Understanding Returns to Birthweight

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Birthweight

- Birthweight ... one of the most extensively used measures of infant health.
- Widely documented "*worse future outcomes of low birthweight babies*".
  - Not only in the medical literature but also in the social science literature.
  - Various short-term and long-term outcomes studied so far.

Causation and Correlation

- However, how should we interpret "*worse future outcomes of low birthweight babies*"?
- Story 1: If you are born with very low birthweight, you are doomed to go through very tough future life.
- Story 2: Those who have worse future outcomes are more likely to be born with low birthweight.
  - Birthweight and future outcomes have common factors: Mother's education and income, in-utero environment, physical and mental health, stress, unwanted babies, ...
- Implications for a country's human capital development.
  - Also, fairness, medical cost, welfare reliance.
  - Important to distinguish the two stories. Very different policy implications.

This Study

- Our aim is to quantitatively understand the *causal effect* of birthweight on future outcomes.
- We achieve this, relying on two key features:
  1. Danish register data
  2. New IV: Placenta previa
- Danish Register Data:
  - Administrative data — Large sample. High quality. Results generalizable.
  - We use population data of cohorts born 1981-2010 (over 1.7 million newborns) — We can study time trend too.
  - An extensive set of outcome variables

Empirical Specification

- $Y_i = \alpha + \beta \ln(BW_i) + X_i\gamma + \varepsilon_i$
- Measurement of birthweight: ln(birthweight)
  - Black et al (2007) find this is the best in terms of model fit.
- Linear form reasonable for population average effect.
- Our focus is to get the big picture by looking at an extensive set of outcomes.
- We use only singleton pregnancy.
- Controls: sex, birth year dummies, birth month dummies, mother age dummies, birth order, number of past pregnancy, prior abortions (spontaneous and induced) and stillbirth, number of past c-sections, mother's number of days in hospital during 180 days around conception, smoking, marital and cohabitation status, father age if living together, parental education, immigrant status, income and working status of parents in the previous year, county dummies.

If We Run Simple OLS...

Additional BW significantly reduces infant mortality. Similarly, ...

- Hospital admission. Permanent disability.
- Educational attainment
- Labour market outcomes and social welfare benefit
- Marital status
- Birthweight of their children
- Teen pregnancy, criminal offense.
- IQ, body size.

All estimates show "extra birthweight is wonderful" at 0.1% significance!

- Is it really causal?

Recent Literature: Twin Fixed Effects Model

- Recent attempts to quantify the causal birthweight effect rely on the *twin fixed-effects* approach:
  - Almond, Chay, Lee (2005) QJE
  - Behrman, Rosenzweig (2004) REStat
  - Black, Devereux, Salvanes (2007) QJE
  - Conley, Bennett (2000) American Sociological Review
  - Conley, Strully, Bennett (2006) Economics and Human Biology
  - Miller, Mulvey, Martin (2005) Economics Letters
  - Oreopoulos, Stabile, Walld, Roos (2008) Journal of Human Resources
  - Royer (2009) AEJ: Applied Economics
- Their findings are fairly mixed.

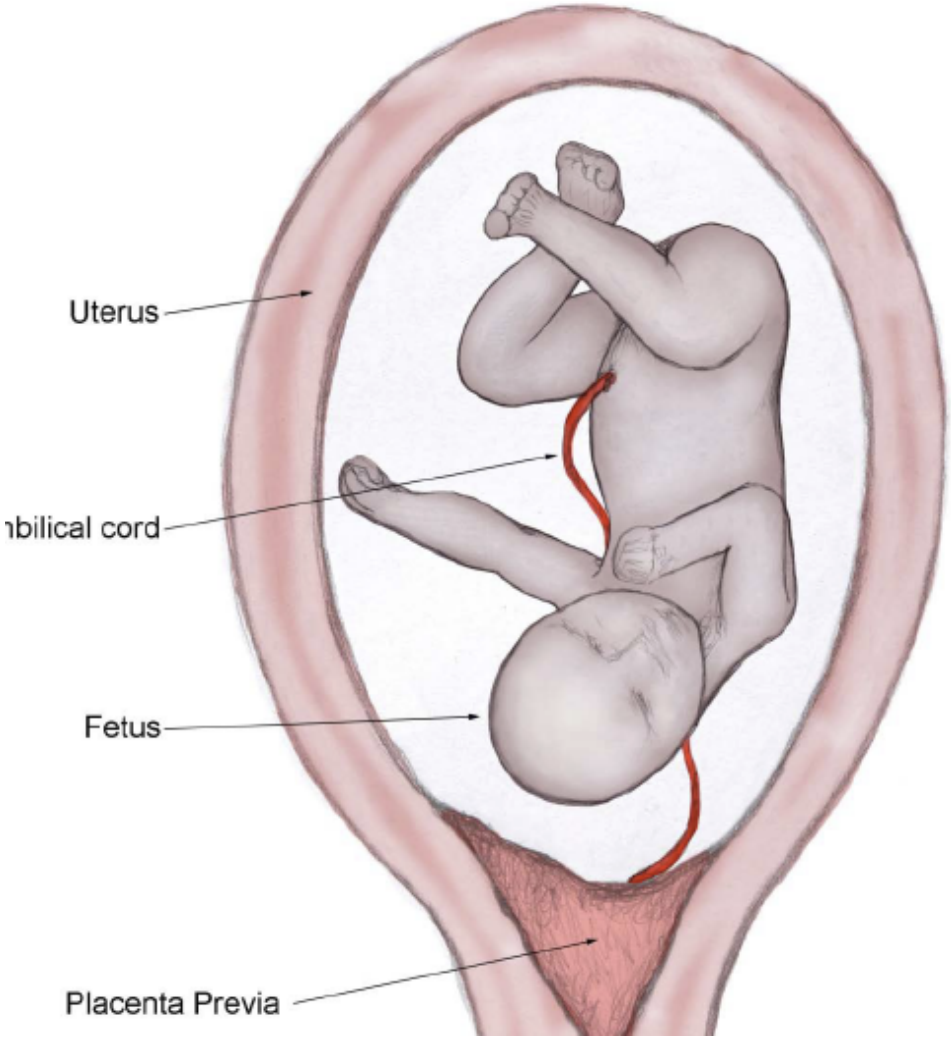
Instrumental Variable (IV) Approach: Concepts

