Appendix
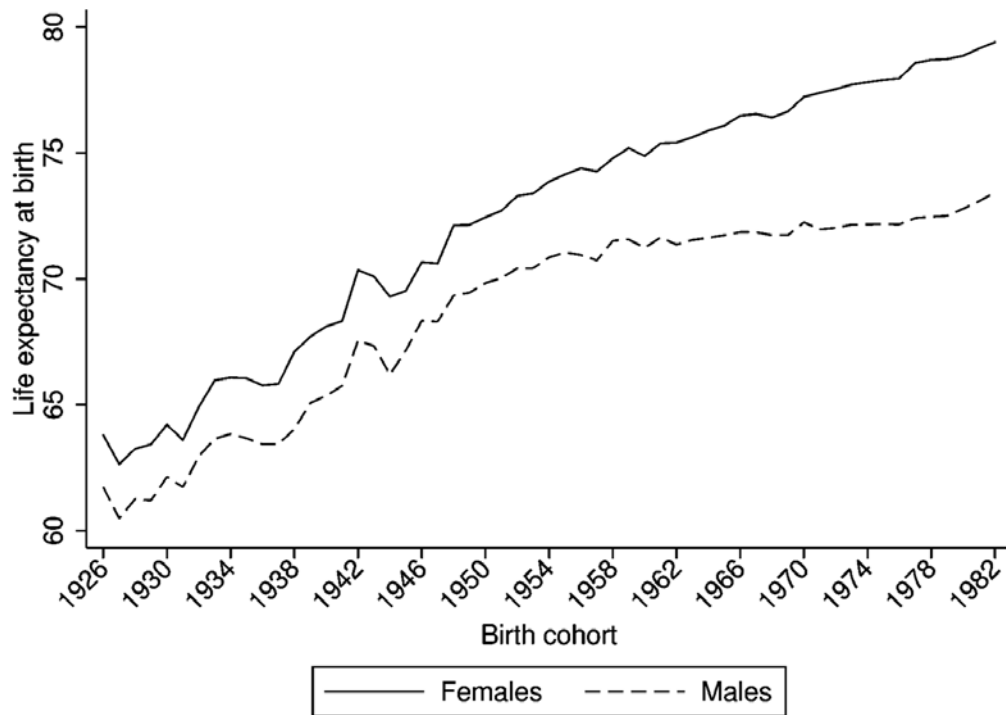
Figure A

Life Expectancy at Birth. Males and Females.
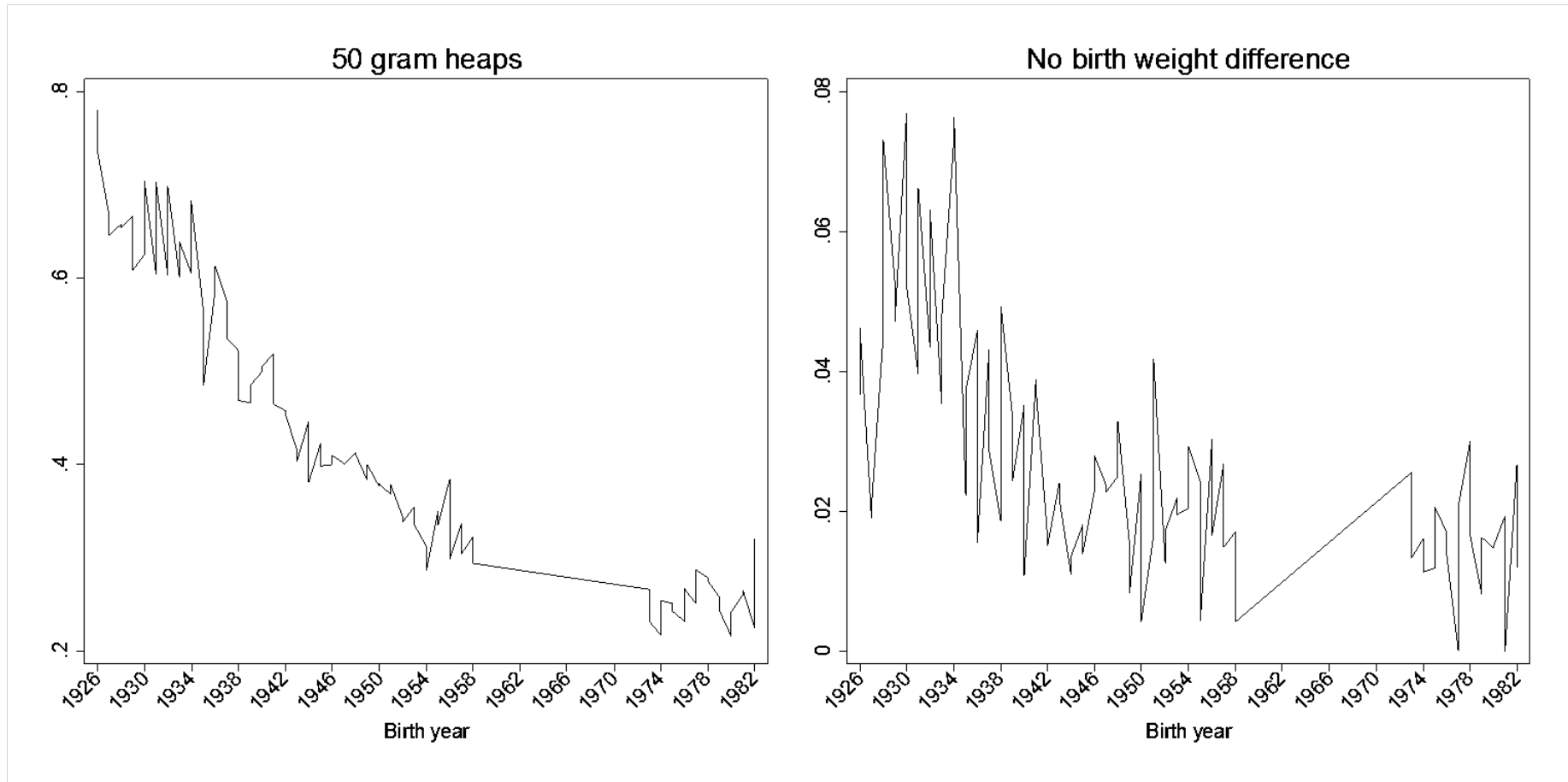
Notes: This graph plots average life expectancy at birth for the cohorts born 1926-1958.

Figure B

Birth weight measurement across cohorts born 1926-1982.

Notes: These graphs plot fraction of twins where birth weight is measured in 50 gram bins (left panel) and fraction of twin pairs with zero difference in birth weight. Cohorts born 1926-1958 and 1973-1982.

Table A

Effects of birth weight on selected outcomes for cohorts born 1973 and onwards and cohorts born 1926-1958. Males.

Dependent variable	Singletons			Twins	
	OLS	Sibling FE	Sibling FE restricted	OLS	Twins FE
Panel A: Cohorts born 1973-					
One-year mortality	-102.402	-153.328	-131.539	-214.389	-68.971
	(1.941)***	(2.910)***	(2.826)***	(10.360)***	(15.569)***
N	780,341		780,335	22,456	
