Appendix Table A1

Sample Selection

Panel A: Application of Inclusion/Exclusion Criteria

Inclusion/Exclusion Criteria	Sample Size	Number (Percent) Omitted from Sample
1) Birth cohorts 1960-1984	1430109	--
2) Keep if parents married by birth of youngest or by 1968	1323730	106379 (7.4%)
3) Drop if mother had prior children with another father	1276291	47439 (3.3%)
4) Keep if mother's age-at-birth 17-42 and father's age-at-birth 19-50	1258443	17848 (1.2%)
5) Drop if mother died by age 24	1235164	23279 (1.6%)
6) Drop if parents divorced by age 24	1003942	231222 (16.2%)
7) Drop if widowed mother remarried by age 24	1001301	2641 (0.2%)
8) Drop if parents' education missing	995503	5798 (0.4%)
9) Drop if child's education missing	986759	8744 (0.6%)
10) Drop if age-at-father's death 22-26	961517	25242 (1.8%)
11) Keep if ≥2 siblings represented	791564	169953 (11.9%)
12) Drop if assigned to neither "Father Died" nor "No Death" subsample	788115	3449 (0.2%)

Panel B: Resulting Sample

	Sample Size	Represented Sibling Groups
Father Died subsample	21986	9091
No Death subsample	766129	308735

Appendix Table A2

Non-Fixed Effect Estimates over Alternative Samples

	Main Sample (1)	*Alt. Sample 1* (2)	*Alt. Sample 2* (3)
Father Educ	0.1853**	0.1860**	0.1860**
	(0.0012)	(0.0010)	(0.0010)
Mother Educ	0.1790**	0.1795**	0.1797**
	(0.0013)	(0.0012)	(0.0012)
Father Death	-0.5378**	-0.5092**	-0.5325**
	(0.0536)	(0.0447)	(0.0355)
x Father Educ	-0.0679**	-0.0546**	-0.0349*
	(0.0207)	(0.0175)	(0.0138)
x Mother Educ	0.0003	-0.0025	-0.0010
	(0.0225)	(0.0186)	(0.0149)
Age at Father Death	0.0132**	0.0116**	0.0133**
	(0.0035)	(0.0027)	(0.0018)
x Father Educ	0.0037**	0.0027**	0.0012^{+}
	(0.0013)	(0.0011)	(0.0007)
x Mother Educ	0.0012	0.0012	0.0011
	(0.0015)	(0.0011)	(0.0007)
Sibling FEs	No	No	No
Observations	788,115	961,517	986,759
Adj R-squared	0.2378	0.2374	0.2382

Notes: Outcome is completed education years at age 27. OLS coefficients reported, with robust standard errors in parentheses, corrected for clustering across siblings (** p<0.01, * p<0.05, $^{+}$ p<0.10). Additional covariates (coefficients not shown) included for female/birth year interactions, family size, birth order, last born status, twin status, Mother's and Father's age-at-birth (linear and quadratic terms), and economic region (based on region in year youngest sibling born). Column 1 replicates column 2 in Table 2. *Alternative Sample 1* omits selection criteria pertaining to sibling representation (criteria 11 and 12; see Appendix Table A1). *Alternative Sample 2* additionally omits selection criteria pertaining to age at Father's death (criterion 10; see Appendix Table A1), with subjects who experience Father's death over ages 22-26 assigned to "Father Death" status.

