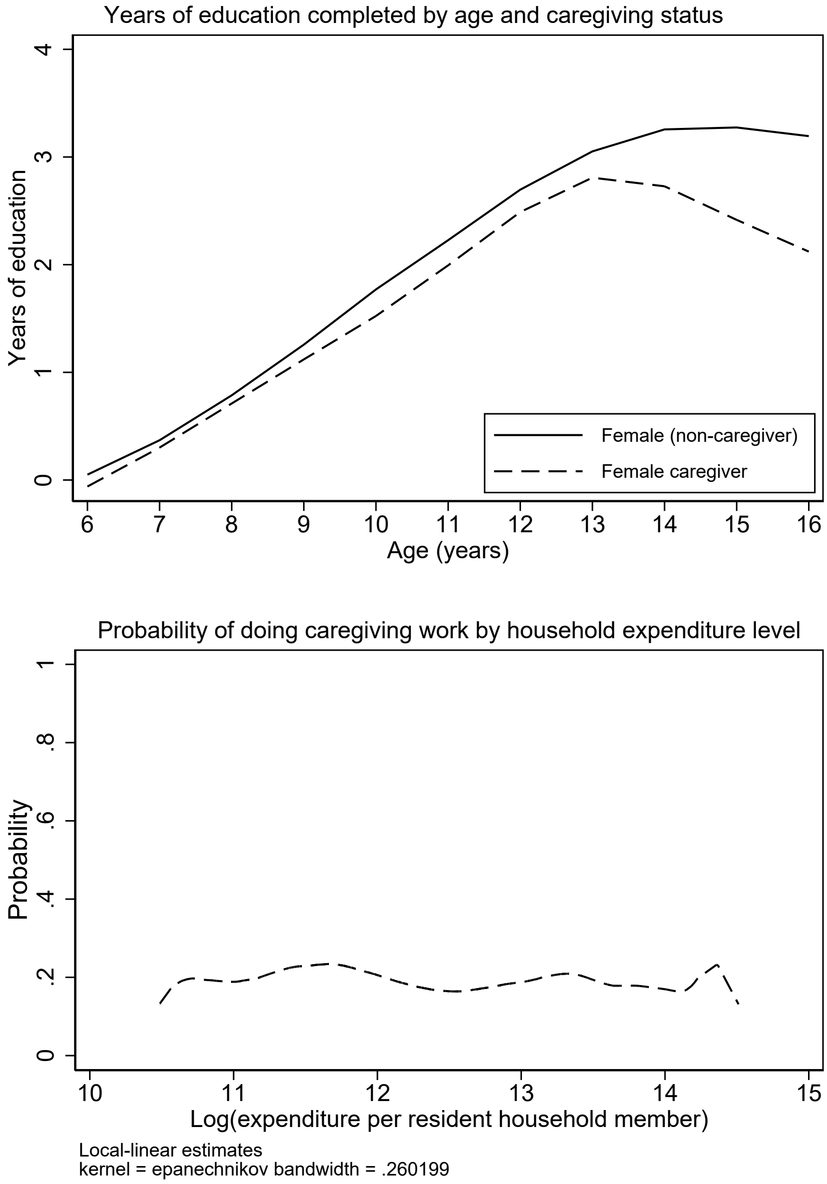
This paper uses data from the Poverty and Family Structure survey (in French Enquête pauvreté et structure familiale, henceforth PSF), a two-wave panel survey covering a nationally representative sample of 1,800 Senegalese households in the first wave (De Vreyer et al. 2008)[3]. The data were collected from April 2006 to July 2007 (wave 1) and between October 2010 and December 2012 (wave 2). 13,269 (82%) of the 16,210 individuals who were interviewed at baseline were tracked and re-interviewed in the second wave of the survey. Panel observations with complete data include 3,556 children who were aged 6 to 17 in the first wave of PSF and who are the focus of this paper. Six years of age is the lower age bound for which PSF collected domestic work information in both waves. It also corresponds to the age at which children are expected to start primary school in Senegal. I restrict my analysis to individuals aged less than 18 at baseline because I am interested in identifying the effect of conducting caregiving work during childhood and teenage years on educational outcomes.

The PSF questionnaire collected the usual data on each individual's education and market work. It also contains a detailed domestic work module. The domestic tasks covered by the module include: purchasing food and cooking meals, collecting wood, fetching water, cleaning the house, washing clothes, doing home improvements, looking after cattle, as well as caring for children, elderly or sick individuals. For each of these tasks, self-reported weekly hours of unpaid work are recorded with the following question: During a normal week of the past month, how many hours (in the week) did you spend on [activity]?. This paper makes extensive use of the data on caregiving which is defined as time dedicated to children, elderly or sick people in the survey questionnaire. This definition is not specific enough to exclude the possibility that hours of work reported as caregiving work overlap with hours reported for other domestic activities such as cooking, cleaning or doing the laundry. To take this risk into account, I treat caregiving work separately from other domestic tasks in my analysis and therefore report descriptive statistics and regression results separately for caregiving work, domestic work other

3. A more detailed presentation of the design of PSF is included in Appendix A.

than caregiving work, and market work in what follows.

Figure 2: Educational attainment and caregiving responsibilities among girls in the baseline sample



Source: PSF Survey, wave 1. Sample: female children aged 6-17. Top panel: Non-parametric estimation of the expected educational attainment by age group conditional on caring responsibilities. Bottom panel: non-parametric regression of an indicator variable equal to 1 if a child conducts caregiving work and 0 otherwise on the natural logarithm of the annual per capita expenditure of the household of residence. Spending is reported in Francs CFA and trimmed for bottom and top 1% of the distribution.

Measurement error is a well-known problem in self-reported time-use data. Common issues include recall bias, proxy reporting error, response fatigue, and social desirability bias. Except for social desirability bias, these sources of measurement error are likely to lead to loss of precision and attenuation bias rather than systematic over or under-reporting. Social desirability bias (Nederhof 1985) is a greater source of concern because it could lead to systematic under-reporting of some activities, with both its incidence and magnitude potentially differing between study groups. For instance, in the case of children reporting their hours of domestic work, male respondents might be tempted to under-report their time spent on activities which are more frequently ascribed to women while female respondents might be doing the opposite. Although this can be an issue when working with cross-sectional data, this paper uses longitudinal data and its main results are based on econometric models which incorporate individual fixed effects. Assuming that an individual's sensitivity to social desirability is stable over time, the fixed effects should control for this unobservable characteristic.

Another issue with time use data is the fact that summing the time reported by an individual for all of her activities can result in totals which exceed the maximum number of hours available in a week (112 hours if one assumes 8 hours of sleep and leisure per day). This can be due to the fact that some activities can be conducted concomitantly but also reflects measurement error with individuals reporting an unrealistically high number of hours for some activities. To deal with this problem, I winsorize all time use variables, including informal caregiving time, at the 99th percentile[4].

The analysis focuses on two main outcomes of interest: current school enrollment and educational attainment. School enrollment is measured by an indicator variable equal to one if a child is currently enrolled in school at the time of the survey and to zero otherwise[5]. Educational attainment or years of education is a variable equal to the number of years of formal education completed at the time of the survey. The variable ranges from 0 to 17 which reflects the fact that the Senegalese schooling system includes 6 years of primary school, 4 years of middle school, 3 years of high school, and that higher education is recorded up to 4 years after high school.

Finally, my treatment variable of interest is an indicator variable equal to one in wave 2 if the wave 1 household hosted an individual aged 60 or more who died between the two waves of the survey (and to zero otherwise). I choose to set the lower bound of the elderly age category at 60 because this corresponds to the 95th percentile of the age distribution in the baseline sample of PSF (see Appendix Figure B.1). Interestingly, 60 is also a threshold at which an individual's

4. Trimming these variables for the top 1% highest values yields qualitatively similar results (not shown in the paper).

5. The variable is also coded 0 if the child only attends koranic school.

health condition and productivity are likely to start declining markedly as illustrated by the self-reported data from PSF wave 1 displayed in Appendix Figure B.2. The average hours of market work reported per week for the 60-69 age category in particular drop below the sample mean of 26 hours per week[6] while the proportion of individuals who consider themselves in bad or very bad health reaches 13% (less than 5% among prime age adults). This suggests that household members are likely to become increasingly dependent, require more informal care and generate less income after reaching the age of 60. Working with this age limit increases the probability that the death of a household member results in a negative shock of demand for caregiving work. It also lowers the likelihood that such a death generates a negative income shock, which could threaten my identification strategy.

3.2 Descriptive statistics

Appendix Table C.1 provides some descriptive statistics for the broader sample of children who were between 6 and 17 years old at the time of the first survey, in 2006 or 2007, and who were re-interviewed in 2010-12. The average sample child had only two years of education at baseline. A third of the children had never attended school. Considering that pupils are expected to enter primary school at age 6 in Senegal and that the mean age is 11 in the sample, we would expect the mean years of schooling to be close to five if children were on track with the Senegalese schooling curriculum. While children were four years older on average at the time of the second wave of PSF, the mean schooling attainment only increases by two years between the two survey waves. The data also show that the gender disparities in education were non-negligible in the generation of children under study. Compared to boys, girls are four percentage points (0.80-0.76) less likely to have ever attended school at the time of the second survey wave[7].

The descriptive statistics on child labor also reflect important differences between genders. In line with the qualitative literature on child labor in Senegal (Evans et al. 2016) I find that girls tend to specialize in domestic work and caregiving work while boys are more likely to be doing market work. These differences increase as children grow older so that girls are 37 percentage points (0.82-0.45) more likely to report some domestic work and 21 percentage points (0.24-0.45) less likely to be doing market work at the end of the study period. Turning to caregiving

6. Among adults.
7. This difference is significant at the 1% level in unequal variance t-tests on the equality of means.

work in particular, it is striking that this is an almost exclusively feminine activity. Only 5.6% of boys were doing any caregiving work at all at baseline, while 21% of girls were caring for a relative. As a result, the average time spent on informal caregiving is close to zero for boys while girls dedicate 1.7 hours of their time to this activity every week on average (Figure 1, top panel). This corresponds to close to 8 hours of caregiving work per week for the subgroup of female caregivers (Figure 1, bottom panel).

Importantly, Figure 1 shows that caregiving work accounts for a non-negligible share of female children's domestic work time. It claims almost as much time as cleaning or washing activities and more than water and wood fuel fetching when considering unconditional mean work hours per task. Conditional on being a caregiver, caregiving work turns out to be by far the most time consuming domestic work activity. This suggests that the burden of caring for other household members significantly affects the allocation of time among girls and to a lesser extent among the rare boys who happen to carry this burden. Indeed, the simple non-parametric analysis conducted in the top panel of Figure 2 shows that caregivers consistently lag behind other girls in terms of grade-for-age and the gap increases markedly as they enter into teenage years. This difference is unlikely to be explained by economic inequalities alone since the probability of conducting caregiving work does not vary much between girls from lower and higher income groups (Figure 2, bottom panel). It could of course reflect the fact that female children with lower innate learning capacities are selected into caregiving work as they become teenagers. Finally, turning back to Appendix Table C.1, the average total number of work hours supplied by female children (16.7 hours per week) is much larger than what male children report (14 hours per week). When informal care is kept out of the comparison to take potential overlaps with other domestic tasks into account, girls still work one extra hour per week.

4 Empirical strategy and results

4.1 Identification strategy and estimating equations

My empirical strategy uses the deaths of elderly resident household members which occurred between the two waves of PSF as a source of variation in demand for caregiving work. To exploit these death shocks, I restrict my sample of interest to the children who resided with an elderly adult at baseline. This ensures that all the children considered in the analysis had a

Table 1: Baseline characteristics by treatment status

	Raw means				IP-weighted means		
	Treated (1)	Control (2)	Diff. (3)	SE (4)	Control (5)	Diff. (6)	SE (7)
Panel A: Girls							
Age	10.6	10.7	-0.12	(0.34)	10.7	-0.12	(0.49)
Years of education completed	2.52	3.05	-0.53*	(0.31)	2.58	-0.063	(0.33)
Completed primary school [yes=1]	0.084	0.15	-0.067*	(0.037)	0.12	-0.034	(0.042)
Ever worked (market work) [yes=1]	0.11	0.12	-0.018	(0.051)	0.16	-0.051	(0.062)
Working (market work) [yes=1]	0.039	0.096	-0.058**	(0.029)	0.064	-0.025	(0.033)
Any domestic work [yes=1]	0.62	0.57	0.056	(0.066)	0.63	-0.0083	(0.076)
Any caregiving work [yes=1]	0.23	0.13	0.10*	(0.055)	0.18	0.054	(0.064)
Hours of economic work /week	0.56	2.07	-1.50**	(0.74)	0.81	-0.24	(0.46)
Hours of domestic work /week	5.36	6.42	-1.06	(1.28)	6.20	-0.84	(1.66)
Hours of caregiving /week	1.50	0.89	0.62	(0.48)	1.23	0.27	(0.59)
Urban [yes=1]	0.57	0.51	0.068	(0.082)	0.50	0.068	(0.093)
Household size	15.8	14.5	1.37	(1.33)	14.5	1.39	(1.41)
Female headed household [yes=1]	0.097	0.25	-0.16***	(0.050)	0.091	0.0066	(0.042)
Head has some education [yes=1]	0.27	0.29	-0.022	(0.068)	0.24	0.029	(0.077)
Years of education of household head	2.33	2.38	-0.048	(0.71)	1.93	0.40	(0.76)
Age of elderly co-resident	73.4	68.6	4.78***	(1.09)	72.7	0.69	(1.26)
Productivity of elderly (hrs/week)	14.2	21.2	-7.08*	(3.61)	15.4	-1.22	(3.62)
Observations	103	384	487		384	487	
p-value for joint nullity test			0.000			0.968	
Panel B: Boys							
Age	12.0	11.1	0.91***	(0.34)	12.0	-0.054	(0.39)
Years of education completed	3.78	3.07	0.71**	(0.30)	3.82	-0.041	(0.34)
Completed primary school [yes=1]	0.24	0.17	0.068	(0.048)	0.28	-0.041	(0.057)
Ever worked (market work) [yes=1]	0.25	0.26	-0.0055	(0.063)	0.26	-0.0083	(0.071)
Working (market work) [yes=1]	0.22	0.18	0.039	(0.059)	0.21	0.012	(0.066)
Any domestic work [yes=1]	0.39	0.33	0.052	(0.070)	0.34	0.047	(0.078)
Any caregiving work [yes=1]	0.088	0.040	0.048	(0.042)	0.070	0.018	(0.048)
Hours of economic work /week	1.93	4.04	-2.11*	(1.15)	1.97	-0.043	(0.84)
Hours of domestic work /week	1.90	2.78	-0.88	(0.72)	2.11	-0.21	(0.73)
Hours of caregiving /week	0.38	0.20	0.17	(0.19)	0.26	0.11	(0.21)
Urban [yes=1]	0.52	0.46	0.055	(0.086)	0.50	0.020	(0.094)
Household size	16.4	14.5	1.96	(1.74)	14.6	1.78	(1.73)
Female headed household [yes=1]	0.12	0.20	-0.075	(0.059)	0.094	0.028	(0.054)
Head has some education [yes=1]	0.30	0.32	-0.026	(0.077)	0.31	-0.0069	(0.085)
Years of education of household head	2.48	2.35	0.13	(0.72)	2.31	0.17	(0.75)
Age of elderly co-resident	71.3	68.6	2.74***	(1.01)	71.5	-0.19	(1.10)
Productivity of elderly (hrs/week)	16.0	22.1	-6.05	(4.30)	16.5	-0.52	(4.12)
Observations	114	404	518		404	518	
p-value for joint nullity test			0.007			0.999	

Source: PSF Survey, wave 1. Sample: Children aged 6-17 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Treated individuals are the children who were exposed to an elderly death shock between waves. Column 5 reports inverse propensity score reweighted means (Hirano and Imbens 2001; Brunell and DiNardo 2004) for the control group. Differences between the treated and control means are presented in columns 3 and 6, using the unweighted control means (column 1 - column 2) and the inverse propensity score reweighted control means (column 1 - column 5) respectively. Missing observations are imputed using multivariate normal multiple imputation (Schafer 1997) for the variables years of education completed, completed primary school, and hours of domestic work per week. The standard errors on the differences are estimated from running the corresponding least squares regression allowing for the errors to be clustered by household. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

non-zero probability of being treated and share the unobservable characteristics associated with this type of co-residence. I further restrict the sample to the children who were in school at the time of the first survey for similar reasons, because children who had already dropped out of school at baseline had a much lower probability to see their educational attainment affected by the death or survival of an elderly co-resident. Appendix Table C.2 shows that the resulting sample includes 1,005 school children of whom 217 (21.6%) were exposed to the death shock of interest between the two waves.