Baseline mean	5.98	5.98	5.91	26.45	26.45
Five minute	0.745	1.083	0.919	1.666	0.466
APGAR score	(0.013)***	(0.019)***	(0.020)***	(0.062)***	(0.107)***
N	701,972		701,967	20,522	
Baseline mean	9.62	9.62	9.62	9.31	9.31
High school	0.054	-0.007	0.006	0.061	0.067
completion	(0.007)***	(0.011)	(0.014)	(0.030)**	(0.050)
N	146,766		146,765	4,992	
Baseline mean	0.78	0.78	0.78	0.79	0.79
ln(earnings)	0.060	0.047	0.078	0.039	0.121
Ages 25-33	(0.007)***	(0.013)***	(0.016)***	(0.028)	(0.054)**
N	86,365		80,739	3,180	
Baseline mean	287,971	287,971	288,118	287,977	287,977
Panel B: Cohorts born 1926-1958					
High school	-	-	-	0.049	0.111
completion	-	-	-	(0.023)**	(0.038)***
N	-	-	-	12,888	
Baseline mean				0.39	0.39
ln(earnings)	-	-	-	0.017	0.083
Ages 25-33	-	-	-	(0.021)	(0.036)**
N	-	-	-	8,232	
Baseline mean				199,529	199,529
Years of	-	-	-	0.114	0.554
schooling	-	-	-	(0.139)	(0.210)***
N	-	-	-	12,888	
Baseline mean				10.85	10.85