- $Y_i = \alpha + \beta \ln(BW_i) + X_i\gamma + \varepsilon_i$
- If birthweight, BW, is completely random (like a lottery), we can claim β is the causal effect.

- Let's find some "randomness" in BW and utilize it to obtain causal effect estimates.
- Requirements for an instrument Z_i:
  1. Z_i offers variation to birthweight.
  2. Z_i is "random", unrelated to other relevant unobservable birth-specific factors, e.g. mother's health knowledge (after controlling for X_i).
  3. Z_i does not affect Y_i except through the channel of birthweight (after controlling for X_i).

- We propose **placenta previa** as an instrument that reasonably satisfies the above three requirements.

Placenta Previa

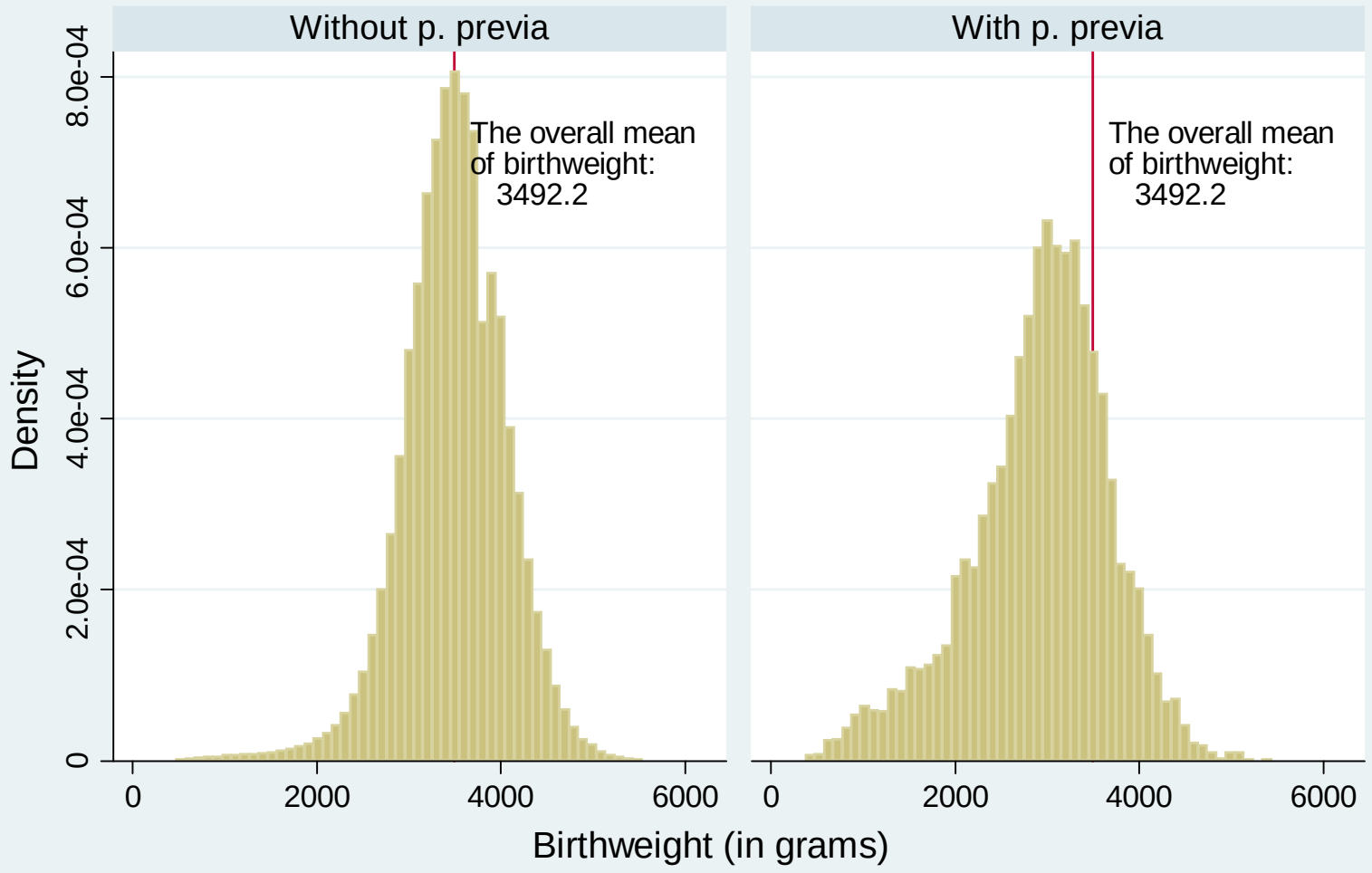


source: Joy et al., 2010

Placenta Previa

- The **placenta** is an organ that develops during pregnancy to connect the developing fetus to the uterine wall of the mother.
- **Placenta previa** is an obstetric complication in which the placenta is attached to the lower uterine segment close to or covering the cervix.
- In the US (1979-1987), incidence of placenta previa is 0.48% (Iyasu et al., 1993).
- It often requires cesarean delivery.
- $\Rightarrow$ More than half of placenta previa cases result in preterm birth with low birth weight.
    - Sugimoto (2007) reports 59% for preterm births, 41% for less than 32 weeks, 15% for below 28 weeks, 51% for low birthweight ($<$2,500g), 12% for less than 1,500g

Requirement 1: Does it Affect Birthweight?



Based on singleton cohorts 1981-2010. Placenta previa accounts for 0.35% of the sample.

Requirements 2 & 3

(2) Is it random?

- The medical literature has identified some risk factors:
  - mother's age, prior c-section, pregnancy termination, uterine surgery, multiple pregnancy, increasing parity, and smoking
- But once certain risk factors are controlled for, the incidence of placenta previa seems to be highly random.

(3) No direct effect?

- Placenta previa occurs as an abnormal position of placenta.