While this choice of inclusion criteria allows me to compare treated and control children who are relatively similar socio-economic characteristics and are likely to react to the treatment, the resulting analytical sample is selected and includes only 28.3% of all children in the age group of interest (1,005 out of 3,556). Appendix Table C.3 shows that included children came from larger households, had more years of education and were less likely to be conducting market work at baseline. To ensure that the conclusions of the paper are not driven by selection bias, I also conduct my main analysis in two extended samples: the sample of children aged 6-17 who were co-residing with an elderly adult in wave 1 irrespective of their school enrollment status (1,757 children), and the broadest possible sample including all panel children aged 6-17 in wave 1 (3,556 children). In the robustness checks section of the paper, I show that the results of the main analysis are qualitatively similar when considering these alternative samples instead of the main analytical sample. Another important feature of the analytical sample is that it is less affected by attrition than the overall sample: 90.5% (1,062 out of 1,173) of the children who were included in the wave 1 survey were tracked in wave 2 and 85,7% (1,005 out of 1,173) have sufficiently complete data for the outcomes and covariates of interest in the two survey waves to be included in the analysis [8].

I estimate the impact of the death shocks on girls' schooling outcomes by comparing the girls who were exposed to the shock (treated girls) to those who did not lose an elderly household member between wave 1 and wave 2 (control girls). The second dimension of the comparison is over time. In Table 1, I compare treated and control girls on their observables as a first check of the pre-treatment differences between the two groups. Column 3 of the table shows that treated girls had completed 0.5 less years of education at the beginning of the study period. They were 10 percentage points more likely to be conducting domestic work and 6 percentage points less likely to be involved in market work than the control group. As a result, they dedicated 1.5

8. A detailed analysis of attrition rates is presented in Appendix Figure B.4 and Table C.17.

hours less of their time to market work. This is consistent with a situation in which the elderly individuals with whom treated girls were living at baseline were in worse physical condition and required more support than those who were living with the control girls, as illustrated by the large differences in the mean age and number of productive hours per week of elderly co-residents. Last, treated girls were significantly less likely to live in female headed households. There are also some baseline differences between the two groups of boys.

These baseline differences on some of my key outcomes of interest represent a threat to identification in a standard difference-in-differences (DID) design. The differences in educational attainment between treated and control girls in particular could reflect pre-treatment differences in trends given that girls are of the same age on average in the two groups. An additional limitation is that it is difficult to test the parallel trends assumption directly through a standard test of pre-trends with the data at hand because PSF is a two-wave survey.

I address this issue in two ways. First, I estimate econometric models which include child fixed-effects so that comparisons are within child-period cells. The child fixed-effects are particularly useful in ensuring that the estimations are not confounded by differences on time-invariant variables such as early childhood human capital accumulated prior to the age of 6 or innate abilities between treated and control children. Second, to account for potential sources of bias due to unobserved time-varying variables affecting treated and control girls in different ways, I follow Jayachandran and Lleras-Muney (2009) and construct triple difference (DDD) estimates of the impact of the death shocks on the outcomes of interest across time and gender. This strategy compares the outcomes of girls relative to boys in treated households to the outcomes of girls relative to boys in comparison households. It rests on the assumption that the *relative* outcomes of treated girls and control girls would have followed parallel trends absent the treatment. This assumption is easier to satisfy than the parallel trends assumption in standard DID designs because the addition of boys to the comparison differences out the bias from non-gender-specific unobservable differences between girls from treated households and comparison households (see Olden and Møen 2022, for a formal discussion). Put differently, if the parallel trends assumption is violated for both girls and boys and the resulting bias is not gender-specific, the addition of a third difference across genders can effectively remove this bias. Since the assumption of parallel trends cannot be tested in a standard way with the PSF data, I conduct a cross-sectional placebo test comparing the relative outcomes of girls and boys across age cohorts at baseline to provide support for a causal interpretation of the triple-difference coefficients.

4.1.1 Triple difference model

The data comprise 2,010 observations corresponding to the 1,005 children included in the sample. The triple difference is estimated by:

$$Y_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 Female_i \times \theta_t + \beta_3 Female_i \times T_{it} + \theta_t + \gamma_i + \epsilon_{it} \tag{1}$$

where Y_{it} is the outcome of interest for child i in wave t, T_{it} is a treatment dummy, $Female_i$ is a dummy equal to one if individual i is a girl, θ_t is a time fixed-effect, γ_i is a child fixed effect and ϵ_{it} is an idiosyncratic error term. T_{it} is equal to one in wave 2 if the observed child's baseline household hosted an elderly adult who died between the two survey waves, to zero in wave 2 if all the elderly adults who belonged to the baseline household are still alive at the end of the study period, and to zero in wave 1 for all observations. β_3 is the coefficient of interest which I expect to be positive for schooling outcomes if elderly adult deaths have an impact on girls' education by lowering the burden of caregiving work for treated girls. I use a linear probability model instead of a standard ordinary least squares model when the outcome variable is an indicator variable[9].

4.1.2 Testing for parallel trends

Olden and Møen (2022) show that the triple difference estimator can be written as:

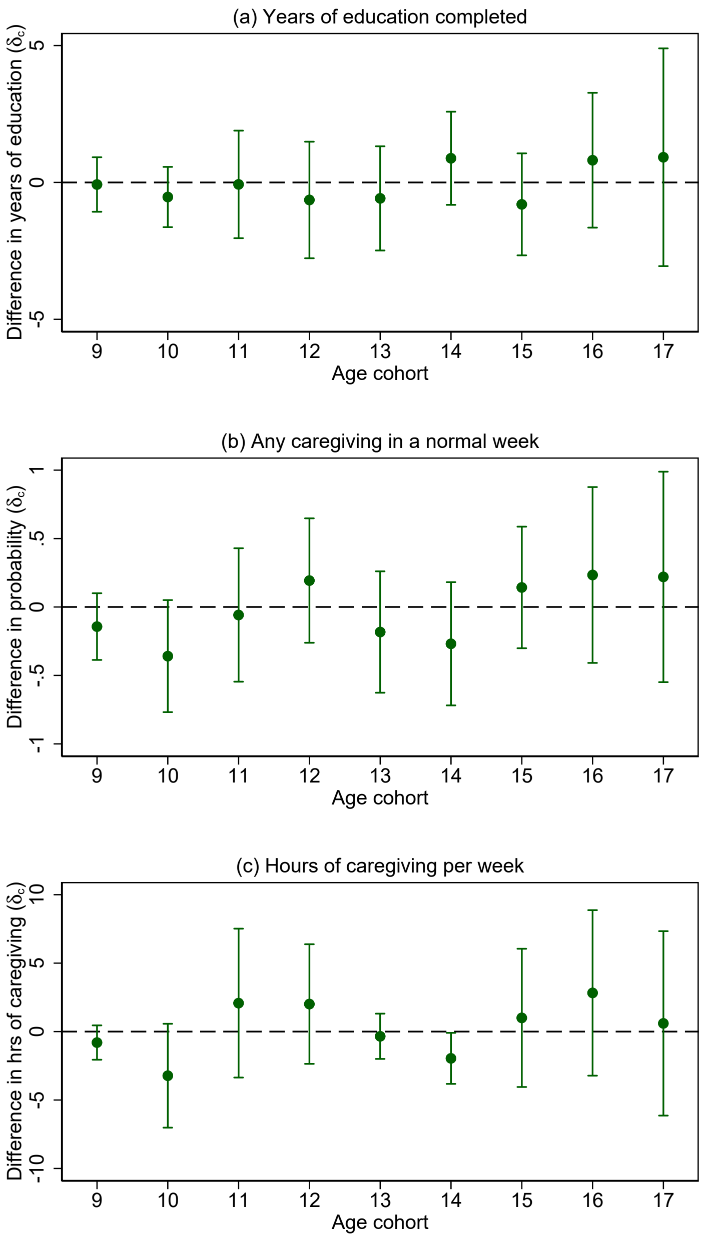
$$\begin{aligned} \hat{\delta}_{triple} = & [(\bar{Y}_{girl,pre,treat} - \bar{Y}_{boy,pre,treat}) - (\bar{Y}_{girl,post,treat} - \bar{Y}_{boy,post,treat})] \\ & -[(\bar{Y}_{girl,pre,cont} - \bar{Y}_{boy,pre,cont}) - (\bar{Y}_{girl,post,cont} - \bar{Y}_{boy,post,cont})] \end{aligned} \tag{2}$$

The assumption of parallel trends on relative outcomes requires that $\hat{\delta}_{triple} = 0$ in pre-treatment periods. Since I only have pre-treatment data for a single time period, I check that this assumption is satisfied by estimating the following equation for the baseline observations:

$$\begin{aligned} Y_{ic} = & \beta_0 + \beta_1 Female_i + \beta_2 T_i + \beta_3 Female_i \times T_i + \sum_c \mu_c (Cohort_c \times Female_i) \\ & + \sum_c \rho_c (Cohort_c \times T_i) + \sum_c \delta_c (Cohort_c \times Female_i \times T_i) + \lambda_c + \epsilon_{ic} \end{aligned} \tag{3}$$

9. I also present results for logit models in Appendix Table C.8.

Figure 3: Placebo tests



Source: PSF Survey, wave 1. Sample: Children aged 6-17 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Graphs display triple difference coefficients (δ_c) estimated via OLS following Equation 3. The dependent variable is (a) the number of years of education completed at the time of the survey, (b) a dummy equal to one if the child reports doing any caregiving in a normal week, and (c) the number of hours of caregiving per week. The first three cohorts (children aged 6-8) are used as the reference category. Standard errors are clustered at the household level. Vertical spikes indicate 95% confidence intervals.

where Y_{ic} is the outcome of interest for child i in age cohort c, T_{it} and $Female_i$ are defined as in Equation 1 and λ_c is a cohort fixed-effect. δ_c is the coefficient of interest for the test of parallel trends on relative outcomes. Because my sample is small, I use the first three cohorts, children aged between 6 and 8 at baseline, as the reference category.

Assuming that relative trends in education and domestic work are not cohort-specific, differential trends over time should also be captured by relative differences across cohorts. Thus, if the difference in educational gender gap which appears in Table 1[10] is due to a different relative trend in educational attainment rather than to an age composition effect[11], these differences should be detected by the proposed placebo tests.

I report the results of the tests in Figure 3 for educational attainment, for the probability that a child reports being involved in caregiving activities and for the number of hours of caregiving generally conducted in a normal week of the month preceding the survey. Note that I cannot conduct the test for the probability of being enrolled in school because the analytical sample is restricted to children who were attending school at baseline. The placebo coefficients are generally small and statistically insignificant for each of the three outcomes, with only a handful of exceptions. Where the coefficients differ from zero, there is no particular pattern which would suggest that the relative outcomes were trending differently across cohorts at the beginning of the study period. These results are reassuring regarding the feasibility of estimating the effects of elderly death shocks using the proposed strategy.

Several limitations of these placebo tests are worth highlighting. First, they rely on the untestable assumption that pre-treatment relative trends in education and caregiving responsibilities were similar across age cohorts within the treated group on one hand and within the control group on the other, so that observed differences between cohorts can serve as proxies for the pre-treatment trends of the treated and control groups. Second, they only support a causal interpretation of the triple-difference coefficients under the additional assumption that age or cohort-related factors affect treated and control cohorts similarly. Third, they may be subject to sampling bias because the PSF survey was designed to be representative at the national level but not by age cohort.

10. +1.37 years of education for boys relative to girls in the treatment group, -0.02 years for boys relative to girls in the control group.

11. Boys in the treatment group are on average 1.4 years older than treated girls and 0.9 years older than control boys.

4.1.3 Inverse propensity score reweighting

As an additional check of the robustness of the main results, I also estimate an inverse propensity score weighted (IPW) version of Equation 1 following the approach developed in Hirano and Imbens (2001) and Brunell and DiNardo (2004). I obtain the propensity scores from a logit model in which I regress the treatment variable on a vector of baseline covariates X[12]. In order to recover an unbiased estimate of the average treatment effect on the treated (ATT), I then derive the weights ω^{T} and ω^{c} for the treatment and the control group respectively as:

$$\omega_i^T = 1 \text{ and } \omega_i^c = \frac{Pr(T=1|X_i)}{1-Pr(T=1|X_i)} \times \frac{p^c}{p^T} \tag{4}$$

where p^c is the proportion of control observations and p^T is the proportion of treated observations. The coefficients in column 6 of Table 1 and the p-values on the F-test of joint significance reported in the last row of each panel show that the IPW procedure successfully removes baseline differences on the outcomes of interest and on selected covariates in the female and in the male subsamples[13]. This suggests that including the inverse propensity weights in the estimation of the treatment effects is helpful to reduce bias from pre-treatment differences in trends and levels and provides more robust results. Nevertheless, I interpret my results with caution in what follows given my inability to conduct a conventional test of pre-trends.

12. The list of covariates includes: the household size, the number of elderly co-residents, the mean age of the elderly co-residents, the mean hours of productive work of elderly co-residents, the age of the household head, the household's per capita food and non-food expenditure, an index of asset ownership, the child's age, educational attainment, market work, domestic work and caregiving work, as well as dummy variables for male elderly co-residents, female headed households, polygamous household heads, first born household heads, urban households and households with access to electricity. Missing values on some of these outcomes are handled using stochastic imputation to compute a propensity score for each individual in the analytical sample.