Appendix Table A3

Comparison of Non-Fixed Effect and Fixed Effect Estimates

	(1)	(2)	(3)	(4)	(5)
Father Educ	0.1853**	0.1853**	0.1256**	0.1250**	
	(0.0012)	(0.0012)	(0.0055)	(0.0055)	
Mother Educ	0.1790**	0.1790**	0.0742**	0.0721**	
	(0.0013)	(0.0013)	(0.0062)	(0.0062)	
Father Death	-0.5378**	-0.4691**	-0.4482**	-0.4228**	
	(0.0536)	(0.0847)	(0.0847)	(0.0847)	
x Father Educ	-0.0679**	-0.1735**	-0.1749**	-0.1270**	
	(0.0207)	(0.0316)	(0.0317)	(0.0320)	
x Mother Educ	0.0003	0.0701*	0.0583^{+}	0.0815*	
	(0.0225)	(0.0351)	(0.0351)	(0.0355)	
Age at Father Death	0.0132**	0.0085	0.0062	0.0043	0.0121
	(0.0035)	(0.0058)	(0.0058)	(0.0058)	(0.0075)
x Father Educ	0.0037**	0.0112**	0.0112**	0.0078**	0.0078**
	(0.0013)	(0.0022)	(0.0022)	(0.0022)	(0.0028)
x Mother Educ	0.0012	-0.0037	-0.0032	-0.0048*	-0.0055^{+}
	(0.0015)	(0.0024)	(0.0024)	(0.0024)	(0.0031)
Mean(Age at F Death)		0.0061	0.0082	0.0097	
		(0.0072)	(0.0072)	(0.0072)	
x Father Educ		-0.0100**	-0.0106**	-0.0073**	
		(0.0027)	(0.0027)	(0.0028)	
x Mother Educ		0.0061*	0.0047	0.0064*	
		(0.0030)	(0.0030)	(0.0030)	
Mean(Age)			-0.0144**	0.0996**	
			(0.0018)	(0.0085)	
x Father Educ			0.0020**	0.0036**	
			(0.0002)	(0.0003)	
x Mother Educ			0.0038**	0.0020**	
			(0.0002)	(0.0004)	
Relative Age				0.0793**	-0.0263^{+}
				(0.0083)	(0.0155)
x Father Educ				0.0021**	0.0040**
				(0.0002)	(0.0004)
x Mother Educ				0.0039**	0.0027**
				(0.0002)	(0.0005)
Sibling FEs:	No	No	No	No	Yes
Observations	788,115	788,115	788,115	788,115	788,115
Adj R-squared	0.2378	0.2378	0.2389	0.2393	0.4268

Notes: Outcome is completed education years at age 27. OLS coefficients reported, with robust standard errors in parentheses, corrected for clustering across siblings (** p<0.01, * p<0.05, $^{+}$ p<0.10). Additional covariates (coefficients not shown) included for female/birth year interactions, family size, birth order,

last born status, twin status, Mother's and Father's age-at-birth (linear and quadratic), and economic region (based on region in year youngest sibling born). "Mean(Age at F Death)" refers to mean age at father's death over represented siblings, set to zero for sibling groups in No Death sample. "Mean(Age)" refers to mean age (on 1/1/2000) over represented siblings.

Discussion of Results Presented in Appendix Table A3

In Appendix Table A3, we present results to clarify the impact that inclusion of sibling fixed effects has on our estimates. Column 1 replicates estimates from Equation 2 previously reported in Table 2, Column 2. As noted in the text, the estimates of interest (the interactions of age at father death and parental education) are very sensitive to the inclusion of sibling fixed effects. This finding indicates an important source of across-family heterogeneity in the effects of parental education exists, which the inclusion of sibling fixed effects effectively differences out. Specifically, this suggests that parental education plays a different role in sibling groups that lose their father at earlier ages compared with sibling groups that lose their father at later ages.

To demonstrate, Column 2 includes covariates for the mean age at father's death over the siblings represented in each sibling group (set to zero for No Death sibling groups) and its interaction with parental education. As we see, evidence of substantial heterogeneity exists among Father Died sibling groups exposed to father death at later ages. The predictive effect of father's education on child education is smaller while the predictive effect of mother's education is larger – findings that are definitively at odds with Hypotheses 1 and 2. By controlling for this heterogeneity, Column 2 produces estimates on our covariates of interest that are very similar to those generated under Equation 3 (see Table 3, Column 3). While it is unclear why parental education would demonstrate differential effects based on the mean age at which siblings were exposed to their father's death, this finding nonetheless highlights the importance of controlling

for sibling fixed effects in our context. Lending further support for inclusion of sibling fixed effects, we also find that the placebo tests decided fail in models that exclude sibling fixed (see footnote 32).