- The placenta is a temporary organ during pregnancy. It is discarded after birth.
- C-section is often required, but the literature has confirmed no long-term impact of C-sections.
- $\Rightarrow$ Placenta previa has little direct impact on a child, except for its effect through the channel of low birthweight.

How to Interpret the Results?

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1] Infant mortality (from birth to 365 days) (1981-2010) $\bar{Y}$=0.0047, N=1,783,340						
	-0.0761****	-0.0825****	-0.106****	-0.0776****	-0.133****	-0.0757****
	(0.00119)	(0.00886)	(0.00173)	(0.0118)	(0.00217)	(0.0144)

- 10% increase in birthweight would reduce 1-year mortality by 7.6∼8.2 deaths per 1,000 births.
- In addition to OLS and IV regression, we estimate mother fixed-effects models and grandmother fixed-effects models.

Results: Neonatal / Infant outcomes

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1] Permanent disability diagnosis by 2nd birthday (1981-2009)				$\bar{Y}$=0.0024, N=1,706,598		
	-0.0164****	-0.0274****	-0.0199****	-0.0209***	-0.0218****	-0.0229***
	(0.000537)	(0.00614)	(0.000782)	(0.00733)	(0.000965)	(0.00826)
[2] Number of days in hospital before 2nd birthday (1981-2009)				$\bar{Y}$=2.572, N=1,706,598		
	-21.08****	-39.43****	-24.64****	-38.07****	-26.07****	-35.92****
	(0.137)	(1.176)	(0.184)	(1.405)	(0.220)	(1.605)

- Birthweight is critical for infant health.

Results: Time Trends

[1A] Infant mortality, period 1 (1981-1993) $\bar{Y}$=0.0066, N=723,817					
-0.0883****	-0.133****	-0.140****	-0.151****	-0.175****	-0.164****
(0.00187)	(0.0163)	(0.00323)	(0.0269)	(0.00398)	(0.0314)
[1B] Infant mortality, period 2 (1994-2010) $\bar{Y}$=0.0034, N=1,059,523					
-0.0676****	-0.0413****	-0.100****	-0.0322**	-0.124****	-0.0287*
(0.00155)	(0.00907)	(0.00243)	(0.0128)	(0.00298)	(0.0163)

- The effect became smaller, partly because mortality decreased over time, but also because of improved medical technology.