13. Standardized differences are also presented in Appendix Table C.4

Table 2: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling outcomes - Child fixed effects

	Currently in school		Years of education		Completed primary school	
	(1)	(2)	(3)	(4)	(5)	(6)
Death shock x female	0.093	0.12	0.65***	0.61**	0.099	0.17*
	(0.064)	(0.078)	(0.24)	(0.28)	(0.076)	(0.089)
Death shock	-0.011	-0.014	0.016	0.028	0.0098	0.022
	(0.048)	(0.053)	(0.16)	(0.21)	(0.052)	(0.059)
Female x 2nd wave	-0.00041	-0.023	-0.088	-0.047	-0.0064	-0.072
	(0.031)	(0.054)	(0.11)	(0.17)	(0.038)	(0.061)
2nd wave	-0.21***	-0.21***	2.87***	2.86***	0.36***	0.35***
	(0.021)	(0.031)	(0.085)	(0.15)	(0.026)	(0.038)
Constant	1***	1.00***	3.07***	3.18***	0.16***	0.20***
	(0.0072)	(0.012)	(0.031)	(0.048)	(0.0085)	(0.011)
IP-weights	NO	YES	NO	YES	NO	YES
Observations	2010	2010	1788	1788	1788	1788
Number of individuals	1005	1005	894	894	894	894
Adjusted R-squared	0.20	0.21	0.79	0.79	0.37	0.35
P-value death shock + death shock x female = 0	0.050	0.090	0.0043	0.013	0.075	0.0071

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from OLS regressions with individual fixed-effects in columns 1, 3 and 5 (linear probability model in columns 1 and 5). Columns 2, 4, and 6 report results from inverse propensity score weighted WLS regressions with individual fixed effects (linear probability model in columns 2 and 6). Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Triple difference (DDD) estimates of the impact of the death shock on girls' caregiving responsibilities - Child fixed effects

			Distribution of treatment effects on hours of informal caregiving							
	Hours of informal caregiving per week		0 hours/week [$YES=1$]		1-5 hours/week [$YES=1$]		6-15 hours/week [$YES=1$]		>15 hours/week [$YES=1$]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Death shock x female	-1.087*	-0.740	0.067	0.056	-0.020	-0.024	-0.007	0.007	-0.034*	-0.038**
	(0.635)	(0.787)	(0.072)	(0.097)	(0.063)	(0.073)	(0.040)	(0.071)	(0.020)	(0.019)
Death shock	-0.257	-0.163	0.065	0.044	-0.058	-0.045	-0.008	0.001	0.000	-0.000
	(0.202)	(0.209)	(0.045)	(0.051)	(0.043)	(0.050)	(0.014)	(0.017)	(0.004)	(0.001)
Female x 2nd wave	0.634*	0.286	-0.088***	-0.078	0.063**	0.067	0.015	0.001	0.005	0.009
	(0.332)	(0.571)	(0.031)	(0.073)	(0.026)	(0.045)	(0.016)	(0.061)	(0.011)	(0.009)
2nd wave	-0.077	-0.170	0.005	0.026	0.005	-0.008	-0.010	-0.019	-0.000	0.000
	(0.095)	(0.109)	(0.014)	(0.028)	(0.013)	(0.028)	(0.007)	(0.012)	(0.004)	(0.001)
Constant	0.617***	0.765***	0.900***	0.870***	0.060***	0.071***	0.032***	0.053***	0.009***	0.006***
	(0.070)	(0.109)	(0.008)	(0.014)	(0.007)	(0.010)	(0.004)	(0.011)	(0.002)	(0.002)
IP-weights	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Number of individuals	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005
Adjusted R-squared	0.010	0.005	0.019	0.009	0.016	0.011	-0.000	0.002	0.004	0.008
P-val. death shock + death sh. x female = 0	0.027	0.236	0.021	0.234	0.102	0.207	0.697	0.903	0.080	0.043

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from OLS regressions with individual fixed-effects in odd columns. Even columns report results from inverse propensity score weighted WLS regressions with individual fixed-effects. Linear probability models are used in columns 3-10. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.2 Results

4.2.1 Schooling outcomes

Table 2 reports results from triple difference estimations for the schooling outcomes of interest. The first and second columns show the results for school enrollment. The unweighted coefficient on death shock x female in column 1 is positive as expected but statistically insignificant. Column 2 presents the results estimated with inverse propensity weights. The coefficient on the interaction between death shock and female remains insignificant in this specification. Note that the Wald test of joint significance of the coefficients on death shock and death shock x female is significant at the 5% level (see last row of the table), suggesting that female children who were exposed to the death shock are more likely to still be enrolled in school than they would be in the absence of treatment when taking into account both the female-specific effect of the death shock (coefficient β_3 in Equation 1) and the effect which is common to boys and girls (coefficient β_1 in Equation 1). However, given the statistical insignificance of the coefficient on death shock x female, I cannot rule out that the effect for girls and boys is similar.

In column 3, I turn to the effect of the treatment on the educational attainment of female children. The coefficient of interest is positive and statistically significant. The estimate implies that the difference in years of education completed by treated girls relative to control girls represents approximately 0.6 years of extra education after adjusting for the same comparison among boys. To assess the relative magnitude of this effect, one can compare it to the average educational attainment in the reference group before treatment (boys in wave 1) which is captured by the constant term. This comparison shows that the effect of the death shock on girls represents a 20% increase in educational attainment. This result is robust to the inclusion of inverse propensity score weights and the magnitude of the effect is nearly unchanged in this case (column 4). The Wald test of joint significance of the coefficients on death shock and death shock x female is significant at the 5% level, which confirms that there is a gain in education accumulated during the study period for treated girls when both the female-specific effect and the non-gender-specific effect of the death shock are taken into account. Note that the small and statistically insignificant coefficients on death shock suggest that there is no treatment effect on schooling outcomes for boys.

Columns 5 and 6 of Table 2 estimate the effect of the death shock on the probability that children completed their primary school curriculum during the study period. The coefficient of

Table 4: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - By age group, child fixed-effects

	Currently in school		Years of education		Any caregiving		Hrs of caregiving per week	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Children aged 6-11								
Death shock x female	0.0086	0.040	0.36	0.23	0.058	0.15	0.25	0.76
	(0.067)	(0.072)	(0.31)	(0.35)	(0.095)	(0.12)	(0.56)	(0.80)
Death shock	0.040	0.012	0.31	0.43*	-0.10*	-0.11*	-0.40	-0.44
	(0.049)	(0.050)	(0.20)	(0.23)	(0.060)	(0.065)	(0.32)	(0.32)
Female x 2nd wave	0.00044	-0.031	-0.071	0.054	0.072**	-0.015	-0.012	-0.53
	(0.036)	(0.045)	(0.14)	(0.20)	(0.035)	(0.076)	(0.24)	(0.63)
2nd wave	-0.14***	-0.11***	2.96***	2.83***	8.2e-19	0.011	-0.077	-0.036
	(0.024)	(0.026)	(0.10)	(0.15)	(0.019)	(0.032)	(0.080)	(0.071)
Constant	1***	1.00***	1.56***	1.43***	0.082***	0.12***	0.49***	0.73***
	(0.0082)	(0.0099)	(0.039)	(0.052)	(0.0087)	(0.017)	(0.056)	(0.14)
IP-weights	NO	YES	NO	YES	NO	YES	NO	YES
Observations	1146	1146	1030	1030	1146	1146	1146	1146
Number of individuals	573	573	515	515	573	573	573	573
Adjusted R-squared	0.130	0.121	0.802	0.805	0.019	0.003	0.001	0.014
P-val. death sh. + death sh. x fem. = 0	0.284	0.318	0.024	0.037	0.520	0.707	0.731	0.661
Panel B: Children aged 12-17								
Death shock x female	0.15	0.21	0.77**	0.81**	-0.25**	-0.33**	-3.20**	-2.93**
	(0.11)	(0.14)	(0.35)	(0.41)	(0.10)	(0.15)	(1.27)	(1.42)
Death shock	-0.023	-0.046	-0.14	-0.26	-0.036	0.0040	-0.14	0.039
	(0.073)	(0.081)	(0.22)	(0.30)	(0.046)	(0.056)	(0.27)	(0.27)
Female x 2nd wave	-0.028	-0.090	-0.14	-0.18	0.11*	0.18	1.66**	1.39
	(0.053)	(0.10)	(0.17)	(0.26)	(0.057)	(0.13)	(0.71)	(0.95)
2nd wave	-0.29***	-0.27***	2.76***	2.88***	-0.011	-0.051	-0.077	-0.26
	(0.035)	(0.049)	(0.13)	(0.24)	(0.021)	(0.039)	(0.19)	(0.17)
Constant	1***	1.00***	5.12***	5.01***	0.12***	0.14***	0.78***	0.80***
	(0.012)	(0.020)	(0.042)	(0.071)	(0.011)	(0.021)	(0.13)	(0.15)
IP-weights	NO	YES	NO	YES	NO	YES	NO	YES
Observations	864	864	758	758	864	864	864	864
Number of individuals	432	432	379	379	432	432	432	432
Adjusted R-squared	0.295	0.298	0.784	0.778	0.032	0.044	0.036	0.034
P-val. death sh. + death sh. x fem. = 0	0.122	0.160	0.035	0.100	0.002	0.026	0.008	0.041

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from OLS regressions with individual fixed-effects in odd columns. Even columns report results from inverse propensity score weighted WLS regressions with individual fixed-effects. Linear probability models are used in columns 1-2 and 5-6. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

interest is large in both specifications and statistically significant at the 10% level in column 6 when the IPW procedure is used. The latter coefficient suggests that the relative effect of the death shock on treated girls is a 17 percentage points increase in the probability to have completed primary school. This represents 85% of the baseline primary school completion rate among boys. I obtain very similar results when I exclude boys from the analysis and conduct a simple difference-in-differences analysis of the impacts of elderly death shocks in the sub-sample of girls as shown in columns 1 to 3 of Appendix Table C.5.

4.2.2 Mechanisms

To see if a reduction in caregiving responsibilities could be one of the channels through which elderly death shocks affect educational attainment, I next analyze the time use data collected in both waves of PSF. In Table 3, I present results from running triple difference (DDD) estimations of the impact of the death shocks on caregiving work outcomes. Columns 1 and 2 show DDD results for the number of weekly caregiving work hours reported by the respondents. The coefficient of interest is negative and statistically significant at the 10% level in column 1. When the inverse propensity weights are included in the estimation, the treatment effect is no longer precisely estimated although the sign on the coefficient of interest remains negative (column 2).

Columns 3 to 10 of Table 3 break down the analysis by intervals of the distribution of caregiving work hours. They report linear probability estimates of the relationship between elderly adult death shocks and the probability of falling into each interval. Columns 3 and 4 report coefficients for the probability of not having cared for anyone in the previous month. They inform us on the effect of the death shock on the extensive margin of caring. The positive signs on the coefficients for death shock x female are consistent with a negative relationship between the death of an elderly household member and the probability of caring. However, the estimates are imprecise.

At the other end of the distribution, in columns 9 and 10, there is a negative effect of the death shocks on the probability that female children dedicate more than 15 hours per week to providing informal care to their relatives. This result is statistically significant at the 5% level in the IPW estimation and the effect size of 3.8 percentage points is large considering that the baseline probability of conducting any caregiving work was 0.23 among treated girls and 0.13 among control girls (see Table 1). Given that the coefficients corresponding to a moderate burden of caring are statistically insignificant and relatively small (columns 5 to 8), it appears that the main effect of elderly adult deaths on caregiving activities is a decrease in the proportion of girls who dedicate very large amounts of time to caring for their relatives.

Finally, in Appendix Table C.7, I conduct a multiple hypothesis test in which I estimate the effect of the death shocks on an index combining the probability of conducting any caregiving work, the number of hours of caregiving work per week and the probability of conducting more than 15 hours of caregiving work per week. The index is constructed following the standardized inverse-covariance weighted average of indicators method proposed in Anderson (2008) which takes into account the correlation between the components of the index. The results of the test confirm that the death shocks caused a relative decrease in caregiving work among treated girls with a negative standardized effect of 0.39 which is significant at the 10% level in both the unweighted and IPW specifications. In addition, in order to account for simultaneous effects of death shocks on caregiving and schooling outcomes, I also compute an education index[14] and estimate stepdown adjusted Romano-Wolf p-values controlling for the familywise error rate in a joint test of the treatment effect on the two indices (Romano and Wolf 2016). The Romano-Wolf p-values reject the null hypothesis of no treatment effect for both the education index (p-value = 0.009) and the caregiving index (p-value = 0.069).

4.2.3 Heterogeneity analysis

Disaggregating the results by age group provides a more refined understanding of the treatment effects on schooling and caregiving outcomes. In Table 4, I consider the effects of death shocks on younger and older children separately[15]. The coefficients of interest are statistically insignificant for all outcomes irrespective of the specification when looking at girls aged 6 to 11 in wave 1. On the other hand, the analysis points to a significant positive effect of the death shocks on the intensive margin of schooling when considering the group of girls aged 12-17. This result is matched by large and significant coefficients on death shock x female for the caregiving outcomes.

The fact that the positive impact of elderly death shocks on schooling outcomes is paralleled by a negative effect on caregiving work and that these effects are concentrated in the same age group supports this paper's core hypothesis: namely, that elderly deaths have a positive

14. This index combines the three outcome variables studied in Table 2.
15. See Appendix Figure B.5 for a complementary analysis with smaller age groups.

impact on girls' schooling because they result in a negative shock of demand for caregiving work. Interestingly, the effects are observed among the girls who were already teenagers at the time of the first survey, showing that female teenagers and young adults play a specific role in terms of informal care provision in Senegalese households. This is in line with the available qualitative literature on this topic (Evans 2010; Evans et al. 2016).

To provide more evidence in support of these key findings, I also investigate the relationship between the effect of the death shock and the level of dependency of the deceased person at baseline. Unfortunately, the PSF questionnaire does not include a direct measure of a respondent's functional autonomy. As a proxy, I compute the total productivity of each respondent by summing their reported market and domestic work hours. I then assign elderly respondents to a highly productive group and a less productive group based on their total productive hours using mean productive hours in the group of respondents aged 60 or more at baseline as the cut-off point between the two groups. While the validity of such a proxy would be questionable in a country where a majority of workers are covered by a retirement pension scheme, leisure time is less likely to increase after retirement age in Senegal where pension coverage is very low. As a result, decreases in productivity at old age are more likely to be involuntary and to correspond to a decline in functional autonomy.

In Table 5, I replicate my analysis with separate treatment variables for the death of an elderly individual who was highly productive at baseline and for the death of a person whose productive time was below the mean of 20 hours per week. I find clear evidence of treatment effects among the girls who were exposed to the death of a less productive elderly adult. The coefficients on death shock (low productivity) x female are significant for all schooling ouctomes in the IPW specification. The signs and magnitudes of the effects are very similar to what was found in the main analysis. On the other hand, the coefficients on death shock (high productivity) x female are generally smaller and are always statistically insignificant[16]. This tends to show that my main results are driven by the deaths of functionally dependent elderly individuals and constitutes additional suggestive evidence that changes in demand for informal caregiving might be behind the observed impacts of elderly death shocks on the outcomes of interest.

16. However, in Wald tests I cannot reject the null-hypothesis that the coefficients on these two terms are equivalent for any of the schooling or caregiving outcomes, potentially due to the small size of my sample.