Notes: The table shows estimates of the relationship between birth weight and selected outcomes for the cohorts born 1973 and onwards and cohorts born 1926-1958. The number of cohorts included depend on the outcome studied, see data section for detailes. In the OLS regresssions, we control for year and month of birth, mother's education, birth order, mother's

year of birth, and sex of the child. Sibling FE regressions control for all of the above except for mother's year of birth and mother's education. Twin FE regressions control for sex. The third column shows siblingFE results when controlling for gestational ages and when restricting the birth weight range to that in the corresponding twin sample. In the OLS regressions for the cohorts born 1926-1958, we control sex of the child and birth cohort. Clustered standard errors in parentheses. ***p<0.01, **p 0.05, *p 0.1.

Table B

Effects of birth weight on selected outcomes for cohorts born 1973 and onwards and cohorts born 1926-1958. Females.

Dependent variable	Singletons			Twins	
	OLS	Sibling FE	Sibling FE restricted	OLS	Twins FE
Panel A: Cohorts born 1973-					
One-year mortality	-86.389	-133.421	-118.091	-172.516	-29.857
	(1.970)***	(3.034)***	(2.926)***	(10.721)***	(12.733)**
N	701,817		701,813	21,754	
Baseline mean	4.76	4.76	4.55	20.04	20.04
Five minute	0.652	0.990	0.820	1.499	0.547
APGAR score	(0.013)***	(0.020)***	(0.020)***	(0.067)***	(0.099)***
N	628,488		628,485	19,750	
Baseline mean	9.66	9.66	9.66	9.38	9.38
High school	0.053	-0.007	0.007	0.016	0.075
completion	(0.007)***	(0.011)***	(0.013)***	(0.025)	(0.040)*
N	131,016		131,014	5,050	
Baseline mean	0.84	0.84	0.84	0.85	0.85
ln(earnings)	0.027	0.037	0.048	0.001	0.141
Ages 25-33	(0.008)***	(0.014)***	(0.017)**	(0.028)	(0.060)**
N	66,937		64,618	2,864	
Baseline mean	226,942	226,942	226,865	228,458	228,458
Panel B: Cohorts born 1926-1958					
High school	-	-	-	0.054	0.087
completion	-	-	-	(0.020)***	(0.033)***
N	-	-	-	13,266	
Baseline mean				0.33	0.33
ln(earnings)	-	-	-	-0.029	0.100
Ages 25-33	-	-	-	(0.038)	(0.075)
N	-	-	-	8,168	
Baseline mean				123,024	123,024
Years of	-	-	-	0.374	0.604
schooling	-	-	-	(0.120)***	(0.184)***
N	-	-	-	13,266	
Baseline mean				10.81	10.81

Notes: The table shows estimates of the relationship between birth weight and selected outcomes for the cohorts born 1973 and onwards and cohorts born 1926-1958. The number of cohorts included depend on the outcome studied, see data section for detailed information. In the OLS regresssions, we control for year and month of birth, mother's education, birth order,

mother's year of birth, and sex of the child. Sibling FE regressions control for all of the above except for mother's year of birth and mother's education. Twin FE regressions control for sex. The third column shows sibling FE results when controlling for gestational age and when restricting the birth weight range to that in the corresponding twin sample. In the OLS regressions for the cohorts born 1926-1958, we control sex of the child and birth cohort. Clustered standard errors in parentheses. ***p<0.01, **p <0.05, *p <0.1.

Table C

Effect of birth weight on permanent income by birth cohort categories. Twins FE models.

	(1)	(2)	(3)	(4)
	Model A		Model B	
Log birth weight	0.106***	0.111*	0.105***	0.109*
	(0.035)	(0.058)	(0.035)	(0.057)
Log birth weight*C_1940-1949		0.008		0.013
		(0.078)		(0.077)
Log birth weight*C_1933-1939		-0.053		-0.051
		(0.102)		(0.100)
Observations	22,588	22,588	22,588	22,588
Number of twin pairs	11,294	11,294	11,294	11,294

Notes: This table shows twins FE estimates of log(birth weight) on permanent income (ages 35-45) across cohorts born 1933-1939, 1940-1949, and 1950-1958. Permanent income is calculated as the average income between the ages 35 and 45. Column (1) shows the estimate for the combined sample of men and women. Column (2) interacts birth weight with the birth cohort categories, i.e. these estimates come from the same regression. Columns (3) and (4) repeats the analysis in Columns (1) and (2), but recodes the birth weight data into 50g bins, i.e., analyzes whether measurement error matters. *p<0.10, **p<0.05, ***p<0.01.