Results: Time Trends

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1] Permanent disability diagnosis by 2nd birthday (1981-2009) $\bar{Y}$=0.0024, N=1,706,598						
	-0.0164****	-0.0274****	-0.0199****	-0.0209***	-0.0218****	-0.0229***
	(0.000537)	(0.00614)	(0.000782)	(0.00733)	(0.000965)	(0.00826)
[1A] Permanent disability diagnosis by 2nd birthday, period 1 (1981-1993) $\bar{Y}$=0.0024, N=716,658						
	-0.0189****	-0.0329****	-0.0233****	-0.0343***	-0.0240****	-0.0308**
	(0.000879)	(0.00996)	(0.00150)	(0.0133)	(0.00173)	(0.0157)
[1B] Permanent disability diagnosis by 2nd birthday, period 2 (1994-2009) $\bar{Y}$=0.0024, N=989,940						
	-0.0146****	-0.0229***	-0.0181****	-0.0148	-0.0194****	-0.0204*
	(0.000671)	(0.00771)	(0.00105)	(0.00975)	(0.00129)	(0.0104)
[2] Number of days in hospital before 2nd birthday (1981-2009) $\bar{Y}$=2.572, N=1,706,598						
	-21.08****	-39.43****	-24.64****	-38.07****	-26.07****	-35.92****
	(0.137)	(1.176)	(0.184)	(1.405)	(0.220)	(1.605)
[2A] Number of days in hospital before 2nd birthday, period 1 (1981-1993) $\bar{Y}$=2.713, N=716,658						
	-20.00****	-40.46****	-23.77****	-38.67****	-25.37****	-36.71****
	(0.200)	(2.014)	(0.307)	(3.216)	(0.367)	(3.593)
[2B] Number of days in hospital before 2nd birthday, period 2 (1994-2009) $\bar{Y}$=2.470, N=989,940						
	-21.85****	-38.62****	-25.40****	-37.10****	-26.36****	-35.92****
	(0.185)	(1.388)	(0.269)	(1.695)	(0.318)	(1.727)

- Similarly the effect has diminished for infant disabilities.

Results: Hospital Admission

[3A] Hospitalization: 2nd to 5th birthday (1981-1991) $\bar{Y}$=0.1744, N=586,397					
-0.111****	-0.178****	-0.128****	-0.252***	-0.121****	-0.199**
(0.00317)	(0.0495)	(0.00608)	(0.0860)	(0.00755)	(0.0975)
[3B] Hospitalization: 5th to 10th birthday (1981-1991) $\bar{Y}$=0.1803, N=584,147					
-0.0837****	-0.121**	-0.0953****	-0.151*	-0.0875****	-0.0848
(0.00316)	(0.0496)	(0.00607)	(0.0859)	(0.00748)	(0.0975)
[3C] Hospitalization: 10th to 15th birthday (1981-1991) $\bar{Y}$=0.1447, N=582,800					
-0.0454****	-0.109**	-0.0385****	-0.0962	-0.0349****	-0.105
(0.00286)	(0.0461)	(0.00559)	(0.0818)	(0.00696)	(0.0922)
[3D] Hospitalization: 15th to 20th birthday (1981-1991) $\bar{Y}$=0.1674, N=580,379					
-0.0338****	-0.0802*	-0.0276****	-0.102	-0.0183**	-0.0299
(0.00297)	(0.0475)	(0.00584)	(0.0858)	(0.00726)	(0.0976)

- The birthweight effect diminishes as a child grows older.

Results: Education

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1] Completed Grade 9 by year of age 16 (1981-1995) $\bar{Y}$=0.852, N=820,136						
	0.147****	0.139****	0.137****	0.155***	0.136****	0.119*
	(0.00241)	(0.0375)	(0.00410)	(0.0584)	(0.00502)	(0.0661)
[2] National exam score, Grade 9 (≈ age 16): overall mean (1986-1994) $\bar{Y}$=0.017, N=459,105						
	0.196****	-0.0121	0.135****	-0.289*	0.124****	-0.0964
	(0.00641)	(0.106)	(0.0112)	(0.163)	(0.0133)	(0.175)
[3] Standardized exam score: Danish (oral) (1986-1994) $\bar{Y}$=0.033, N=458,007						
	0.120****	-0.101	0.0734****	-0.229	0.0738****	0.0737
	(0.00849)	(0.142)	(0.0161)	(0.232)	(0.0203)	(0.262)
[4] Standardized exam score: Danish (written) (1986-1994) $\bar{Y}$=0.052, N=459,060						
	0.176****	-0.0612	0.118****	-0.393*	0.113****	-0.138
	(0.00752)	(0.126)	(0.0133)	(0.202)	(0.0160)	(0.217)
[5] Standardized exam score: English (1986-1994) $\bar{Y}$=0.006, N=449,444						
	0.117****	-0.109	0.0496***	-0.449*	0.0487**	-0.242
	(0.00877)	(0.143)	(0.0160)	(0.235)	(0.0193)	(0.255)
[6] Standardized exam score: Mathematics (1986-1994) $\bar{Y}$=0.052, N=457,662						
	0.337****	0.153	0.269****	-0.269	0.233****	-0.135
	(0.00817)	(0.135)	(0.0145)	(0.211)	(0.0174)	(0.228)
[7] Standardized exam score: Science (1986-1994) $\bar{Y}$=0.020, N=436,290						
	0.159****	-0.0689	0.102****	-0.0321	0.103****	0.119
	(0.00883)	(0.156)	(0.0169)	(0.253)	(0.0212)	(0.279)