Table 5: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - By level of productivity of the deceased, child fixed-effects

	Currently in school		Years of education		Completed primary school		Any caregiving		Hrs of caregiving per week		Caregiving time >15 hours/week	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Death shock (low productivity) x female	0.12*	0.14*	0.69***	0.65**	0.12	0.19*	-0.084	-0.073	-1.16*	-0.81	-0.029	-0.033*
	(0.070)	(0.083)	(0.26)	(0.30)	(0.085)	(0.097)	(0.082)	(0.11)	(0.64)	(0.79)	(0.020)	(0.019)
Death shock (low productivity)	-0.029	-0.031	-0.019	-0.0074	-0.035	-0.023	-0.060	-0.038	-0.30	-0.21	0.0000	-0.00013
	(0.054)	(0.058)	(0.18)	(0.22)	(0.056)	(0.062)	(0.050)	(0.056)	(0.24)	(0.24)	(0.0035)	(0.00098)
Death shock (high productivity) x female	-0.0067	0.016	0.48	0.44	-0.017	0.049	0.0070	0.018	-0.79	-0.44	-0.055	-0.059
	(0.11)	(0.12)	(0.49)	(0.51)	(0.14)	(0.15)	(0.10)	(0.12)	(1.61)	(1.67)	(0.051)	(0.051)
Death shock (high productivity)	0.065	0.063	0.18	0.19	0.22**	0.23**	-0.090	-0.069	-0.066	0.027	2.0e-17	-0.00013
	(0.075)	(0.078)	(0.23)	(0.27)	(0.087)	(0.091)	(0.093)	(0.096)	(0.17)	(0.18)	(0.0035)	(0.00098)
Female x 2nd wave	-0.00041	-0.023	-0.088	-0.047	-0.0064	-0.072	0.088***	0.078	0.63*	0.29	0.0052	0.0092
	(0.031)	(0.054)	(0.11)	(0.17)	(0.038)	(0.061)	(0.031)	(0.073)	(0.33)	(0.57)	(0.011)	(0.0093)
2nd wave	-0.21***	-0.21***	2.87***	2.86***	0.36***	0.35***	-0.0050	-0.026	-0.077	-0.17	-1.2e-18	0.00013
	(0.021)	(0.031)	(0.085)	(0.15)	(0.026)	(0.038)	(0.014)	(0.028)	(0.095)	(0.11)	(0.0035)	(0.00098)
Constant	1***	1.00***	3.07***	3.18***	0.16***	0.20***	0.10***	0.13***	0.62***	0.77***	0.0090***	0.0061***
	(0.0072)	(0.012)	(0.031)	(0.048)	(0.0084)	(0.011)	(0.0077)	(0.014)	(0.070)	(0.11)	(0.0023)	(0.0019)
IP-weights	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	2010	2010	1788	1788	1788	1788	2010	2010	2010	2010	2010	2010
Number of individuals	1005	1005	894	894	894	894	1005	1005	1005	1005	1005	1005
Adjusted R-squared	0.20	0.21	0.79	0.79	0.37	0.35	0.019	0.0084	0.0097	0.0050	0.0034	0.0082
P-val. death sh. + death sh. x fem. = 0 (low prod.)	0.039	0.076	0.011	0.025	0.18	0.023	0.021	0.20	0.012	0.17	0.14	0.081
P-val. death sh. + death sh. x fem. = 0 (high prod.)	0.56	0.47	0.11	0.14	0.15	0.052	0.43	0.67	0.61	0.81	0.28	0.24

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from OLS regressions with individual fixed-effects in odd columns. Even columns report results from inverse propensity score weighted WLS regressions with individual fixed-effects. Linear probability models are used in columns 1-2, 5-8, and 11-12. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Triple differences (DDD) in other outcomes - Child fixed effects

	Any domestic work	Hrs of domestic work / week	Any market work	Hrs of market work / week	Household size	Log(exp. per capita)	Log(school exp. per capita)	Female HH head	Child is fostered
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Death shock x female	0.019	2.63	0.081	1.72	2.46^{**}	-0.038	0.52	0.00094	-0.048
	(0.13)	(2.95)	(0.11)	(4.00)	(1.20)	(0.15)	(0.59)	(0.085)	(0.054)
Death shock	-0.10	-0.26	-0.070	-2.17	-1.98	-0.045	-0.30	0.25^{***}	0.0086
	(0.12)	(0.92)	(0.083)	(3.42)	(1.36)	(0.14)	(0.59)	(0.068)	(0.027)
Female x 2nd wave	0.11	4.82^{**}	0.0083	-5.34^{**}	-1.26^{**}	0.075	-0.17	0.048	-0.000057
	(0.097)	(2.23)	(0.071)	(2.54)	(0.57)	(0.066)	(0.34)	(0.041)	(0.026)
2nd wave	0.084	-0.12	0.17^{***}	12.9^{***}	0.58	0.15^{**}	0.78^{**}	0.035	0.00013
	(0.077)	(0.70)	(0.051)	(2.29)	(0.50)	(0.061)	(0.35)	(0.026)	(0.018)
Constant	0.48^{***}	3.81^{***}	0.14^{***}	1.39^{*}	14.9^{***}	12.2^{***}	7.29^{***}	0.097^{***}	0.072^{***}
	(0.021)	(0.25)	(0.016)	(0.72)	(0.24)	(0.027)	(0.13)	(0.013)	(0.0085)
IP-weights	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2010	1944	2010	2010	2010	1810	1838	2010	2010
Number of individuals	1005	972	1005	1005	1005	905	919	1005	1005
Adjusted R-squared	0.039	0.099	0.10	0.20	0.011	0.056	0.039	0.16	0.00043
P-val. death shock + death sh. x fem. = 0	0.35	0.34	0.89	0.88	0.67	0.58	0.67	0.0025	0.45

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from OLS regressions with individual fixed-effects in odd columns. Even columns report results from inverse propensity score weighted WLS regressions with individual fixed-effects. Linear probability models in columns 1, 3 and 8-9. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Last, the mechanisms underlying the treatment effects on girls' education could also pertain to the specific structure of households in Senegal where polygamy is common. Prior research on polygamous households has shown that children of co-wives of higher rank tend to receive less human capital investment than those of first wives (Strauss 1990; Matz 2016; Mammen 2019). Daughters of second or third wives may therefore bear a greater share of the burden of domestic tasks as a result, and they also have older fathers on average. The effect of the death shocks could thus be driven by polygamous households and, in particular, by daughters of women with higher spousal ranks. I test this hypothesis in Appendix Tables C.9 and C.10, first by estimating DDD results separately for the subsample of children who were living in households headed by polygamous and non-polygamous households at baseline, and second by comparing children living under the responsibility of a co-wife of higher rank to other children.

The first heterogeneity analysis shows no significant difference in treatment effects between girls living in polygamous households and other girls when children of first wives and higher ranked wives are considered together. On the other hand, the second heterogeneity analysis suggests that the impacts of the death shocks on educational attainment are particularly pronounced for girls placed under the responsibility of a co-wife of high rank. The estimated difference in educational attainment is 1.5 years for treated girls in this subsample (p-value = 0.053). This suggests that daughters of higher-ranked co-wives are a particularly vulnerable group and should be a key target for policy interventions seeking to mitigate the gendered consequences of old-age dependency. However, the analysis lacks power due to the small size of the sub-sample of children living with cell heads of higher spousal rank and I cannot reject that the effects of the death shocks are similar for girls living with a co-wife of higher rank and for other girls[17].

4.2.4 Other outcomes

I move on to testing a range of potential alternative mechanisms which could also explain the effect of elderly death shocks on treated girls' schooling outcomes and thus confound my analysis. In columns 1 to 4 of Table 6, I investigate the effect of the treatment on two other dimensions of children's time use, domestic work and market work, using the IPW specification. The coefficients of interest are positive for the intensive and extensive margin of these two outcomes but they are very imprecisely estimated. Thus, the analysis does not provide clear

17. See test of equality in last row of Appendix Table C.10.

evidence that the death shocks result in a change in the allocation of girls' time to market and non-market productive activities other than caregiving work[18].

In columns 5 to 9 of Table 6, I estimate the impact of the death of an elderly household member on a range of other outcomes including household size, total per capita household expenditure and per capita schooling expenditure in the household of residence, as well as whether the household of residence is female headed and whether the respondent reports being a foster child. The treatment effect on household size is of interest because if elderly adults tend to be negative net contributors to the budget of their household of residence, their death could result in a positive consumption shock for the remaining household members which could also positively affect children's ability to attend school and to accumulate human capital. I could thus be mistaking the effect of a negative shock of demand for informal care for that of a consumption shock. In this case, I would expect the coefficient of interest to be negative and significant in column 5 which reports estimates of the treatment effect on household size and positive and significant in column 6 which shows results for the impact on household per capita consumption. This is not what I find. The triple difference coefficient is positive and statistically significant when estimating the treatment effect on household size but the test of joint significance for the coefficients on death shock and death shock x female has a p-value of 0.67. Thus, there is no specific effect of the death shocks on household size when both the girl-specific effect and the effect which is common to treated girls and treated boys are taken into account. The lack of effect of the death shock on household size is somewhat surprising at first glance but can be explained by the fact that 15% of children in the analytical sample belonged to a different household in wave 1 and in wave 2[19]. The coefficients of interest for log per capita expenditure also suggest that there is no treatment effect for this outcome.

Column 7 looks at the effect of the death on the allocation of resources within the household and in particular on per capita schooling expenditure. The coefficient of interest is once again insignificant as is the test of joint significance for this outcome, suggesting that we can rule out direct investments in human capital as a potential channel for the effect of elderly death shocks on educational attainment.

Table 6 column 8 presents regression results where the dependent variable is an indicator variable equal to one if the child resides in a household which is headed by a woman. The

18. I also report the results of a disaggregated analysis of the impacts on domestic work by task in Appendix Table C.12.

19. In Appendix Table C.13 I show that this trend is not driven by earlier marriages among treated girls.

coefficient on death shock x female is small and insignificant. However, the coefficient on death shock alone equals 0.25 and has a p-value of less than 0.01. This coefficient indicates that there is a positive impact of the death shock on the probability of living in a female headed household for girls and boys alike. This could be a source of concern for my identification strategy if female household heads happen to be more prone to investing in their children's education than their male counterparts. To assess the extent of the problem, I re-estimate the regressions from Table 2 after restricting my sample to the children who live in a male headed household in both waves of PSF. The results are displayed in Appendix Table C.14. The effects observed in the main sample of interest are robust to this test and, if anything, statistically more significant. This rules out the possibility that the effect of elderly death shocks on girls' schooling are entirely driven by children who end up living in a female headed household after the death of an elderly relative.

Finally, Table 6 column 9 shows that exposure to the shock associated with the death of an old age household member does not increase the probability that the child was fostered out to a household other than his parents' household at the time of the wave 2 survey. A statistically significant effect of the treatment on this outcome would have questioned the role of changes in demand for informal caregiving as the main mechanism explaining my results because previous research has shown that changes in household structure, and in particular the fostering of children out of their parents' household, could be associated with improvements in school enrollment and educational attainment in the context of West Africa (Akresh 2004).

5 Robustness and additional analyses

5.1 Selection bias

To address potential concerns regarding sample selection, I estimate Equation 1 for the key ouctomes of interest after extending the analytical sample to the categories of children which were initially excluded from the analysis. First, I extend the sample to children who were not enrolled in school at baseline but were living with an elderly relative. The results presented in Appendix Table C.15 are very similar to the main results with statistically significant effects on the main coefficient of interest for the number of years of education completed, for the number of hours of caregiving per week and for the probability to be conducting more than 15 hours of caregiving per week. The sign and magnitude of these effects are comparable to what I find in

Tables 2 and 3. The conclusions of the analysis are therefore unchanged when the children whose relative's needs were important enough to prevent enrollment as of wave 1 are also considered. In Table C.16, I further extend the sample to include all panel children aged 6-17 with complete data, including those who were not living with an elderly person at baseline. The results are again robust to this change of sample definition, which allows me to completely rule out the fact that the paper's main findings are driven by the choice to focus on a particular sub-sample of children.

5.2 Missing data

As previously mentioned, there is approximately 10% attrition in the analytical sample and a similar proportion of missing data for educational attainment. This could bias my results if missing educational attainment data are not random and happen to be correlated with unobserved predictors of education and with the death shocks. In Appendix Table C.17, I show that the differential attrition rate between observations from households in which an elderly death occurred between waves and observations from control households is only 0.9%. Despite the absence of differential attrition, selection into attrition could nevertheless introduce bias in my analysis.

To assess the extent of this issue, I estimate a Heckman selection model which corrects for the potential bias from non-random missing values (Heckman 1979). In the first step, I estimate the probability of attrition and missing data on the ouctome variables in any of the two survey waves using a probit. This probit model uses two sets of excluded variables. First, PSF data collection took place over relatively long time periods and data quality likely varied from month to month during each survey wave. Seasonal factors such as rainy seasons or summer vacation periods could have affected the data collection process for instance. So, I use a series of dummies for the month and year in which the household was interviewed as excluded variables. Second, I follow De Vreyer and Nilsson (2019) and also include a series of dummies indicating the identity of the supervisor in charge of the team which tracked and interviewed the household. This second set of excluded variables exploits idiosyncratic differences in skills between supervisors to account for missing values. Overall, both sets of excluded variables are likely to be good predictors of missing data while being uncorrelated with unobserved predictors of the outcome of interest.

The first stage results (not shown) suggest that the sets of excluded variables predict missing outcomes relatively well (χ^2 comprised between 50 and 80, p-values ranging from 0.0001 to 0.002). The second step of the model is estimated in first differences to remove the fixed effects as suggested in Wooldridge (2010). The second step results are presented in Table C.18. The coefficient on the inverse Mills ratio is statistically significant for school enrollment, the extensive margin of caregiving and the caregiving index, suggesting that missing values are indeed non-random. The corrected coefficients on death shock x female are generally similar to those presented in my main analysis, with statistically significant coefficients for educational attainment, the education index, high caregiving hours, and the caregiving index. Correcting for non-random missing data therefore leaves the initial findings essentially unchanged regarding the impact of elderly death shocks on girls educational attainment.

5.3 Alternative treatment definitions

The somewhat arbitrary age limit used to define the elderly population category is another area of potential concern. Note that modifying this definition affects both the boundaries of the sub-sample of interest and the treatment itself. To assess the robustness of the results to alternative definitions of the elderly age group, I replicate my analysis with two different age limits. Panel A of Appendix Table C.19 presents the results from estimating my main model for the sample of children who resided with an adult aged 58 or more at baseline. The definition of the death shock is also modified to include all deaths of household members aged 58 or more between PSF wave 1 and PSF wave 2. This change of definition increases the number of individuals in the sample by 7% and the number of treated children by 3%. In panel B of Table C.19, the sample is restricted to the children who resided with an adult aged 62 or more at baseline and the definition of the treatment is modified accordingly. This reduces the sample size by 13% and the number of treated children by 7%. The results remain very similar to the main findings presented in Tables 2 and 3.

5.4 Spillovers

Intra-household spillovers are a well-known threat to identification in the case of approaches which compare female and male children within the same households. In the present situation, the estimated coefficients for the impact of elderly deaths on girls' education could be biased upwards if the fact that girls tend to attend school more regularly leads boys to reduce their own school hours. From a theoretical perspective however, there are few reasons to think that such spillovers are at play.

First, human capital investment theory suggests that parents will tend to invest more in the education of the children with the highest returns to education in a context of resource and credit constraints. This is the sibling rivalry theory which predicts that male childrens education tends to get priority when there is pro-male bias in returns as is most likely the case in Senegal (Garg and Morduch 1998). It therefore seems unlikely that treated households would keep their daughters in school at the expense of their sons' education. The fact that the non-interacted coefficients on the death shock in my DDD specification in Table 2 are close to zero and statistically insignificant supports this line of thought[20].

Second, considering that girls tend to specialize in domestic work, negative spillover effects on boys would most likely occur if the treatment led female children to reduce their domestic work hours in order to attend school. As mentioned before, the results presented in Table 6 for domestic work ouctomes do not point to a clear negative effect of elderly adult deaths on these outcomes among treated girls. This questions the plausibility of a negative spillover effect through that channel.

Finally, the existing empirical literature in the economics of education tends to point towards positive rather than negative spillovers on boys from interventions aimed at increasing girls' school attendance (Kim, Alderman, and Orazem 1999; Kazianga, Walque, and Alderman 2012; Kazianga et al. 2013). If such positive spillovers were at play in the case of elderly death shocks, the above analysis would be underestimating the positive impact of the shocks on girls' school enrollment and educational attainment[21].

5.5 Implications for literacy skills in adulthood

The findings of this paper suggest that informal caregiving displaces schooling for the most intensive caregivers and causes them to drop out of school, to attend school less frequently, or to learn less than they would have done in the absence of caregiving duties. This caregiving penalty seems to affect teenage girls in particular. Do the months of education lost by the girls who resided with an elderly adult throughout the study period make a difference in terms of actual skill retention in early adulthood? To provide suggestive evidence on this matter, I

20. In Appendix Table C.6 I also estimate the treatment effects separately for the male sub-sample using a difference-in-difference specification with inverse propensity weights. This confirms that treatment effects are relatively precise zeros.

21. There is also no clear evidence of spillover effects between girls of different birth ranks in the study sample as shown in Appendix Table C.11.

estimate the marginal effect of an extra year of education at the PSF wave 2 sample mean[22] on reading skills, newspaper reading habits, internet usage and mobile money usage among female respondents aged 18 to 30 in the Senegal Demographic and Health Survey (DHS) 2019 (Agence Nationale de la Statistique et de la Démographie and The DHS Program - ICF 2020). The comparison uses entropy balancing to address potential bias from self-selection into longer school curricula (Hainmueller 2012). The procedure balances the two groups on the first, second, and third moments of the following covariates: age, ethnicity dummies, urban area of residence, region of residence dummies, and the DHS wealth index[23].