Table D

Literature overview on OLS and twins fixed effects estimates.

Paper	Short-run outcomes	Medium-run outcomes	Long-run outcomes
Almond et al. (2005)	OLS>FE (mortality)	na	na
Black et al. (2007)	OLS>FE (mortality & APGAR)	OLS>FE (height) OLS<FE (BMI, IQ) OLS~FE (high school completion)	OLS>FE (full time work) OLS~FE (log earnings)
Royer (2009)	OLS>FE (mortality)	OLS~FE (education)	OLS~FE (zip code poverty) OLS>FE (zip code median income, child's birthweight, gestational length, diabetes, labor complications, NICU transfer) OLS<FE (hypertension, pregnancy complications, csection)
Oreopolous et al. (2008)	OLS>FE (mortality, physician visits)	OLS>FE (language arts score)	OLS~FE (social assistance after age 18)
Figlio et al. (2014)	na	OLS<FE (test scores in school)	na
Bharadwaj et al., forthcoming	na	OLS<FE (test scores in school)	na
Behrman and Rosenzweig (2004)		OLS<FE (schooling) OLS>FE (BMI) OLS~FE (height)	OLS<FE (log wage)
Nakamuro et al. (2013)	na	OLS<FE (test scores, college ranking) OLS>FE (highest years of schooling)	na

Notes: This table summarizes the findings from studies that have compared OLS and twin fixed effects estimates of the effect of birth weight on various short-, medium-, and long-run outcomes. See text for details.

Table E

Birth weight and permanent income (ages 35-45). Non-linear specifications. Twin FE models.

	Pooled		Males		Females	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Permanent income (age 35-45)					
A. Less than 1500 grams	-0.033	-0.023	-0.084	-0.060	-0.002	-0.001
	(0.047)	(0.046)	(0.060)	(0.058)	(0.070)	(0.069)
B. Less than 2000 grams	-0.032	-0.028	-0.041	-0.044	-0.026	-0.018
	(0.018)*	(0.018)	(0.023)*	(0.022)**	(0.027)	(0.027)
C. Less than 2500 grams	-0.025	-0.021	-0.017	-0.013	-0.032	-0.029
	(0.012)**	(0.012)*	(0.013)	(0.013)	(0.019)*	(0.019)
Observations	22,588	22,588	11,214	11,214	11,374	11,374
# twin pairs	11,294	11,294	5,607	5,607	5,687	5,687
Baseline mean	12.08	12.08	12.36	12.36	11.81	11.81
	Panel B: Permanent labor income (age 35-45)					
A. Less than 1500 grams	-0.082	-0.069	-0.085	-0.057	-0.080	-0.078
	(0.054)	(0.053)	(0.074)	(0.072)	(0.078)	(0.077)
B. Less than 2000 grams	-0.038	-0.033	-0.021	-0.023	-0.048	-0.039
	(0.021)*	(0.021)	(0.028)	(0.028)	(0.030)	(0.030)
C. Less than 2500 grams	-0.034	-0.029	-0.019	-0.014	-0.048	-0.043
	(0.014)**	(0.013)**	(0.017)	(0.016)	(0.021)	(0.021)**
Observations	22,200	22,200	11,060	11,060	11,140	11,140
# twin pairs	11,100	11,100	5,530	5,530	5,570	5,570
Baseline mean	12.02	12.02	12.31	12.31	11.73	11.73
Control for schooling	No	Yes	No	Yes	No	Yes

Notes: This table shows twins FE estimates of having a birth weight below various thresholds on permanent income for cohorts born 1933-1958. Columns (1) to (2) show results for the pooled sample of males and females. Columns (3) and (4) show results for males and columns (5) and (6) for females. Panel A show results for permanent total income and Panel B show results for permanent labor income. Income is defined as labor income from employment and self-employment plus taxable benefits, whereas labor income excludes the latter. Permanent income is calculated as the average income between the ages 35 and 45. Years of schooling is included in columns (2), (4), and (6) and is controlled for using discrete categories. The regressions on permanent income include cohorts born 1933-1958. *$p<0.10$, **$p<0.05$, ***$p<0.01$.

Table F

Birth weight and *income* across the lifecycle. Balanced panels. Twins FE models.