Results: Social Welfare

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1A] Receipt of disability pension during the three years of age 19-21 (1981-1991) $\bar{Y}$=0.011, N=578,987						
	-0.0353****	-0.0533***	-0.0438****	-0.0811***	-0.0496****	-0.0817**
	(0.00135)	(0.0177)	(0.00244)	(0.0283)	(0.00296)	(0.0323)
[1B] Receipt of disability pension: DKK100,000+, during 3 years of age 19-21 (1981-1990) $\bar{Y}$=0.009, N=519,772						
	-0.0330****	-0.0526***	-0.0400****	-0.0596**	-0.0460****	-0.0714**
	(0.00135)	(0.0175)	(0.00252)	(0.0282)	(0.00305)	(0.0319)
[1C] Number of weeks of disability pension receipt during 3 years of age 19-21 (1981-1991) $\bar{Y}$=1.307, N=578,987						
	-4.610****	-5.880***	-5.955****	-8.308**	-6.725****	-10.59**
	(0.181)	(2.253)	(0.333)	(3.574)	(0.405)	(4.341)

- Low birthweight significantly increases the chance of disability pension.
- Moderate effect for other welfare benefits (income assistance, job training, etc).

Results: Socioeconomics: Teen pregnancy

[3A] Pregnancy as a mother by the birthday of age 20 (1981-1990) $\bar{Y}$=0.0512, N=253,631					
-0.0152****	0.0132	0.00218	-0.00792	0.0142	0.00849
(0.00259)	(0.0399)	(0.00749)	(0.0946)	(0.0101)	(0.120)
[3B] Pregnancy as a father by the birthday of age 20 (1981-1990) $\bar{Y}$=0.0123, N=267,010					
-0.00191	0.0300**	0.00287	0.102**	0.00944*	0.0791*
(0.00121)	(0.0146)	(0.00376)	(0.0446)	(0.00519)	(0.0476)

- Teen pregnancy is a major source of poverty in early life.
- BW has positive effect on teen fatherhood.

Results: Intergenerational

[5] Birthweight of the first child by age 22 (1981-1990) $\bar{Y}$=3391.1, N=25,902					
585.7****	-225.5	382.6****	30.43	253.7**	237.8
(22.97)	(295.3)	(91.83)	(502.2)	(108.5)	(525.4)
[5A] Birthweight of the first child by age 22: female (1981-1990) $\bar{Y}$=3394.3, N=18,421					
672.5****	-314.0	463.3****	-481.0	285.7*	N too small
(27.63)	(394.9)	(126.5)	(2425.1)	(156.6)	
[5B] Birthweight of the first child by age 22: male (1981-1990) $\bar{Y}$=3383.1, N=7,481					
378.5****	-152.1	258.8	-313.5	-332.7	N too small
(42.40)	(438.7)	(320.9)	(248.5)	(489.6)	

- The strong correlation is not causal.
- Similar conclusion for marriage outcome and income.

Results: Crime

[6A] Any criminal sentence by the 20th birthday (1981-1991) $\bar{Y}$=0.092, N=580,492					
-0.00860****	0.0481	0.0199****	0.0751	0.0300****	0.0707
(0.00219)	(0.0347)	(0.00433)	(0.0591)	(0.00530)	(0.0662)
[6B] Probation or unconditional sentence by the 20th birthday (1981-1991) $\bar{Y}$=0.033, N=580,492					
-0.00564****	0.0245	0.00929****	0.0472	0.0159****	0.0284
(0.00136)	(0.0211)	(0.00282)	(0.0369)	(0.00344)	(0.0430)
[6C] Any charge of violent crime by the 20th birthday (1981-1991) $\bar{Y}$=0.028, N=580,492					
-0.000120	0.0345*	0.00998****	0.0375	0.0129****	0.00454
(0.00124)	(0.0184)	(0.00260)	(0.0344)	(0.00319)	(0.0386)

- Though weakly, BW increases crime tendency.

Results of Child Outcomes: Military Exam

	OLS	IV	OLS Grandmother FE	IV Grandmother FE	OLS Mother FE	IV Mother FE
[1] Conscription session attendance (1988-1993) $\bar{Y}$=0.762, N=183,877						
	0.0965****	0.185**	0.111****	0.546**	0.103****	0.521**
	(0.00597)	(0.0890)	(0.0163)	(0.242)	(0.0231)	(0.255)
[2] Qualified for military service (inclusive of restricted qualification) (1988-1993) $\bar{Y}$=0.564, N=183,877						
	0.119****	0.221**	0.124****	0.764***	0.132****	0.688**
	(0.00657)	(0.0980)	(0.0185)	(0.295)	(0.0261)	(0.348)
[3] Color vision deficiency at conscription examination (1988-1993) $\bar{Y}$=0.0612, N=139,414						
	0.000890	-0.0521	0.0127	0.0894	0.00507	0.0671
	(0.00393)	(0.0653)	(0.0109)	(0.138)	(0.0155)	(0.121)
[4] IQ test standardized score at conscription examination (1988-1993) $\bar{Y}$= –0.003, N=138,924						
	0.447****	0.0994	0.322****	0.0456	0.361****	0.117
	(0.0156)	(0.227)	(0.0425)	(0.625)	(0.0574)	(0.613)
[5] Height at conscription examination (1988-1993) $\bar{Y}$=180.46, N=140,090						
	10.39****	2.604*	7.976****	0.462	7.125****	-0.920
	(0.117)	(1.558)	(0.301)	(4.047)	(0.367)	(4.202)
[6] Weight at conscription examination (1988-1993) $\bar{Y}$=77.67, N=139,973						
	15.38****	5.989*	12.47****	4.348	9.631****	-4.911
	(0.255)	(3.595)	(0.714)	(9.732)	(0.876)	(10.47)
[7] BMI at conscription examination (1988-1993) $\bar{Y}$=23.82, N=139,972						
	1.994****	1.137	1.763****	1.102	1.113****	-1.344
	(0.0707)	(1.027)	(0.205)	(2.809)	(0.254)	(2.968)