The comparison shows that respondents who have completed 7 years of education instead of 6 are 34 percentage points more likely to be able to read full sentences and 10 percentage points more likely to occasionally read the newspapers (Appendix Figure D.1). The coefficients are not significant for internet usage and mobile money usage although they are also positive. Thus, it seems that relatively small marginal increases in educational attainment have non-trivial implications in terms of retained skills in early adulthood in the Senegalese context[24]. In other words, sacrificing a few months of schooling to attend to the needs of a sick or elderly relative might involve sacrificing part of one's future capabilities as an adult for the teenage girls who do so.

6 Conclusion

In this article, I document the involvement of children, and especially girls, in the provision of informal caregiving to their relatives in the context of Senegal. I also evaluate the effect of co-residence with elderly individuals and the associated caregiving responsibilities on the educational attainment of female children. I find that more than one in five girls in the age range 6-17 had some caring responsibilities in 2006-2007. This burden did not account for a very large share of their time: young female caregivers dedicated 8 hours per week to this task on average. However, my results suggest that having an elderly co-resident affected the educational outcomes of these young caregiver significantly.

To identify this impact, I exploit the deaths of elderly co-residents which occur during my

22. Female respondents in the control group had 6 years of education on average when interviewed for PSF 2.
23. See Appendix D for a more detailed presentation of the procedure.
24. Assuming a linear relationship between educational attainment and literacy, the 0.6 years of extra education completed by bereaved schoolgirls in my sample of interest would increase the probability of being a fluent reader at adult age by 20 percentage points.

study period and find that the schoolgirls who were affected by the death of an elderly household member between 2007 and 2010 completed approximately 0.6 years of additional education compared to girls who still resided with an elderly adult at the end of this period. I also find a direct effect of elderly death shocks on the intensive margin of caregiving: the proportion of bereaved girls dedicating more than 15 hours per week to caregiving tasks decreased significantly relative to the control as a result of the shock. The effects on both schooling and caregiving outcomes are driven by adolescent girls, whose involvement in caregiving tasks is well-documented in the literature on informal caregiving arrangements in Senegal. I provide evidence that changes in demand for caregiving are likely to be one of the mechanisms through which elderly deaths impact education. In particular, I show that deaths of less productive - and therefore most likely less autonomous - individuals seem to be driving the effects on educational attainment.

These results need to be interpreted with caution given the self-reported nature of the time-use variables and the fact that the main identifying assumption of difference-in-difference designs cannot be tested directly with the available data. Nevertheless, taken together, the descriptive and analytical results call for greater policy attention to gender inequalities in elderly care work, as well as in other forms of care work such as household childcare. In Senegal, and in many other sub-Saharan African countries, female children work significantly more than their male counterparts when all forms of labor are taken into account, including domestic work and informal caregiving. It will be difficult to close the gender gap in education if this imbalance is not addressed. In particular, it appears that the lack of formal caregiving services in many sub-Saharan African countries increases the demand for female child labor and pushes many girls to leave school prematurely. Investing in public and private forms of formal elderly care and childcare could reduce that burden, and, in doing so, would improve the long-term welfare of African populations. This study also shows that gender norms influencing the organization of home production activities within the household have implications for gender inequalities in education. Further research is needed to assess how interventions aimed at reshaping these norms affect women's education and job market outcomes in developing countries.

Acknowledgements

I am grateful to the Poverty and Family Structure (PSF) research team at the Paris School of Economics and Paris Dauphine University, and in particular to Sylvie Lambert and Philippe

De Vreyer, for giving me access to the PSF database. The paper was inspired by discussions with Kenneth Houngbedji and Jean-Noël Senne. I would also like to thank Tanguy Bernard, Philippe De Vreyer, Véronique Gille, Jessica Goldberg, Michael Grimm, Elise Huillery, Sylvie Lambert, Stéphanie Monjon, Björn Nilsson, Rajesh Ramachandran, Marine de Talancé, and participants at ADRES, the AFEDEV International Conference in Development Economics, the Paris-Dauphine DIAL seminar, the Nordic Conference in Development Economics, and the 35th Journées de Microéconomie Appliquée for comments on earlier versions of this paper.

Funding sources

The author acknowledges financial support from ANRT under a Cifre doctoral grant.

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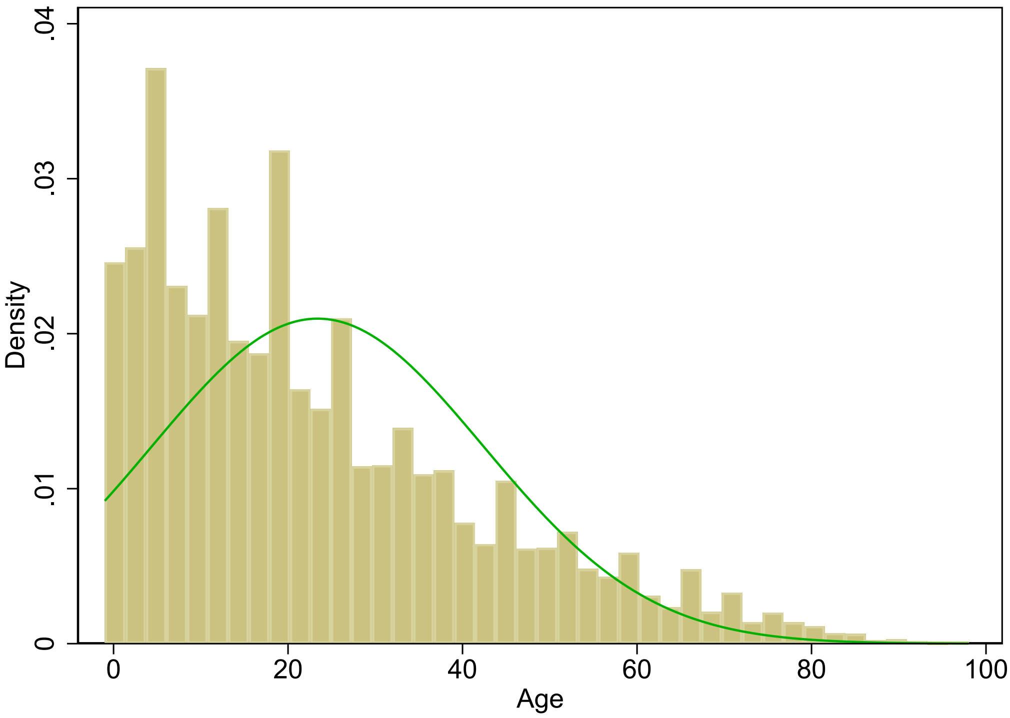
Appendix A - Design of the Poverty and Family Structure survey

The PSF survey uses a standard two-stage cluster sampling strategy: 150 districts were randomly drawn from the map of Senegals census districts and 12 households were then randomly selected in each district. A specific feature of this survey is that 220 secondary households were added to the baseline household. These are the households in which non-resident spouses of the 1,800 primary household heads happened to be living at the time of the survey. These households were included in the sample because one of the goals of the research team which designed the survey was to study the intra-household allocation of resources in Senegal, accounting for the complex structure of polygamous households (see De Vreyer and Lambert 2021). Although this paper has a different focus, my analysis includes the individuals who belong to these secondary households to ensure that children living in polygamous households are not underrepresented in the sample. All wave 1 household members were tracked individually at wave 2, including those who had migrated to a different region of Senegal. A tracking sheet was filled out for each individual. It included a question on the survival status of the participant. This question was answered either directly by the surviving individuals or indirectly by other wave 1 household members for deceased individuals.

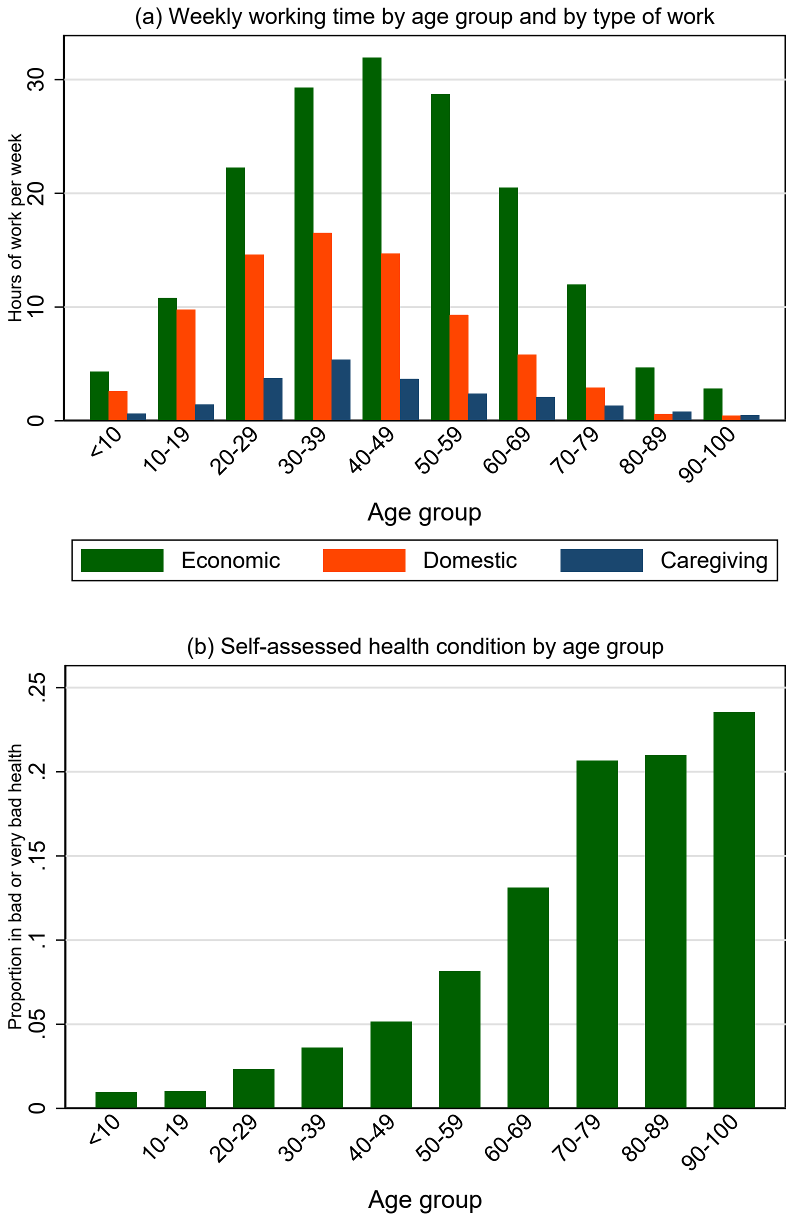
Appendix B - Supplementary figures

Figure B.1: Age distribution of the baseline sample (PSF Wave 1)



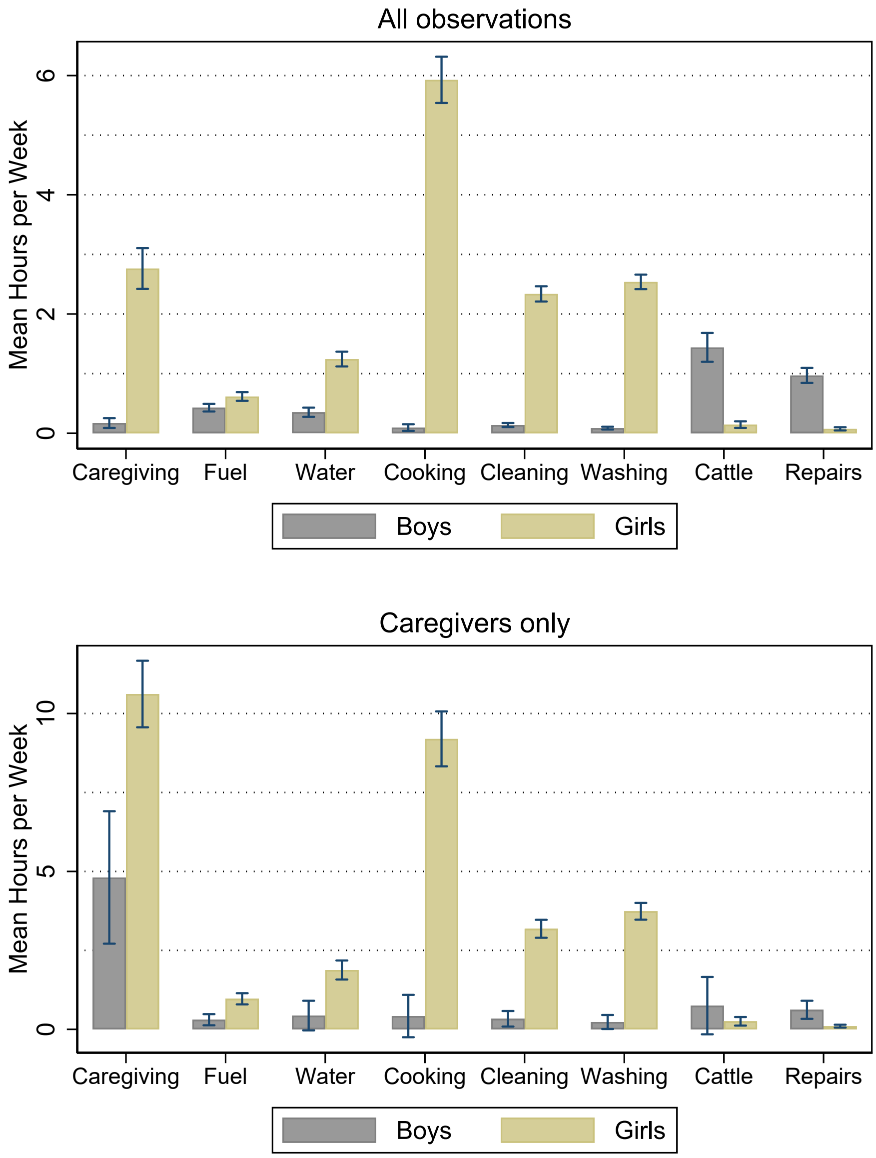
Source: PSF Survey, wave 1. Sample : All observations. Author's calculations.

Figure B.2: Productive time and self-reported health among wave 1 respondents



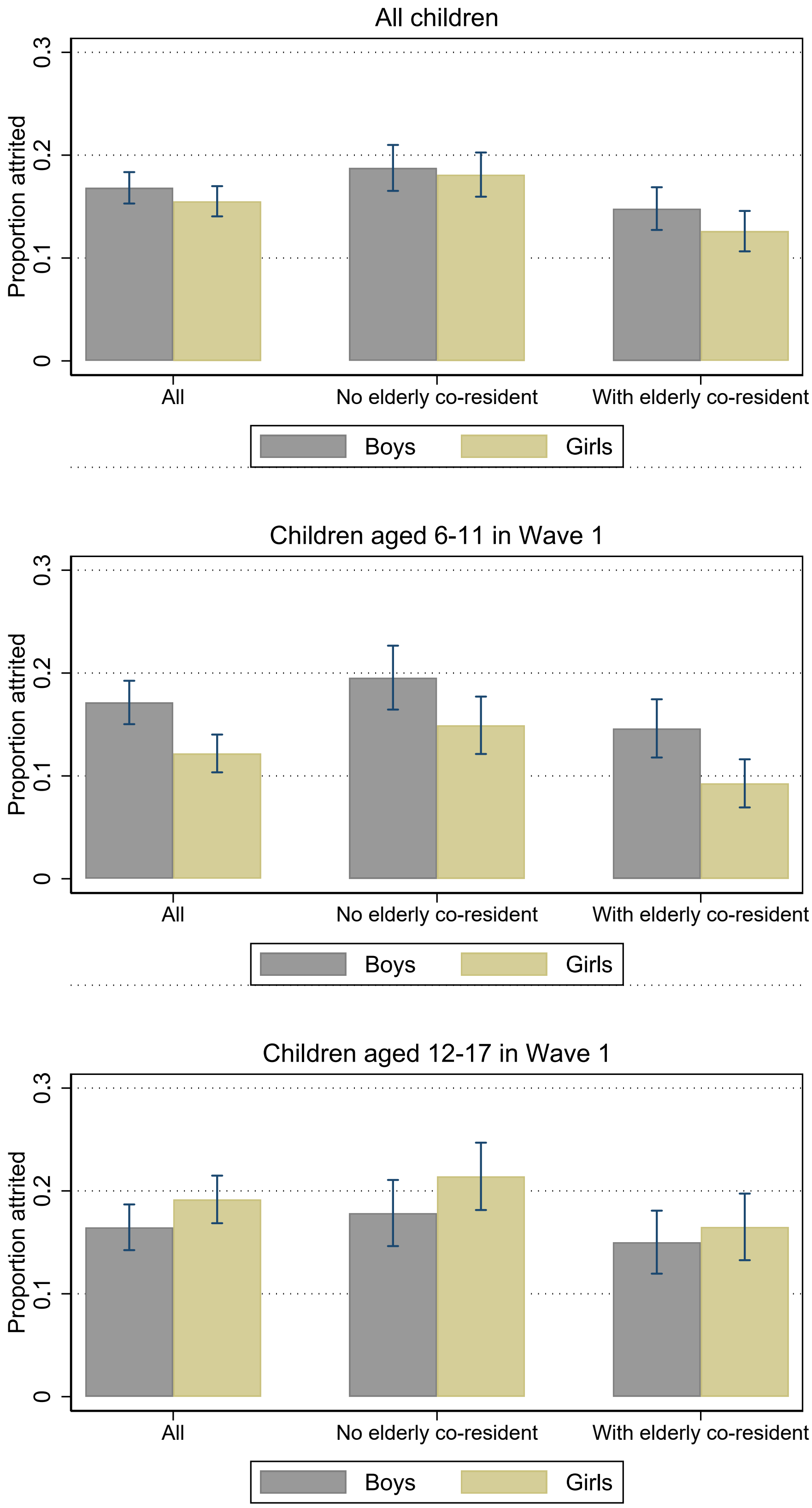
Source: Author's calculations using PSF Survey, wave 1. Sample: All wave 1 observations (panel and attrited).