	30	35	Age 40	45	50	55
Balanced panels			Panel A: Income, males			
Log birth weight	0.123	0.112	0.106	0.076	0.055	0.052
	(0.049)**	(0.047)**	(0.049)**	(0.054)	(0.062)	(0.068)
Observations	7,722	7,722	7,722	7,722	7,722	7,722
Number of twin pairs	3,861	3,861	3,861	3,861	3,861	3,861
Baseline mean	12.18	12.28	12.34	12.39	12.45	12.49
			Panel B: Labor income, males			
Log birth weight	0.122	0.116	0.110	0.099	0.021	-0.073
	(0.048)**	(0.051)**	(0.054)**	(0.077)	(0.087)	(0.108)
Observations	6,668	6,668	6,668	6,668	6,668	6,668
Number of twin pairs	3,334	3,334	3,334	3,334	3,334	3,334
Baseline mean	12.20	12.29	12.35	12.44	12.42	12.39
			Panel C: Income, females			
Log birth weight	0.358	0.239	0.082	-0.002	0.061	0.089
	(0.138)***	(0.109)**	(0.077)	(0.058)	(0.056)	(0.061)
Observations	7,722	7,722	7,722	7,722	7,722	7,722
Number of twin pairs	3,861	3,861	3,861	3,861	3,861	3,861
Baseline mean	11.27	11.58	11.84	12.03	12.16	12.24
			Panel D: Labor income, females			
Log birth weight	0.284	0.193	0.041	-0.035	-0.009	-0.004
	(0.153)*	(0.122)	(0.087)	(0.073)	(0.091)	(0.135)
Observations	5,536	5,536	5,536	5,536	5,536	5,536
Number of twin pairs	2,768	2,768	2,768	2,768	2,768	2,768
Baseline mean	11.31	11.58	11.83	12.09	12.11	12.11

Notes: This table shows twins FE estimates of log(birth weight) on income for a balanced panel across the lifecycle for the cohorts born 1926-

1958. Panels A and B show regressions on average five-year income and average five-year labor income among males. Panels C and D shows the

corresponding regressions for females. Income is defined as labor income from employment and self-employment plus taxable benefits, whereas labor income excludes the latter. The ages in the table refer to the midpoints of the five-year averages. No controls for schooling are made. The cohorts included in the regressions vary, see the text for details. *p<0.10, **p<0.05, ***p<0.01.

Table G

Birth weight and *income* across the lifecycle. Non-linear specifications. Twins FE models.

				Age			
	30	35	40	45	50	55	60
Male twins, unbalanced							
A. Less than 1500 grams	-0.043	-0.042	-0.083	-0.156	-0.127	-0.037	-0.033
	(0.069)	(0.068)	(0.070)	(0.077)**	(0.084)	(0.091)	(0.111)
B. Less than 2000 grams	-0.060	-0.038	-0.025	-0.024	-0.054	-0.045	-0.019
	(0.026)**	(0.026)	(0.026)	(0.028)	(0.030)*	(0.034)	(0.039)
C. Less than 2500 grams	-0.034	-0.029	-0.022	-0.018	-0.017	0.006	-0.020
	(0.015)**	(0.015)*	(0.015)	(0.017)	(0.018)	(0.020)	(0.023)
Observations	10,636	11,632	12,554	12,368	12,044	9,886	7,292
Number of twin pairs	5,318	5,816	6,277	6,184	6,022	4,943	3,646
Baseline mean	12.16	12.27	12.33	12.39	12.44	12.44	12.43
Male twins, balanced							
A. Less than 1500 grams	-0.032	-0.081	-0.087	-0.049	-0.127	0.012	-
	(0.074)	(0.072)	(0.075)	(0.083)	(0.095)	(0.103)	-
B. Less than 2000 grams	-0.040	-0.032	-0.043	-0.034	-0.075	-0.081	-
	(0.028)	(0.028)	(0.029)	(0.032)	(0.036)**	(0.039)**	-
C. Less than 2500 grams	-0.029	-0.019	-0.011	-0.006	0.016	0.014	-
	(0.016)*	(0.016)	(0.017)	(0.018)	(0.021)	(0.022)	-
Observations	7,722	7,722	7,722	7,722	7,722	7,722	-
Number of twin pairs	3,861	3,861	3,861	3,861	3,861	3,861	-
Baseline mean	12.18	12.28	12.34	12.39	12.45	12.49	