Comparison (1): Twin OLS vs Singleton OLS

	Twin OLS	Twin Fixed Effects	Singleton OLS	Singleton Mother FE	Singleton IV	Singleton Mother FE IV
[1] Infant mortality (from birth to 365 days) (1981-2010) $\bar{Y}$=0.0181 / 0.0047, N=60,047 / 1,783,340						
	-0.183****	-0.0406****	-0.0761****	-0.133****	-0.0825****	-0.0757****
	(0.00659)	(0.00708)	(0.00119)	(0.00217)	(0.00886)	(0.0144)
[2] Permanent disability diagnosis by 2nd birthday (1981-2009) $\bar{Y}$=0.0061 / 0.0024, N=56,135 / 1,706,598						
	-0.0332****	-0.00669	-0.0164****	-0.0218****	-0.0274****	-0.0229***
	(0.00270)	(0.00464)	(0.000537)	(0.000965)	(0.00614)	(0.00826)
[3] Number of days in hospital before 2nd birthday (1981-2009) $\bar{Y}$=11.517 / 2.572, N=56,135 / 1,706,598						
	-57.71****	-6.259****	-21.08****	-26.07****	-39.43****	-35.92****
	(0.585)	(0.672)	(0.137)	(0.220)	(1.176)	(1.605)

- Correlation between birthweight and infant health is larger for Twins.
- Mainly because $\overline{Y}$ is larger! The distribution of twins is different.
- $\longrightarrow$ Singletons and Twins are different. Twins results not generalizable.

Comparison (2): Twin FE vs Singleton FE

	Twin OLS	Twin Fixed Effects	Singleton OLS	Singleton Mother FE	Singleton IV	Singleton Mother FE IV
[1] Infant mortality (from birth to 365 days) (1981-2010) $\bar{Y}$=0.0181 / 0.0047, N=60,047 / 1,783,340						
	-0.183****	-0.0406****	-0.0761****	-0.133****	-0.0825****	-0.0757****
	(0.00659)	(0.00708)	(0.00119)	(0.00217)	(0.00886)	(0.0144)
[2] Permanent disability diagnosis by 2nd birthday (1981-2009) $\bar{Y}$=0.0061 / 0.0024, N=56,135 / 1,706,598						
	-0.0332****	-0.00669	-0.0164****	-0.0218****	-0.0274****	-0.0229***
	(0.00270)	(0.00464)	(0.000537)	(0.000965)	(0.00614)	(0.00826)
[3] Number of days in hospital before 2nd birthday (1981-2009) $\bar{Y}$=11.517 / 2.572, N=56,135 / 1,706,598						
	-57.71****	-6.259****	-21.08****	-26.07****	-39.43****	-35.92****
	(0.585)	(0.672)	(0.137)	(0.220)	(1.176)	(1.605)