Figure B.3: Time dedicated to caregiving and other domestic work by task in Wave 2



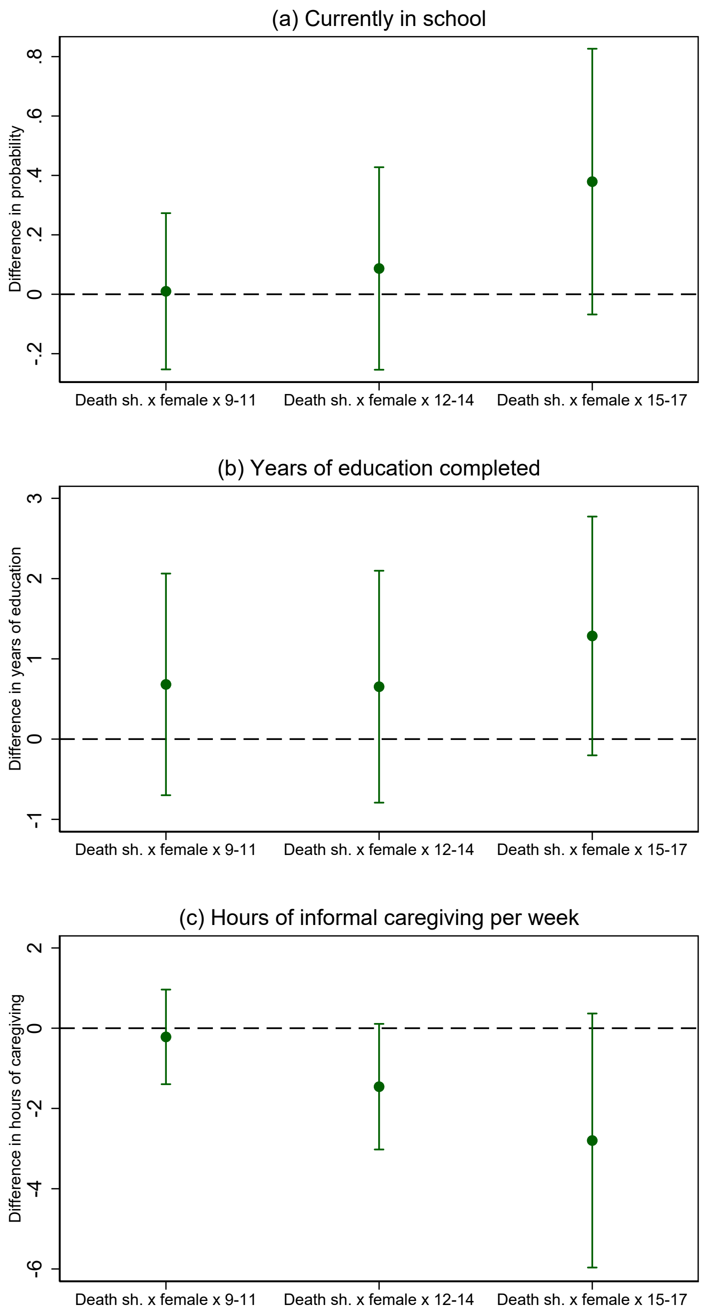
Source: PSF Survey, wave 2. Sample: panel individuals aged 6-17 in wave 1 of PSF. Vertical spikes indicate 95% confidence intervals.

Figure B.4: Attrition rates in the sample of children aged 6-17 in wave 1



Source: PSF Survey, waves 1 and 2. Sample: individuals aged 6-17 in wave 1 of PSF. Vertical spikes indicate 95% confidence intervals.

Figure B.5: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - By age group



Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Each plot presents coefficients on a triple interaction term of the form "death shock x female x age group" from a single inverse propensity score weighted WLS regressions with individual fixed-effects. The age group 6-8 is used as the reference group. A linear probability model is used in panel (a). Vertical spikes indicate 95% confidence intervals computed from standard errors allowing for clustering at the household level.

Appendix C - Supplementary tables

Table C.1: Descriptive statistics (children aged 6-17 in wave 1, panel observations)

	Wave 1 (2006-7)		Wave 2 (2010-12)	
	Mean	SD	Mean	SD
Panel A: Girls				
Age	11.1	3.44	15.5	3.62
Schooling outcomes				
Ever went to school [yes=1]	0.64	0.48	0.76	0.43
Currently in school [yes=1]	0.57	0.50	0.55	0.50
Years of education completed	1.91	2.43	4	3.38
Completed primary school [yes=1]	0.098	0.30	0.31	0.46
Child labor				
Ever worked (market work) [yes=1]	0.21	0.41	0.39	0.49
Working (market work) [yes=1]	0.17	0.38	0.24	0.43
Currently doing domestic work [yes=1]	0.65	0.48	0.82	0.38
Currently doing caregiving work [yes=1]	0.21	0.41	0.26	0.44
Hours of economic work per week	5.42	14.9	8.38	16.4
Hours of domestic work per week	9.58	14.5	13.4	15.0
Hours of caregiving per week	1.73	4.52	2.66	7.55
Observations	1806		1806	
Panel B: Boys				
Age	11.2	3.43	15.5	3.52
Schooling outcomes				
Ever went to school [yes=1]	0.68	0.46	0.80	0.40
Currently in school [yes=1]	0.62	0.49	0.59	0.49
Years of education completed	2.18	2.58	4.46	3.44
Completed primary school [yes=1]	0.12	0.33	0.37	0.48
Child labor				
Ever worked (market work) [yes=1]	0.36	0.48	0.57	0.49
Working (market work) [yes=1]	0.31	0.46	0.45	0.50
Currently doing domestic work [yes=1]	0.41	0.49	0.45	0.50
Currently doing caregiving work [yes=1]	0.056	0.23	0.035	0.18
Hours of economic work per week	9.71	20.3	19.6	26.2
Hours of domestic work per week	4.12	9.98	4.05	10.3
Hours of caregiving per week	0.28	1.64	0.15	1.65
Observations	1750		1750	

Source: PSF Survey, waves 1 and 2. Sample : Children aged 6-17 in wave 1. Author's calculations.

Table C.2: Co-residence with household members aged 60 or more in wave 1 by sex - Children aged 6-17

	All		In school		Girls in school		Boys in school	
Status of elderly coresident:	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Deceased or alive at wave 2:								
Any elderly member	1757	49.41	1005	28.26	487	13.70	518	14.57
Elderly household head	1088	30.60	646	18.17	312	8.77	334	9.39
Eldery woman	1061	29.84	658	18.50	321	9.03	337	9.48
Elderly man	1032	29.02	585	16.45	285	8.01	300	8.44
Deceased between wave 1 and wave 2:								
Any elderly member	337	9.48	217	6.10	103	2.90	114	3.21
Elderly household head	151	4.25	100	2.81	45	1.27	55	1.55
Eldery woman	151	4.25	95	2.67	46	1.29	49	1.38
Elderly man	189	5.31	122	3.43	57	1.60	65	1.83
Observations	3556		2115		1032		1083	

Source: PSF Survey, wave 1 and wave 2. Author's calculations. Sample: Children aged 6-17 in wave 1 (panel observations only). Percentages correspond to the share of the total sample (3906 observations).

Table C.3: Baseline characteristics - analytical sample vs. other children aged 6-17 in wave 1 (panel observations)

	Analytical sample (A)	Other children (O)	Difference (A - O)	S.E.
Panel A: Girls				
Age	10.7	11.3	-0.62***	(0.17)
Married [yes=1]	0	0.040	-0.040***	(0.0057)
Years of education completed	2.95	1.54	1.41***	(0.14)
Completed primary school [yes=1]	0.14	0.084	0.054***	(0.019)
Ever worked (market work) [yes=1]	0.12	0.25	-0.13***	(0.025)
Working (market work) [yes=1]	0.084	0.20	-0.12***	(0.021)
Any domestic work [yes=1]	0.58	0.67	-0.098***	(0.030)
Any caregiving work [yes=1]	0.15	0.23	-0.076***	(0.023)
Hours of economic work /week	1.75	6.78	-5.03***	(0.74)
Hours of domestic work /week	6.10	10.9	-4.78***	(0.74)
Hours of caregiving /week	1.02	1.99	-0.98***	(0.21)
Urban [yes=1]	0.52	0.44	0.075*	(0.039)
Household size	14.8	11.0	3.74***	(0.56)
Female headed household [yes=1]	0.22	0.22	-0.0024	(0.032)
Head has some education [yes=1]	0.29	0.26	0.032	(0.034)
Years of education of household head	2.37	1.95	0.42	(0.32)
Observations	487	1319		
Panel B: Boys				
Age	11.3	11.2	0.089	(0.18)
Married [yes=1]	0	0.00082	-0.00082	(0.00082)
Years of education completed	3.21	1.77	1.44***	(0.15)
Completed primary school [yes=1]	0.18	0.10	0.079***	(0.021)
Ever worked (market work) [yes=1]	0.26	0.41	-0.15***	(0.031)
Working (market work) [yes=1]	0.19	0.36	-0.17***	(0.029)
Any domestic work [yes=1]	0.35	0.44	-0.097***	(0.031)
Any caregiving work [yes=1]	0.050	0.058	-0.0082	(0.014)
Hours of economic work /week	3.57	12.3	-8.72***	(1.08)
Hours of domestic work /week	2.53	4.80	-2.27***	(0.56)
Hours of caregiving /week	0.24	0.29	-0.053	(0.084)
Urban [yes=1]	0.47	0.46	0.016	(0.038)
Household size	14.9	11.1	3.75***	(0.69)
Female headed household [yes=1]	0.18	0.20	-0.014	(0.030)
Head has some education [yes=1]	0.32	0.30	0.015	(0.037)
Years of education of household head	2.38	2.28	0.10	(0.32)
Observations	518	1232		

Source: PSF Survey, wave 1. Author's calculations. Sample: Children aged 6-17 (panel observations only). Notes: Analytical sample includes children aged 6-17 who co-resided with an elderly individual and were enrolled in school in wave 1. Other children include all panel children who did not satisfy these two conditions and were aged 6-17 in wave 1. The standard errors on the differences are estimated from running the corresponding least squares regression allowing for the errors to be clustered by household. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.4: Baseline characteristics by treatment status with standardized differences

	Raw means			IP-weighted means	
	Treated (1)	Control (2)	Standardized Diff. (1-2) (3)	Control (4)	Standardized Diff. (1-4) (5)
Panel A: Girls					
Age	10.57	10.69	-0.50	10.69	-0.36
	(0.29)	(0.16)		(0.34)	
Years of education completed	2.52	3.05	-2.75	2.58	-0.28
	(0.24)	(0.12)		(0.21)	
Hours of economic work /week	0.56	2.07	-3.83	0.81	-0.84
	(0.34)	(0.44)		(0.23)	
Hours of domestic work /week	5.36	6.42	-1.30	6.20	-0.77
	(1.00)	(0.58)		(1.17)	
Hours of caregiving /week	1.50	0.89	1.99	1.23	0.69
	(0.41)	(0.16)		(0.37)	
Household size	15.84	14.48	2.24	14.45	2.09
	(0.79)	(0.36)		(0.52)	
Years of education of household head	2.33	2.38	-0.14	1.93	0.99
	(0.43)	(0.21)		(0.36)	
Age of elderly co-resident	73.36	68.58	8.56	72.67	0.98
	(0.72)	(0.33)		(0.69)	
Productivity of elderly (hrs/week)	14.16	21.25	-3.94	15.38	-0.65
	(1.99)	(1.58)		(1.76)	
Observations	103	384	487	384	487
Panel B: Boys					
Age	11.98	11.08	3.68	12.04	-0.19
	(0.31)	(0.16)		(0.25)	
Years of education completed	3.78	3.07	3.65	3.82	-0.18
	(0.25)	(0.12)		(0.22)	
Hours of economic work /week	1.93	4.04	-3.65	1.97	-0.09
	(0.51)	(0.64)		(0.45)	
Hours of domestic work /week	1.90	2.78	-2.24	2.11	-0.54
	(0.39)	(0.39)		(0.37)	
Hours of caregiving /week	0.38	0.20	1.34	0.26	0.81
	(0.17)	(0.07)		(0.11)	
Household size	16.41	14.45	2.97	14.64	2.57
	(0.86)	(0.35)		(0.45)	
Years of education of household head	2.48	2.35	0.43	2.31	0.47
	(0.40)	(0.20)		(0.32)	
Age of elderly co-resident	71.30	68.56	5.80	71.49	-0.34
	(0.59)	(0.31)		(0.53)	
Productivity of elderly (hrs/week)	16.01	22.06	-3.10	16.52	-0.27
	(2.27)	(1.57)		(1.55)	
Observations	114	404	518	404	518

Source: PSF Survey, wave 1. Author's calculations. Sample: Children aged 6-17 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Treated individuals are the children who experienced the death of a household member aged 60+ between waves. Column 4 reports inverse propensity score reweighted means (Hirano and Imbens 2001; Brunell and DiNardo 2004) for the control group. Standardized differences (Imbens and Rubin 2015) are reported in columns 3 and 5. Missing observations are imputed using multivariate normal multiple imputation (Schafer 1997) for the variables years of education completed and hours of domestic work per week.