(continued)

Table G (continued)

Female twins, unbalanced							
A. Less than 1500 grams	-0.063	0.197	0.105	-0.035	-0.010	-0.127	-0.288
	(0.138)	(0.121)	(0.100)	(0.080)	(0.074)	(0.081)	(0.104) ***
B. Less than 2000 grams	-0.034	-0.061	-0.056	0.025	0.0019	-0.059	-0.020
	(0.054)	(0.047)	(0.039)	(0.031)	(0.029)	(0.031)*	(0.037)
C. Less than 2500 grams	-0.018	-0.049	-0.017	-0.009	-0.042	-0.042	-0.057
	(0.038)	(0.033)	(0.027)	(0.022)	(0.020)**	(0.022)*	(0.025)**
Observations	9,656	11,064	12,228	12,484	12,434	10,428	8,126
Number of twin pairs	4,828	5,532	6,114	6,242	6,217	5,214	4,063
Baseline mean	11.33	11.47	11.69	11.91	12.04	12.09	12.06
Female twins, balanced							
A. Less than 1500 grams	-0.166	0.172	0.106	0.030	0.012	-0.005	-
	(0.175)	(0.137)	(0.098)	(0.073)	(0.071)	(0.076)	-
B. Less than 2000 grams	-0.080	-0.099	-0.046	0.037	0.002	-0.011	-
	(0.065)	(0.051)*	(0.037)	(0.027)	(0.026)	(0.029)	-
C. Less than 2500 grams	-0.019	-0.021	0.021	0.034	0.0153	-0.005	-
	(0.047)	(0.037)	(0.026)	(0.020)*	(0.019)	(0.021)	-
Observations	6,980	6,980	6,980	6,980	6,980	6,980	-
Number of twin pairs	3,490	3,490	3,490	3,490	3,490	3,490	-
Baseline mean	11.31	11.58	11.83	12.09	12.11	12.11	

Notes: This table shows twins FE estimates of having a birth weight below different thresholds on average five-year income at different ages.

The coefficients come from separate regressions. The ages in the tables refer to the midpoints of the five-year averages. No controls for schooling

are made. *p<0.10, **p<0.05, ***p<0.01.

Table H

Birth weight and *labor* income across the lifecycle. Non-linear specifications. Twins FE models.

| | Age | | | | | | |
	30	35	40	45	50	55	60
Male twins, unbalanced							
A. Less than 1500 grams	-0.037	-0.047	-0.097	-0.307	-0.427	-0.022	-0.037
	(0.072)	(0.076)	(0.087)	(0.104)***	(0.130)***	(0.181)	(0.358)
B. Less than 2000 grams	-0.062	-0.041	0.005	-0.028	-0.129	-0.085	-0.125
	(0.027)**	(0.029)	(0.032)	(0.038)	(0.046)***	(0.064)	(0.123)
C. Less than 2500 grams	-0.045	-0.033	-0.004	-0.047	0.006	0.056	-0.053
	(0.016)***	(0.017)*	(0.019)	(0.023)**	(0.027)	(0.038)	(0.074)
Observations	10,518	11,400	12,126	11,712	11,058	8,662	5,840
Number of twin pairs	5,259	5,700	6,063	5,856	5,529	4,331	2,920
Baseline mean	12.14	12.24	12.28	12.42	12.37	12.33	12.14
Male twins, balanced							
A. Less than 1500 grams	-0.018	-0.107	-0.077	-0.212	-0.107	0.050	-
	(0.076)	(0.079)	(0.084)	(0.119)*	(0.135)	(0.168)	-
B. Less than 2000 grams	-0.043	-0.027	-0.053	-0.056	-0.086	-0.084	-
	(0.029)	(0.030)	(0.032)*	(0.045)	(0.051)*	(0.063)	-
C. Less than 2500 grams	-0.029	-0.016	-0.018	-0.019	0.011	0.036	-
	(0.016)*	(0.017)	(0.018)	(0.025)	(0.029)	(0.036)	-
Observations	6,668	6,668	6,668	6,668	6,668	6,668	-
Number of twin pairs	3,334	3,334	3,334	3,334	3,334	3,334	-
Baseline mean	12.20	12.29	12.35	12.44	12.42	12.39	

(continued)

Table H (continued)