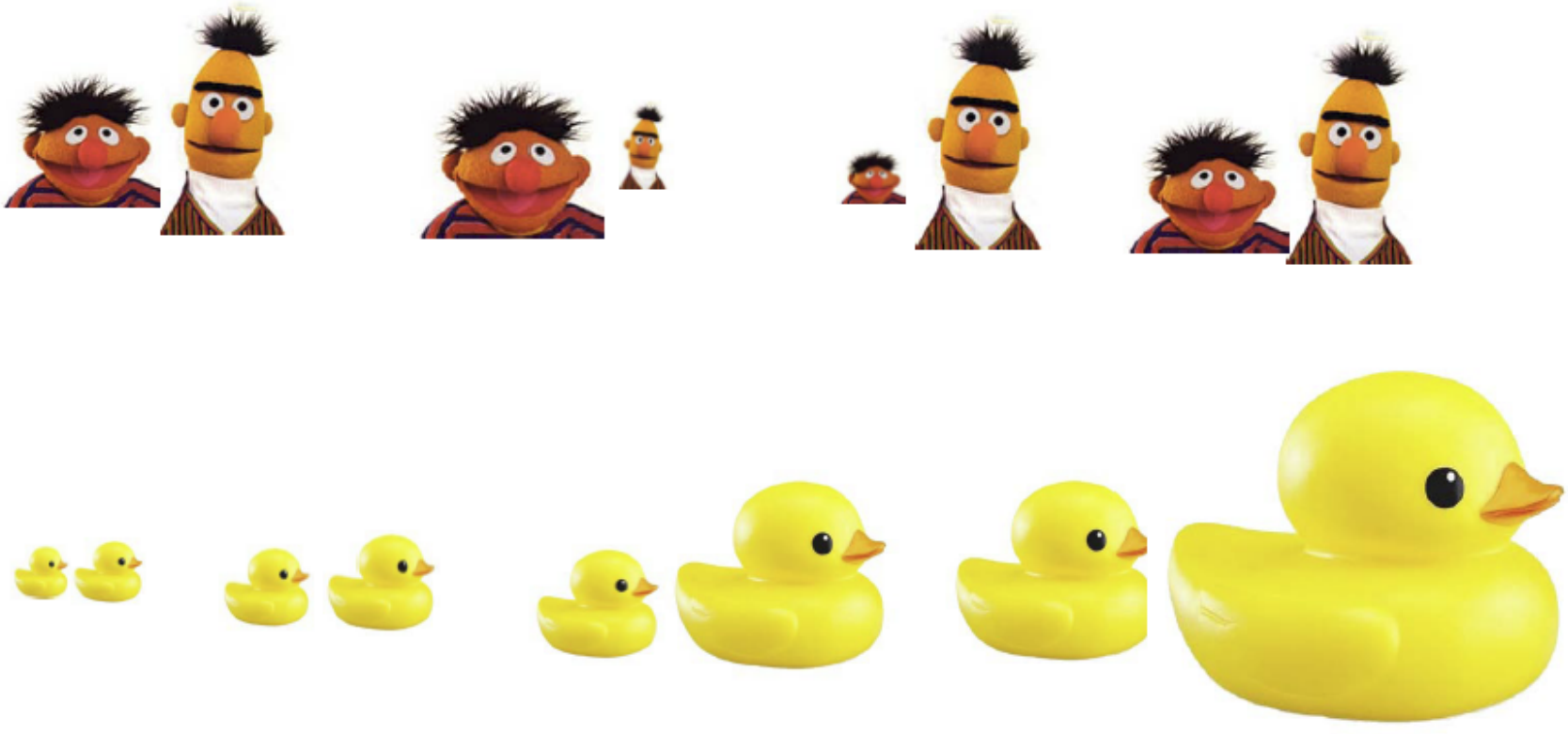
- Twin FE and singleton FE generate opposite results.
- Our explanation: The assignment of birthweight is not random within twins/siblings. Therefore these estimators are looking at different margins.

Non-Random Assignment of Birthweight

Dependent variable: Mean birthweight of two siblings	[1] Singleton siblings	[2] Twins
Difference in birthweight between two siblings (absolute value)	-0.185****	0.094****
	(0.0021)	(0.0136)
Constant	3608.9****	2498.3****
	(1.032)	(6.052)
R^2	0.0220	0.0019
N	729,643	26,298

- If birthweight $\sim$ an iid normal, the coefficient should be zero.

Non-Random Assignment of Birthweight



Comparison (3): Ours vs Black et al (2007)

	Twin OLS	Twin Fixed Effects	Singleton OLS	Singleton Mother FE	Singleton IV	Singleton Mother FE IV
[1] Infant mortality (from birth to 365 days) (1981-2010) $\bar{Y}$=0.0181 / 0.0047, N=60,047 / 1,783,340						
	-0.183****	-0.0406****	-0.0761****	-0.133****	-0.0825****	-0.0757****
	(0.00659)	(0.00708)	(0.00119)	(0.00217)	(0.00886)	(0.0144)
[1-BDS] 1 year mortality, results from Black, Devereux, and Salvanes (2007), Tables I and III.						
			(1967-1997) $\bar{Y}$=0.0311 / 0.0062, N=33,366 / 1,253,546			
	-0.2796****	-0.0411****	-0.1235****	-0.1867****		
	(0.00912)	(0.00764)	(0.00171)	(0.00069)		