Table C.5: Difference-in-difference (DiD) estimates of the impact of the death shock on girls' schooling and caregiving outcomes - Child fixed effects

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Any caregiving	(5) Hrs caregiving per week	(6) Caregiving >15h / week
Death shock	0.10*	0.64**	0.19***	-0.100	-0.90	-0.038**
	(0.060)	(0.26)	(0.069)	(0.084)	(0.76)	(0.019)
2nd wave	-0.23***	2.81***	0.28***	0.051	0.12	0.0093
	(0.050)	(0.14)	(0.043)	(0.069)	(0.56)	(0.0092)
Constant	1***	2.51***	0.11***	0.19***	1.30***	0.012***
	(0.019)	(0.059)	(0.017)	(0.027)	(0.22)	(0.0040)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	974	862	862	974	974	974
Number of individuals	487	431	431	487	487	487
Adjusted R-squared	0.21	0.79	0.34	0.0066	0.0041	0.0087

Source: PSF Survey, waves 1 and 2. Sample: Female children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from inverse propensity score weighted WLS regressions with individual fixed-effects (linear probability model in columns 1, 3, 4 and 6). Standard errors allowing for clustering at the household level between parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.6: Difference-in-difference (DiD) estimates of the impact of the death shock on boys' schooling and caregiving outcomes - Child fixed effects

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Any caregiving	(5) Hrs caregiving per week	(6) Caregiving >15h / week
Death shock	-0.014	0.028	0.022	-0.044	-0.16	-0.00013
	(0.053)	(0.21)	(0.059)	(0.051)	(0.21)	(0.00098)
2nd wave	-0.21***	2.86***	0.35***	-0.026	-0.17	0.00013
	(0.031)	(0.15)	(0.038)	(0.028)	(0.11)	(0.00098)
Constant	1.00***	3.80***	0.27***	0.074***	0.29***	0.00048
	(0.013)	(0.059)	(0.015)	(0.012)	(0.047)	(0.00038)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	1036	926	926	1036	1036	1036
Number of individuals	518	463	463	518	518	518
Adjusted R-squared	0.21	0.79	0.35	0.015	0.016	-0.0019

Source: PSF Survey, waves 1 and 2. Sample: Male children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from inverse propensity score weighted WLS regressions with individual fixed-effects (linear probability model in columns 1, 3, 4 and 6). Standard errors allowing for clustering at the household level between parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.7: Triple difference (DDD) estimates of the impact of the death shock on indices of schooling and caregiving outcomes - Child fixed effects

	Education index		Caregiving index	
	(1)	(2)	(3)	(4)
Death shock x female	0.34**	0.41***	-0.35*	-0.39*
	(0.14)	(0.16)	(0.21)	(0.23)
Death shock	0.0023	-0.0016	-0.13	-0.087
	(0.091)	(0.11)	(0.097)	(0.11)
Female x 2nd wave	-0.022	-0.096	0.19*	0.23
	(0.066)	(0.099)	(0.11)	(0.15)
2nd wave	1.04***	1.04***	-0.0046	-0.044
	(0.049)	(0.073)	(0.042)	(0.061)
Constant	5.6e-16	0.063**	1.7e-18	0.029
	(0.017)	(0.026)	(0.025)	(0.031)
IP-weights	NO	YES	NO	YES
Observations	1788	1788	2010	2010
Number of individuals	894	894	1005	1005
Adjusted R-squared	0.61	0.62	0.011	0.013
Romano-Wolf P-values on death shock x female	0.015	0.0090	0.060	0.069
P-value death shock + death shock x female = 0	0.0062	0.0045	0.017	0.030

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Standardized weighted outcomes are constructed using the method proposed in Anderson (2008) as implemented in Stata by Schwab et al. (2020). The education index combines the variables: currently in school, years of education and completed primary school. The caregiving index includes the variables: any caregiving, hours of caregiving per week and the indicator variable for weekly hours of caregiving exceeding 15 hours. Results from OLS regressions with individual fixed-effects in odd columns. Even columns report results from inverse propensity score weighted WLS regressions with individual fixed-effects. Standard errors allowing for clustering at the household level between parentheses. Stepdown adjusted p-values controlling the familywise error rate (FWER) and accounting for the joint dependence structure of the hypothesis tests are shown in the row titled ”Romano-Wolf P-values on death shock x female” (Romano and Wolf 2016; Clarke, Romano, and Wolf 2020, 1,000 bootstrap replications). *** p<0.01, ** p<0.05, * p<0.1

Table C.8: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - Marginal effects from first-differenced logit and generalized ordered logit models

	Currently in school		Completed primary school		Any caregiving		Caregiving time >15 hours/week	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Death shock x female	0.107	0.130	0.095	0.159^{*}				
	(0.071)	(0.086)	(0.073)	(0.085)				
Reduced outcome					-0.036	-0.041	0.141^{***}	0.084^{**}
					(0.045)	(0.067)	(0.049)	(0.036)
Unchanged outcome					0.059	0.064	-0.126^{**}	-0.066^{*}
					(0.077)	(0.095)	(0.051)	(0.038)
Increased outcome					-0.023	-0.023	-0.015	-0.018
					(0.068)	(0.077)	(0.011)	(0.012)
Death shock	-0.011	-0.013	0.010	0.021				
	(0.045)	(0.051)	(0.052)	(0.056)				
Reduced outcome					0.061	0.033	-0.134^{***}	-0.076^{**}
					(0.040)	(0.057)	(0.047)	(0.032)
Unchanged outcome					-0.013	0.024	0.252^{***}	0.155^{***}
					(0.071)	(0.084)	(0.069)	(0.048)
Increased outcome					-0.048	-0.057	-0.118^{**}	-0.078^{**}
					(0.060)	(0.065)	(0.052)	(0.036)
Female x 2nd wave	-0.000	-0.022	-0.006	-0.075				
	(0.030)	(0.052)	(0.039)	(0.063)				
Reduced outcome					0.063^{***}	0.077^{*}	0.015	0.015
					(0.022)	(0.043)	(0.011)	(0.010)
Unchanged outcome					-0.206^{***}	-0.223^{***}	-0.030^{*}	-0.034^{**}
					(0.033)	(0.059)	(0.016)	(0.016)
Increased outcome					0.142^{***}	0.145^{***}	0.016	0.019
					(0.027)	(0.051)	(0.012)	(0.012)
IP-weights	NO	YES	NO	YES	NO	YES	NO	YES
Observations	1005	1005	894	894	1005	1005	1005	1005

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Marginal effects computed following first-differenced logit estimation in columns 1-4 and generalized ordered logit estimation in columns 5-8. In columns 1 and 2, the dependent variable is $\Delta y_i + 1$, the 1st difference of children's school enrollment plus 1. This variable takes the value 0 for children who dropped out of school between PSF wave 1 and wave 2 (first difference of school enrollment status equal to -1) and 1 for children who were still enrolled in school in wave 2 (first difference of school enrollment status equal to 0). The coefficients on the independent variables can thus be interpreted as the variable's effect on the probability to be enrolled in school in wave 2. For generalized ordered logit models (columns 5-8), I report marginal effects of the independent variables on the probability that the first-difference of the binary outcome variable is equal to -1 ("reduced outcome"), 0 ("unchanged outcome"), or 1 ("increased outcome"). Even columns report inverse propensity score weighted results. Standard errors computed with the delta method. *** p<0.01, ** p<0.05, * p<0.1

Table C.9: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - By polygamous status of the household head

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Any caregiving	(5) Hrs of caregiving per week	(6) Caregiving time >15 hours/week
Panel A: Head of wave 1 household is polygamous						
Death shock x female	0.226*	0.672	0.117	-0.050	-0.748	-0.051**
	(0.122)	(0.434)	(0.138)	(0.150)	(1.192)	(0.024)
Death shock	-0.099	0.044	0.093	-0.111	-0.460	-0.000
	(0.087)	(0.396)	(0.096)	(0.078)	(0.295)	(0.002)
Female x 2nd wave	-0.090	0.079	-0.064	0.107	0.489	0.022*
	(0.085)	(0.300)	(0.096)	(0.107)	(0.924)	(0.012)
Constant	-0.171***	2.736***	0.307***	-0.005	-0.002	0.000
	(0.049)	(0.297)	(0.065)	(0.021)	(0.056)	(0.002)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	433	386	386	433	433	433
Adjusted R-squared	0.010	0.021	0.020	0.024	0.005	0.014
Panel B: Head of wave 1 household is non-polygamous						
Death shock x female	0.014	0.444	0.195*	-0.021	-0.597	-0.020
	(0.088)	(0.338)	(0.113)	(0.105)	(0.846)	(0.032)
Death shock	0.056	0.032	-0.034	0.011	0.078	-0.000
	(0.061)	(0.203)	(0.072)	(0.065)	(0.285)	(0.000)
Female x 2nd wave	0.049	-0.137	-0.056	0.025	-0.092	-0.009
	(0.054)	(0.192)	(0.075)	(0.082)	(0.416)	(0.014)
Constant	-0.233***	2.951***	0.378***	-0.043	-0.303	0.000***
	(0.039)	(0.158)	(0.047)	(0.047)	(0.187)	(0.000)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	572	508	508	572	572	572
Adjusted R-squared	0.003	0.002	0.002	-0.005	-0.002	0.001
P-value for test of equality	0.157	0.678	0.660	0.873	0.917	0.426

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from first-differenced inverse propensity score weighted WLS regressions. Linear probability models are used in columns 1, 3, 4, and 6. The last row of the table reports p-values from a test of equality of the coefficients on Death shock x female in panels A and B. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.10: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - By spousal rank of the cell head

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Any caregiving	(5) Hrs of caregiving per week	(6) Caregiving time >15 hours/week
Panel A: Children living with a co-wife of rank >1						
Death shock x female	0.272	1.468*	0.396**	0.029	-0.779	-0.032
	(0.222)	(0.747)	(0.181)	(0.262)	(1.533)	(0.025)
Death shock	-0.078	0.152	0.026	-0.200	-0.547	-0.000***
	(0.131)	(0.554)	(0.128)	(0.152)	(0.432)	(0.000)
Female x 2nd wave	-0.164	-0.052	-0.113	0.245	2.320*	0.032
	(0.179)	(0.361)	(0.107)	(0.194)	(1.230)	(0.025)
Constant	-0.230***	2.386***	0.282***	0.046	0.085	0.000
	(0.084)	(0.309)	(0.078)	(0.058)	(0.086)	(.)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	170	156	156	170	170	170
Adjusted R-squared	0.015	0.081	0.076	0.070	0.085	0.002
Panel B: Other children						
Death shock x female	0.091	0.374	0.101	-0.076	-0.824	-0.042*
	(0.076)	(0.293)	(0.101)	(0.086)	(0.819)	(0.024)
Death shock	-0.008	-0.028	0.016	-0.016	-0.087	-0.000
	(0.058)	(0.213)	(0.063)	(0.048)	(0.230)	(0.001)
Female x 2nd wave	0.014	-0.009	-0.055	0.033	-0.244	0.003
	(0.047)	(0.196)	(0.073)	(0.067)	(0.551)	(0.010)
Constant	-0.200***	2.965***	0.363***	-0.044	-0.230*	0.000
	(0.033)	(0.165)	(0.042)	(0.031)	(0.132)	(0.001)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	835	738	738	835	835	835
Adjusted R-squared	0.002	0.002	0.002	0.001	0.005	0.009
P-value for test of equality	0.443	0.180	0.142	0.685	0.979	0.824

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). In panel A, the sample is further restricted to children placed under the responsibility of a woman married to a polygamous husband and of spousal rank greater than one. These children are identified by splitting polygamous households in cells so that the head of household and other unaccompanied dependent members are grouped in one cell while the head's wives and their co-residing children each constitute a distinct cell as detailed in De Vreyer and Nilsson (2019). In panel B, the analytical subsample includes children living in polygamous households but whose cell head is not a co-wife of rank > 1 as well as children living in non-polygamous households. Notes: Results from first-differenced inverse propensity score weighted WLS regressions. Linear probability models are used in columns 1, 3, 4, and 6. The last row of the table reports p-values from a test of equality of the coefficients on Death shock x female in panels A and B. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.11: Triple difference (DDD) estimates of the impact of the death shock on first born girls' schooling and caregiving work

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Any caregiving	(5) Hrs caregiving per week	(6) Caregiving >15h / week
Death shock x 1st born girl	-0.11	0.27	0.016	0.020	1.11	0.0074
	(0.11)	(0.44)	(0.13)	(0.15)	(1.22)	(0.038)
Death shock	0.14^{*}	0.55^{*}	0.18^{**}	-0.11	-1.27	-0.039
	(0.082)	(0.31)	(0.088)	(0.12)	(1.07)	(0.027)
1st born girl x 2nd wave	0.044	0.071	0.0033	-0.017	-0.72	0.0027
	(0.085)	(0.23)	(0.084)	(0.13)	(0.98)	(0.017)
2nd wave	-0.25^{***}	2.79^{***}	0.28^{***}	0.055	0.31	0.0048
	(0.072)	(0.17)	(0.052)	(0.100)	(0.87)	(0.012)
Constant	1^{***}	2.50^{***}	0.11^{***}	0.19^{***}	1.32^{***}	0.012^{***}
	(0.019)	(0.060)	(0.018)	(0.027)	(0.22)	(0.0039)
IP-weights	YES	YES	YES	YES	YES	YES
Observations	962	852	852	962	962	962
Number of individuals	481	426	426	481	481	481
Adjusted R-squared	0.21	0.79	0.34	0.0040	0.0065	0.0066
P-value death shock + death sh. x 1st born = 0	0.67	0.027	0.066	0.39	0.84	0.24

Source: PSF Survey, waves 1 and 2. Sample: Female children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Individuals are classified as first born girls if the respondent reported that they were the first born female child among siblings of same mother and same father. Notes: Results from inverse propensity score weighted WLS regressions with individual fixed-effects. Linear probability models are used in columns 1, 3, 4, and 6. Standard errors allowing for clustering at the household level between parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.12: Triple difference (DDD) estimates of the impact of the death shock on girls'time dedicated to domestic tasks - Child fixed effects

	(1) Fuel collection	(2) Water fetching	(3) Cooking	(4) Cleaning	(5) Washing	(6) Cattle keeping	(7) House repairs
Death shock x female	-0.37	0.95*	0.56	0.16	-0.45	0.49	0.87
	(0.44)	(0.53)	(1.20)	(0.43)	(0.72)	(0.58)	(0.59)
Death shock	0.31	0.095	-0.097	0.17	0.17	-0.27	-0.47
	(0.33)	(0.18)	(0.11)	(0.14)	(0.11)	(0.40)	(0.38)
Female x 2nd wave	0.34	-0.19	3.36***	0.61**	1.71***	-0.035	-0.73
	(0.28)	(0.37)	(0.56)	(0.28)	(0.59)	(0.50)	(0.48)
2nd wave	-0.18	-0.016	-0.096**	-0.11	-0.047	-0.054	0.36**
	(0.25)	(0.15)	(0.045)	(0.087)	(0.072)	(0.33)	(0.17)
Constant	0.42***	0.53***	0.63***	0.65***	0.57***	0.43***	0.36***
	(0.065)	(0.086)	(0.12)	(0.060)	(0.085)	(0.057)	(0.054)
IP-weights	YES	YES	YES	YES	YES	YES	YES
Observations	1944	1944	1944	1944	1944	1944	1944
Number of individuals	972	972	972	972	972	972	972
Adjusted R-squared	0.0052	0.014	0.19	0.039	0.15	0.00055	0.019
P-val. death shock + death sh. x fem. = 0	0.85	0.048	0.70	0.45	0.68	0.44	0.27

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from inverse propensity score weighted WLS regressions with individual fixed-effects. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.13: Difference-in-difference (DiD) estimates of the impact of the death shock on girls' marriage - Child fixed effects

	(1) Married	(2) Married
Death shock	-0.030	-0.036
	(0.019)	(0.024)
2nd wave	0.050***	0.056***
	(0.013)	(0.019)
Constant	-0.000021	-0.000023
	(0.0053)	(0.0075)
IP-weights	NO	YES
Observations	970	970
Number of individuals	487	487
Adjusted R-squared	0.045	0.050

Source: PSF Survey, waves 1 and 2. Sample: Female children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from an OLS regression with individual fixed-effects in column 1 and from an inverse propensity score weighted WLS regression with individual fixed-effects in column 2. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.14: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling outcomes - Child fixed effects, restricted sample