In Table 2, we also found our coefficients of interest to be sensitive to heterogeneity in the effects of parental education by relative age. Again, this feature of our data can be demonstrated without including sibling fixed effects, as we show in Columns 3 and 4. In Column 3, we include covariates for the mean age in each sibling group and its interaction with parental education. Parental education appears to have stronger effects on the outcomes for later born sibling groups, but controlling for this source of heterogeneity has little effect on our coefficients of interest. In Column 4, we then add covariates for relative age and its interaction with parental education – the non-fixed effects analogue to Equation 4. As we would expect, the coefficients of interest are very similar to those we generated for Equation 4 (previously reported in Table 2, Column 4 and replicated here in Column 5).

In light of this, we can compare our results to those of Gould and Simhon (2011), who address a similar question as the one we address, but employ a different outcome (whether the child passed a matriculation exam at age 18), in a different context (Israeli schoolchildren), and utilize different methods (without controls for family fixed effects). Using standard regression models, they document empirical patterns generally consistent with the conclusions we draw. In particular, they find father education becomes less predictive of exam passage when a child experiences father death at an earlier age (consistent with Hypothesis 1) while mother education becomes increasingly predictive (though this result is statistically insignificant, so is only weakly consistent with Hypothesis 2). In each case, however, the Gould and Simhon estimates are substantially smaller in magnitude than our preferred estimates. Our preferred estimate

pertaining to the effect of increased exposure to a higher-educated father is an order of magnitude larger than that of Gould and Simhon, despite the fact that the baseline intergenerational coefficient is larger in their context. Interestingly, in specifications most closely analogous to those of Gould and Simhon (e.g. Table 2, Column 2), our coefficient pertaining to father education was substantially smaller than under our preferred specification, while the coefficient pertaining to mother education was small and insignificant. Thus, our estimates more closely resemble theirs when we ignore across-family heterogeneity in the effects of parental education, which provides a possible explanation for the relatively smaller effects estimated in their study. That said, we cannot rule out the possibility that the effects of differential paternal exposure vary for different outcomes and/or across different contexts.

Appendix Table A4

Auxiliary Results, Predictors of Father Death and Age of Father's Death

	(1)	(2)
Outcome:	Age at Father Death	Father Died
Father Educ		-0.0023**
		(0.0001)
Mother Educ		-0.0010**
		(0.0001)
Last born	-1.4079**	0.0014**
	(0.0496)	(0.0004)
Birth order = 2	-2.1194**	0.0012**
	(0.0388)	(0.0003)
Birth order = 3	-4.7064**	0.0033**
	(0.0737)	(0.0007)
Birth order = 4	-7.1179**	0.0077**
	(0.1165)	(0.0011)
Birth order = 5	-9.2528**	0.0104**
	(0.1699)	(0.0020)
Birth order = 6	-11.2787**	0.0159**
	(0.2395)	(0.0034)
Birth order ≥ 7	-13.8759**	0.0308**
	(0.3959)	(0.0073)
Region "Father Death" Pct		0.0063**
		(0.0008)
Mean(Father Age at Birth)		0.0037**
		(0.0001)
Mean(Age)		-0.0004**
		(0.0001)
Sibling Fixed Effects	Yes	No
Sample restriction	Father Died only	none
Observations	21,986	788,115
Adj R-squared	0.9145	0.0167

Notes: OLS coefficients reported, with robust standard errors in parentheses, corrected for clustering across siblings (** $p<0.01$, * $p<0.05$, $^{+}$ $p<0.10$). "Region `Father Death' Pct" refers to percent of children born in subject's region whose father died by child-age 21. "Mean(Father Age at Birth)" refers to Father's mean age-at-birth, calculated over siblings represented in sample. "Mean(Age)" refers to mean age (on 1/1/2000) over siblings in sample.