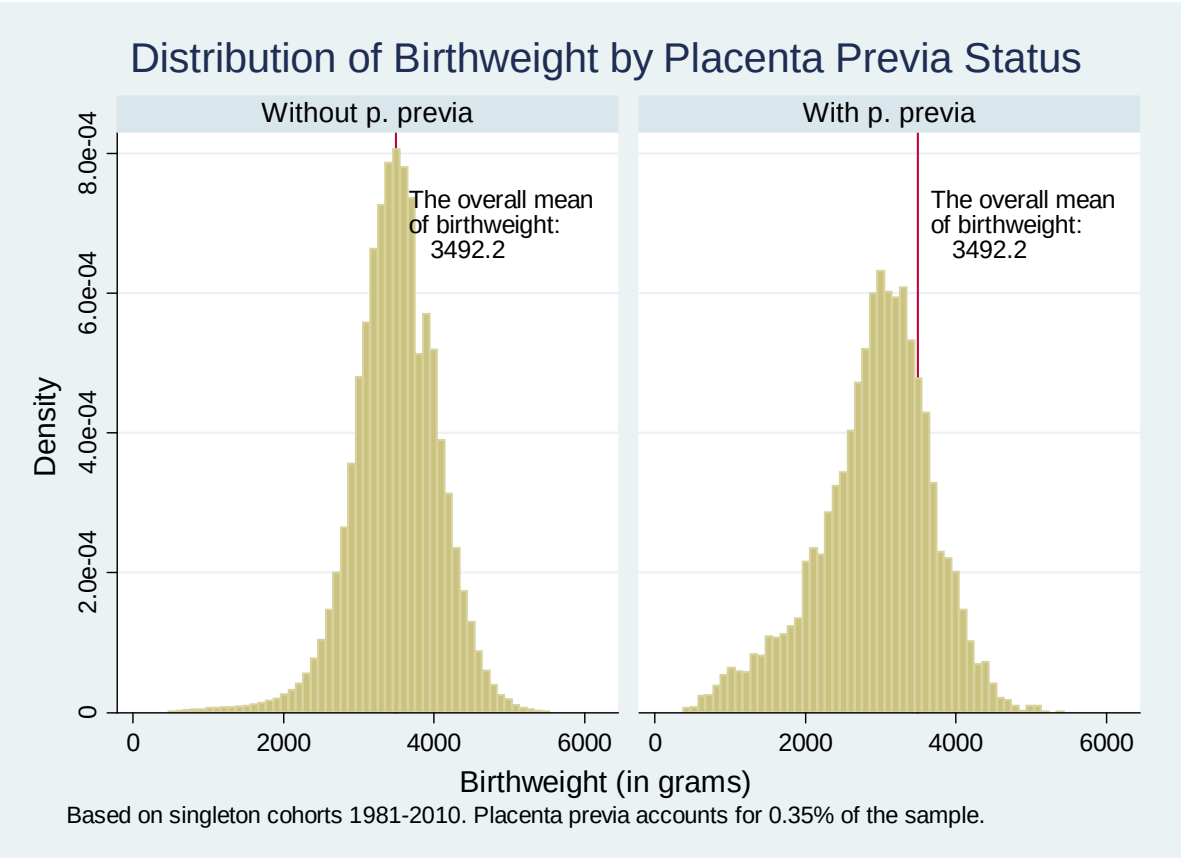
- Consistent patterns in Black, Devereux, and Salvanes (2007, QJE).

Comparison (4): Twin FE vs Singleton IV

	Twin OLS	Twin Fixed Effects	Singleton OLS	Singleton Mother FE	Singleton IV	Singleton Mother FE IV
[1] Infant mortality (from birth to 365 days) (1981-2010) $\bar{Y}$=0.0181 / 0.0047, N=60,047 / 1,783,340						
	-0.183****	-0.0406****	-0.0761****	-0.133****	-0.0825****	-0.0757****
	(0.00659)	(0.00708)	(0.00119)	(0.00217)	(0.00886)	(0.0144)
[2] Permanent disability diagnosis by 2nd birthday (1981-2009) $\bar{Y}$=0.0061 / 0.0024, N=56,135 / 1,706,598						
	-0.0332****	-0.00669	-0.0164****	-0.0218****	-0.0274****	-0.0229***
	(0.00270)	(0.00464)	(0.000537)	(0.000965)	(0.00614)	(0.00826)
[3] Number of days in hospital before 2nd birthday (1981-2009) $\bar{Y}$=11.517 / 2.572, N=56,135 / 1,706,598						
	-57.71****	-6.259****	-21.08****	-26.07****	-39.43****	-35.92****
	(0.585)	(0.672)	(0.137)	(0.220)	(1.176)	(1.605)

- Between FE estimates and IV estimates, there is no clear pattern.
- We argue that our IV estimator generates reasonable population average birthweight effect, because...

Why Is Our IV Good?



1. Placenta previa can occur to everyone.
2. The distribution with PP maintains large variance.
3. PP significantly $\Downarrow$ birthweight (and never $\Uparrow$).

Summary

- We investigated the causal effects of birthweight.
- The existing studies have used twins fixed-effects estimators, but their results are misleading.
- Two key features:
  1. Population data from Danish administrative registers. Over 1.7 million observations since 1981. A wide variety of outcome variables.
  2. New instrument: Placenta previa.

Three Main Conclusions

- (1) The strong correlations between birthweight and future outcomes are mostly non-causal.
  - Those who face a miserable future life are more likely to be born with a smaller birthweight.
    - OLS $\Rightarrow$ very robust, misleading results. Large data does not help.
  - Exception is strong birthweight effects on infant health outcomes.
- (2) As a child grows older, the relative influence of birthweight diminishes.
  - Birthweight is not a critical initial condition for the future.
  - Exception is the propensity of disability pension.
- (3) Over time, the effects of birthweight has diminished.

Overall message: BW is important, but its role should not be over-emphasized. Interpretation requires caution.