Female twins, unbalanced							
A. Less than 1500 grams	-0.071	0.094	0.057	-0.127	-0.038	-0.176	-0.565
	(0.142)	(0.124)	(0.110)	(0.097)	(0.130)	(0.157)	(0.285)**
B. Less than 2000 grams	-0.018	-0.063	-0.046	0.028	0.014	-0.071	-0.158
	(0.055)	(0.048)	(0.043)	(0.037)	(0.050)	(0.062)	(0.110)
C. Less than 2500 grams	-0.018	-0.058	-0.046	-0.017	-0.067	-0.082	-0.107
	(0.039)	(0.034)*	(0.030)	(0.026)	(0.035)*	(0.042)*	(0.071)
Observations	9,426	10,618	11,526	11,504	10,984	8,666	5,964
Number of twin pairs	4,713	5,309	5,763	5,752	5,492	4,333	2,982
Baseline mean	11.30	11.42	11.62	11.94	11.92	11.92	11.74
Female twins, balanced							
A. Less than 1500 grams	-0.098	0.235	0.141	0.070	0.112	0.055	-
	(0.189)	(0.150)	(0.108)	(0.090)	(0.112)	(0.167)	-
B. Less than 2000 grams	-0.057	-0.055	-0.033	0.029	0.007	0.001	-
	(0.074)	(0.058)	(0.042)	(0.035)	(0.044)	(0.065)	-
C. Less than 2500 grams	-0.021	-0.035	0.019	0.010	0.025	-0.017	-
	(0.051)	(0.041)	(0.029)	(0.025)	(0.030)	(0.045)	-
Observations	5,536	5,536	5,536	5,536	5,536	5,536	-
Number of twin pairs	2,768	2,768	2,768	2,768	2,768	2,768	-
Baseline mean	11.31	11.58	11.83	12.09	12.11	12.11	

Notes: This table shows twins FE estimatesof having a birth weight below different thresholds on average five-year labor income at different ages. The coefficients come from separate regressions. The ages in the tables refer to the midpoints of the five-year averages. No controls for schooling are made. *p<0.10, **p<0.05, ***p<0.01.

Table I

Descriptive statistics. Hospitalizations. Means and SDs.

	Old cohorts (1926-1958) Twins	
	Males	Females
Any hospitalization	0.633	0.670
	(0.482)	(0.470)
Cancer hospitalization	0.101	0.184
	(0.302)	(0.388)
CVD hospitalization	0.208	0.140
	(0.406)	(0.347)
Mental disease hospitalization	0.049	0.042
	(0.215)	(0.202)
Respiratory hospitalization	0.083	0.074
	(0.276)	(0.262)
Diabetes hospitalization	0.019	0.013
	(0.135)	(0.111)
Observations	13,022	13,392
# twin pairs (families)	6,511	6,696

Notes: The table shows descriptive statistics for hospitalizations for the "old" cohorts born

1926-1958. The variables measure the fraction that had any hospitalization for various causes

during the time period 1987-2008.

Table J

Birth weight and adult cause-specific mortality. Cox proportional hazard models. Males and Females.

	Males				Females			
	Cancer	CVD	Resp	Nerve	Cancer	CVD	Resp	Nerve
A. Log birth weight	0.464	1.069	1.232	0.0840	1.394	0.614	0.910	21.156
	(0.258)	(0.597)	(1.661)	(0.152)	(0.714)	(0.461)	(1.495)	(52.830)
B. Less than 2500 grams	0.787	1.089	1.400	6.000	0.934	1.167	1.750	0.800
	(0.152)	(0.225)	(0.820)	(6.481)*	(0.154)	(0.290)	(1.097)	(0.537)
C. Lighter twin	1.130	1.000	1.130	2.500	0.873	1.010	1.043	0.650
	(0.106)	(0.098)	(0.324)	(1.046)**	(0.076)	(0.142)	(0.304)	(0.232)
Observations	13,022	13,022	13,022	13,022	13,392	13,392	13,392	13,392
Number of twin pairs	6,511	6,511	6,511	6,511	6,696	6,696	6,696	6,696

Notes: This table shows estimates of log(birth weight) on cause-specific mortality for the cohorts born 1926-1958. All coefficients are from Cox proportional hazard models with twin fixed effects (twin-pair specific baseline hazards). The coefficients represent hazard ratios. The coefficients come from separate regressions. No controls for education or income are made. *p<0.10, **p<0.05, ***p<0.01.