Appendix Table A5

Additional Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age at F Death			0.0118	0.0103	0.0127+	0.0120	0.0114	0.0135+
			(0.0075)	(0.0072)	(0.0076)	(0.0076)	(0.0076)	(0.0074)
x Father Educ			0.0078**	0.0066*	0.0084**	0.0075**	0.0075*	0.0055*
			(0.0028)	(0.0027)	(0.0029)	(0.0029)	(0.0029)	(0.0025)
x Mother Educ			-0.0054+	-0.0049	-0.0059+	-0.0051	-0.0050	
			(0.0031)	(0.0030)	(0.0032)	(0.0032)	(0.0032)	
Relative Age	-0.1539+	-0.0220	-0.0234	-0.0263+	-0.0265+	-0.0252	-0.0259	-0.0265+
	(0.0903)	(0.0158)	(0.0168)	(0.0155)	(0.0158)	(0.0156)	(0.0158)	(0.0155)
x Father Educ	0.0120**	0.0040**	0.0040**	0.0040**	0.0040**	0.0040**	0.0040**	0.0041**
	(0.0029)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
x Mother Educ	-0.0038	0.0027**	0.0026**	0.0027**	0.0027**	0.0028**	0.0027**	0.0026**
	(0.0033)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Sample modification:	Father Died sample	No Death sample		allow remarried widows	exclude twins	exclude if birth order ≥7	exclude if family size ≥7	
Birth spacing controls (Wald test p-value):			0.0093					
Observations	21,986	766,129	788,115	790,158	775,547	784,233	773,854	788,115
Adj R-squared	0.4375	0.4254	0.4268	0.4268	0.4254	0.4260	0.4237	0.4268

Notes: Outcome is completed education years at age 27. OLS coefficients reported, with robust standard errors in parentheses, corrected for clustering across siblings (** p<0.01, * p<0.05, + p<0.10). All specifications include sibling fixed effects; indictors for female/birth cohort interactions; indicators for birth order, last born status, and twin status; and quadratic terms for mother's and father's age-at-birth. Birth spacing

controls (in column 3) include age difference to next older sibling (linear and squared) and an indicator for missing values, with analogous covariates pertaining to the next younger sibling. P-value for Wald test of joint significance reported for birth spacing coefficients.

Appendix Table A6

Sensitivity Checks for Alternative Sample Restrictions on Age-at-Father's Death

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Age at F Death	0.0121	0.0122	0.0095	0.0093	0.0131	0.0131	-0.0010	0.0021	0.0142
	(0.0075)	(0.0075)	(0.0066)	(0.0058)	(0.0081)	(0.0087)	(0.0110)	(0.0160)	(0.0250)
x Father Educ	0.0078**	0.0078**	0.0048*	0.0037^{+}	0.0074*	0.0072*	0.0072^{+}	0.0108^{+}	0.0091
	(0.0028)	(0.0028)	(0.0024)	(0.0022)	(0.0031)	(0.0033)	(0.0043)	(0.0064)	(0.0101)
x Mother Educ	-0.0055^{+}	-0.0055^{+}	-0.0036	-0.0022	-0.0055	-0.0062^{+}	-0.0073	-0.0103	-0.0115
	(0.0031)	(0.0031)	(0.0027)	(0.0024)	(0.0033)	(0.0036)	(0.0047)	(0.0067)	(0.0106)
Sample Modification:									
Father Died			AgeFD≤23	AgeFD≤25	AgeFD≤20	AgeFD≤19	AgeFD≤16	AgeFD≤13	AgeFD≤10
No Death		AgeFD>27							
Observations	793,350	788,154	799,034	805,365	790,758	788,285	781,960	777,266	774,281
Adj R-squared	0.4277	0.4275	0.4278	0.4284	0.4275	0.4274	0.4270	0.4267	0.4264

Notes: Outcome is completed education years at age 27. OLS coefficients reported, with robust standard errors in parentheses, corrected for clustering across siblings (** p<0.01, * p<0.05, $^{+}$ p<0.10). All models include sibling fixed effects; indictors for female, birth cohort and their interaction; indicators for birth order, last born status, and twin status; quadratic terms in mother's and father's age-at-birth, and relative age interacted with father's and mother's education. "AgeFD" refers to sample selection criteria applied to age at Father's death. In Columns 5-9 children whose father died after the AgeFD-threshold specified in table but before age 22 are excluded.