	(1) Currently in school	(2) Years of education
Death shock x female	0.21**	0.79**
	(0.097)	(0.34)
Death shock	-0.015	0.063
	(0.066)	(0.24)
Female x 2nd wave	-0.048	-0.094
	(0.067)	(0.20)
2nd wave	-0.21***	2.78***
	(0.034)	(0.15)
Constant	1.00***	3.09***
	(0.014)	(0.047)
IP-weights	YES	YES
Observations	1376	1214
Number of individuals	688	607
Adjusted R-squared	0.23	0.80
P-val. death shock + death sh. x fem. = 0	0.0047	0.0060

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Sample further restricted to children living in male headed households in both survey waves. Notes: Results from inverse propensity score weighted WLS regressions with individual fixed-effects. Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.15: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - Child fixed effects, sample extended to children who were not enrolled in school at baseline

	(1) Currently in school	(2) Years of education	(3) Any caregiving	(4) Hrs of caregiving per week	(5) Caregiving >15h / week
Death shock x female	0.083	0.46*	-0.019	-1.33**	-0.045**
	(0.062)	(0.27)	(0.063)	(0.66)	(0.022)
Death shock	-0.034	0.38**	-0.039	-0.12	0.0029
	(0.050)	(0.19)	(0.040)	(0.17)	(0.0029)
Female x 2nd wave	-0.0065	-0.23**	0.083***	1.50***	0.021*
	(0.026)	(0.11)	(0.027)	(0.39)	(0.012)
2nd wave	-0.019	2.09***	-0.0014	-0.074	-0.0029
	(0.020)	(0.091)	(0.013)	(0.10)	(0.0029)
Constant	0.57***	1.90***	0.12***	0.94***	0.018***
	(0.0062)	(0.033)	(0.0069)	(0.085)	(0.0026)
Observations	3514	3212	3514	3514	3514
Number of individuals	1757	1606	1757	1757	1757
Adjusted R-squared	0.0023	0.55	0.014	0.020	0.0041
P-val. death shock + death sh. x fem. = 0	0.17	0.00036	0.29	0.027	0.055

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual (panel observations only). Notes: Results from unweighted OLS regressions with individual fixed-effects (linear probability model for columns 1, 3 and 5). Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.16: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - Child fixed effects, sample extended to all children

	(1) Currently in school	(2) Years of education	(3) Any caregiving	(4) Hrs of caregiving per week	(5) Caregiving >15h / week
Death shock x female	0.080	0.46*	-0.0071	-0.98*	-0.032
	(0.059)	(0.25)	(0.059)	(0.58)	(0.020)
Death shock	-0.028	0.25	-0.022	-0.081	0.0025
	(0.047)	(0.18)	(0.039)	(0.15)	(0.0016)
Female x 2nd wave	-0.0039	-0.23***	0.072***	1.15***	0.0080
	(0.016)	(0.072)	(0.018)	(0.24)	(0.0069)
2nd wave	-0.025**	2.22***	-0.018**	-0.12*	-0.0025
	(0.012)	(0.061)	(0.0094)	(0.065)	(0.0016)
Constant	0.59***	2.02***	0.13***	1.02***	0.019***
	(0.0041)	(0.023)	(0.0049)	(0.058)	(0.0017)
Observations	7112	6494	7112	7112	7112
Number of individuals	3556	3247	3556	3556	3556
Adjusted R-squared	0.0035	0.57	0.0072	0.013	0.00073
P-val. death shock + death sh. x fem. = 0	0.11	0.0014	0.56	0.071	0.14

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 (panel observations only). Notes: Results from unweighted OLS regressions with individual fixed-effects (linear probability model for columns 1, 3 and 5). Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.17: Test of differential attrition

	Treated (T)	Control (C)	Difference (T - C)	S.E.
Attrited	0.088	0.097	-0.0088	(0.014)
Observations	262	911		

Source: PSF Survey, wave 1 and wave 2. Author's calculations. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual (panel and attrited observations). The standard error on the difference is estimated from running the corresponding least squares regression allowing for the errors to be clustered by household. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.18: Triple difference (DDD) estimates of the impacts of the death shock on girls' schooling and caregiving outcomes - Heckman selection correction

	(1) Currently in school	(2) Years of education	(3) Completed primary school	(4) Education index	(5) Any caregiving	(6) Hrs of caregiving per week	(7) Caregiving >15h / week	(8) Caregiving index
Death shock x female	0.086	0.53^{**}	0.100	0.27^{**}	-0.050	-0.67	-0.036^{*}	-0.36^{*}
	(0.062)	(0.23)	(0.075)	(0.13)	(0.061)	(0.71)	(0.020)	(0.21)
Death shock	-0.0042	0.026	0.011	0.025	-0.068	-0.27	-0.0011	-0.15
	(0.042)	(0.16)	(0.053)	(0.090)	(0.042)	(0.49)	(0.014)	(0.15)
Female x 2nd wave	0.0052	-0.083	-0.0030	-0.012	0.088^{***}	0.42	0.0094	0.25^{**}
	(0.029)	(0.11)	(0.036)	(0.062)	(0.029)	(0.34)	(0.0094)	(0.10)
Constant	-0.26^{***}	3.00^{***}	0.41^{***}	1.05^{***}	-0.049^{*}	-0.35	-0.0048	-0.15
	(0.031)	(0.15)	(0.048)	(0.082)	(0.028)	(0.33)	(0.0092)	(0.098)
Inverse Mills ratio	0.25^{**}	-0.36	-0.16	-0.17	0.24^{**}	1.56	0.029	0.78^{*}
	(0.13)	(0.36)	(0.12)	(0.20)	(0.12)	(1.41)	(0.039)	(0.42)
Observations	1173	1173	1173	1173	1173	1173	1173	1173
Selected Observations	1052	936	936	935	1062	1057	1057	1057
P-val. death shock + death shock x female = 0	0.068	0.001	0.046	0.002	0.008	0.069	0.010	0.001

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel and attrited observations). Notes: Each column presents results from Heckman's two-step selection consistent estimator (Heckman 1979) implemented in Stata 18 (StataCorp. 2023) with the heckman command. Regressors in the selection equation include indicator variables for the month and year in which data were collected, as well as indicator variables for the identity of the surveyor team head , indicators for female children and children exposed to the death shock, and the interaction between these last two variables. *** p<0.01, ** p<0.05, * p<0.1

Table C.19: Triple difference (DDD) estimates of the impact of the death shock on girls' schooling and caregiving work - Alternative treatment definitions, child fixed-effects

	(1) Currently in school	(2) Years of education	(3) Any caregiving	(4) Hrs of caregiving per week
Panel A: Children co-residing with an adult aged > 57				
Death shock x female	0.077	0.648***	-0.038	-1.046*
	(0.061)	(0.232)	(0.067)	(0.622)
Death shock	0.012	0.022	-0.059	-0.336
	(0.048)	(0.167)	(0.036)	(0.215)
Female x 2nd wave	-0.026	-0.149	0.093***	0.706**
	(0.029)	(0.101)	(0.030)	(0.339)
2nd wave	0.086*	3.249***	0.004	-0.786
	(0.046)	(0.192)	(0.045)	(0.501)
Constant	1.000***	3.174***	0.100***	0.624***
	(0.007)	(0.029)	(0.007)	(0.070)
Observations	2158	1924	2158	2158
Number of individuals	1079	962	1079	1079
Adjusted R-squared	0.243	0.800	0.124	0.013
P-val. death sh. + death sh. x fem. = 0	0.028	0.003	0.088	0.021
Panel B: Children co-residing with an adult aged > 61				
Death shock x female	0.064	0.513**	-0.037	-1.086*
	(0.068)	(0.251)	(0.074)	(0.650)
Death shock	0.031	0.190	-0.047	-0.281
	(0.052)	(0.185)	(0.039)	(0.218)
Female x 2nd wave	0.001	-0.037	0.086**	0.738*
	(0.033)	(0.115)	(0.035)	(0.388)
2nd wave	0.062	3.142***	0.025	-0.581
	(0.053)	(0.220)	(0.051)	(0.552)
Constant	1.000***	2.951***	0.100***	0.596***
	(0.008)	(0.033)	(0.008)	(0.077)
Observations	1754	1544	1754	1754
Number of individuals	877	772	877	877
Adjusted R-squared	0.251	0.795	0.112	0.014
P-val. death sh. + death sh. x fem. = 0	0.035	0.003	0.173	0.031

Source: PSF Survey, waves 1 and 2. Sample: Children aged 6-17 in wave 1 who co-resided with an elderly individual and were enrolled in school at the time of survey (panel observations only). Notes: Results from unweighted OLS regressions with individual fixed-effects (linear probability model for columns 1 and 3). Standard errors allowing for clustering at the household level between parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix D - Entropy balanced comparison of reading skills and reading habits among female respondents aged 18 to 30 in the Senegal DHS 2019

This section presents estimates of the marginal effect of an extra year of education at the PSF wave 2 sample mean (6 years of education) on reading skills, newspaper reading habits, internet usage and mobile money usage among Senegalese women aged 18 to 30. The estimation is based on the multivariate reweighting method of Hainmueller and Xu (2013), also known as entropy balancing. The estimation uses the main sample of women from Senegal's 2019 DHS (Agence Nationale de la Statistique et de la Démographie and The DHS Program - ICF 2020). However, I restrict the sample to women aged 18 to 30 which approximately corresponds to the age range of the PSF sample used in this paper at the time when the DHS data were collected (2019). I further restrict the DHS sample to individuals who report having completed 6 or 7 years of education because I am interested in the marginal effect of an extra year of education conditional on having completed 6 years. The procedure balances the two groups on the first, second, and third moments of the following covariates: age, ethnicity dummies, urban area of residence, region of residence dummies, and the DHS wealth index. Pre and post reweighting balance checks are presented in Table B1.

Estimates from unweighted and weighted probit models are presented in Figure B1. The models regress the four outcomes of interest on a treatement indicator variable equal to 1 if the individual has completed 7 years of education and to 0 otherwise. The unweighted models also control for age, wealth, and indicators for urban respondents, for the region of residence, and for ethnicity. Figure B1 graphs the coefficients on the treatment variable with 95% confidence intervals. Standard errors are clustered at the primary sampling unit level in the unweighted models.

Figure D.1: Impact of 1 extra year of education conditional on having completed 6 years

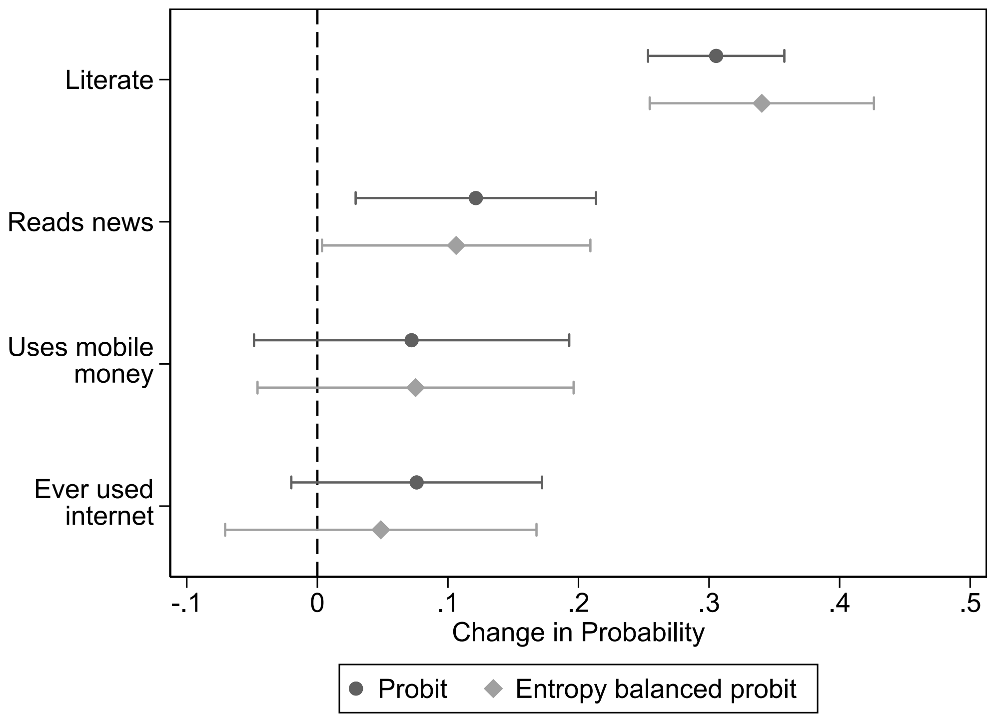


Table D.1: Covariates balance by sub-sample

	Raw means				Entropy-balanced means			
	(1) Educ.: 6 yrs	(2) Educ.: 7 yrs	(3) Diff. (1)- (2)	(4) SE	(5) Educ.: 6 yrs	(6) Educ.: 7 yrs	(7) Diff. (5)- (6)	(8) SE
Age	25.395	20.447	4.948***	(0.624)	20.446	20.447	-0.001	(0.524)
Wealth index	8794.656	10172.463	-1377.807	(6868.037)	10172.629	10172.463	0.166	(8206.483)
Urban	0.413	0.392	0.021	(0.037)	0.392	0.392	0.000	(0.044)
Region: Dakar	0.071	0.045	0.026	(0.018)	0.044	0.045	-0.001	(0.015)
Region: Ziguinchor	0.153	0.125	0.028	(0.026)	0.126	0.125	0.000	(0.028)
Region: Diourbel	0.082	0.032	0.049***	(0.017)	0.032	0.032	0.000	(0.012)
Region: Saint-Louis	0.020	0.045	-0.025*	(0.014)	0.045	0.045	0.000	(0.022)
Region: Tambacounda	0.051	0.051	-0.000	(0.017)	0.051	0.051	0.000	(0.018)
Region: Kaolack	0.120	0.071	0.049**	(0.022)	0.071	0.071	0.000	(0.021)
Region: Thies	0.054	0.109	-0.056***	(0.021)	0.109	0.109	0.000	(0.031)
Region: Louga	0.056	0.048	0.008	(0.017)	0.048	0.048	0.000	(0.017)
Region: Fatick	0.036	0.058	-0.022	(0.016)	0.058	0.058	0.000	(0.023)
Region: Kolda	0.110	0.113	-0.003	(0.024)	0.113	0.113	0.000	(0.028)
Region: Matam	0.051	0.064	-0.013	(0.018)	0.064	0.064	0.000	(0.021)
Region: Kaffrine	0.048	0.035	0.013	(0.015)	0.035	0.035	0.000	(0.014)
Region: Kedougou	0.043	0.103	-0.060***	(0.020)	0.103	0.103	0.000	(0.032)
Region: Sedhiou	0.105	0.100	0.005	(0.023)	0.100	0.100	0.000	(0.025)
Ethnicity: Wolof	0.270	0.190	0.081**	(0.032)	0.189	0.190	-0.001	(0.032)
Ethnicity: Poular	0.296	0.341	-0.045	(0.035)	0.341	0.341	0.000	(0.043)
Ethnicity: Serer	0.125	0.145	-0.020	(0.026)	0.145	0.145	0.000	(0.033)
Ethnicity: Mandingue/ Socé	0.099	0.125	-0.026	(0.024)	0.126	0.125	0.000	(0.030)
Ethnicity: Diola	0.089	0.093	-0.004	(0.022)	0.093	0.093	0.000	(0.026)
Ethnicity: Soninké	0.036	0.035	0.000	(0.014)	0.035	0.035	0.000	(0.016)
Ethnicity: Other Senegalese	0.061	0.051	0.010	(0.017)	0.051	0.051	0.000	(0.018)
Ethnicity: Not Senegalese	0.023	0.019	0.004	(0.011)	0.019	0.019	0.000	(0.011)
Observations	392	311	703		392	311	703	

Source: Author's calculations from Senegal DHS 2019. Sample: Women aged 18 to 30 who have completed between 6 and 7 years of education. Notes: Heteroskedasticity robust standard errors between parentheses. Standard errors and differences obtained from univariate OLS regressions of a dummy variable equal to one if an individual has completed 7 years of education on the covariate of interest. *** $p<0.01$, ** $p<0.05$, * $< p<0.01$.