

Curriculum Reforms and Infant Health

(Conditionally Accepted-Review of Economics and Statistics)

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Importance of Early Childhood Health

- Short term implication
 - ▶ Infant mortality rates in the U.S. are more than twenty times higher for low birth weight (LBW) infants than those of normal weight (National Center for Health Statistics, 2018).
 - ▶ Two-thirds of all infant deaths in 2016 were born premature (National Center for Health Statistics, 2018).

Importance of Early Childhood Health

- Long term implications:
 - ▶ Poor health during adulthood (Oreopoulos et al. 2008; Currie et al. 2010).
 - ▶ Labor market outcomes (Black et al. 2007; Oreopoulos et al. 2008).
 - ▶ Cognitive development (Figlio et al. 2014).

Production of Child Health

- Access to medical care.
- Parental income.
- Genetic makeup.
- Environmental factors (e.g., air quality; disease prevalence).
- In utero exposure to maternal stress.

- Our focus is Maternal Education.

Why should maternal education affect child health?

- Productive efficiency (Grossman 1972).
 - ▶ Ability to produce better health with a given set of inputs.
- Allocative efficiency (Grossman 2006).
 - ▶ Exhibiting health enhancing behaviors.
- Income and Occupation (Card 2001; Oreopoulos 2006).
- Assortative mating.

Motivation

- The empirical evidence is mixed (e.g., Currie and Moretti 2003; and McCrary and Royer 2011).
- Existing studies focus on years of schooling.
- What a student does in school may be equally important.
 - ▶ Allocation of existing school time matters.
 - ▶ Goodman (2019)-math coursework is crucial.

Motivation

- As noted in Altonji (1995):

“From the point of view of the human capital interpretations, one would hope that a year’s worth of high school courses has value regardless of whether one requires an extra year to complete them.”

This Paper

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- **Identification:** Staggered introduction of the new curriculum requirements across the states (changes in minimum core course requirements).
- **Empirical Methodology:** Difference-in-Differences framework.
- **Data:** Confidential Vital Statistics Natality records for high school classes of 1982-1994.

Preview

- **Findings:**

- ▶ Black Mothers: around 3.5 percent reduction on likelihood of LBW and prematurity.
- ▶ White Mothers: the estimated effects are consistently smaller and insignificant.
- ▶ We find suggestive evidence that the results are driven by reforms in math.
- ▶ Curriculum reforms may have closed the black-white gap in infant health by around 3 percent.

- **Social Gain Calculation:**

- ▶ Total social gain can be as large \$568 million (2017 dollars).

- **Mechanisms:**

- ▶ Reduced smoking during pregnancy.
- ▶ Improved economic outcomes.

Background

- Curriculum reforms triggered by “A Nation at Risk” report.
 - ▶ High rates of functional illiteracy.
 - ▶ Dramatic declines in average scores on the SAT.
 - ▶ Rising demand for remedial education.
 - ▶ Declining performance of U.S. students in international assessments.

Background

- Solution: adoption of rigorous curriculum standards.
- The report suggested that:

“high school graduation requirements be strengthened and that, at a minimum, all students seeking a diploma be required to take the following curriculum during their 4 years of high school: (a) 4 years of English; (b) 3 years of mathematics, (c) 3 years of social studies; and (iv) one-half year of computer science.”

Background

- Several states reacted immediately by adopting curriculum reforms that changed the minimum number of core courses required to receive a high school diploma.
- Students starting high school one year would have course requirements that were entirely different than those for students who entered high school just the year before.

Background

- Forty states, in different years, introduced changes to the minimum number of courses required for high school diploma.
- The reforms were introduced between 1980 and 1985.
- Math has been the pivotal subject of the curriculum reforms.

Curriculum Reforms: States, Subjects and Years of Adoption

Table A1: Curriculum Reforms: States, Subjects and Years of Adoption

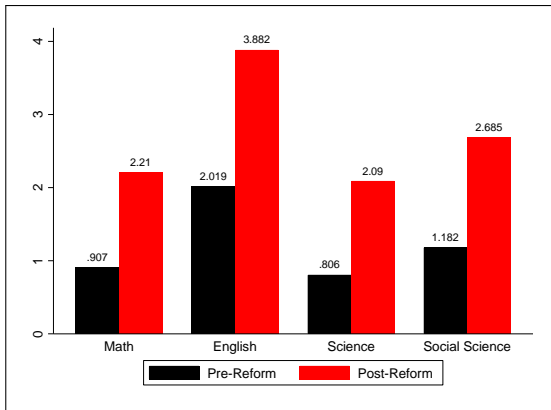
States	Reform Subjects	Reform Years
Alabama	Math	1981
Alaska	Math, Science, English	1981
Arizona	Math	1983
Arkansas	Math, Science, Social Studies	1984
California	Math, Science, Social Studies, English	1983
Connecticut	Math, Science, Social Studies, English	1984
Delaware	Math, Science	1983
D.C.	Math, Science, Social Studies	1981
Florida	Math, Science, Social Studies, English	1983
Georgia	Math, Science, Social Studies, English	1984
Idaho	Math, English	1984
Illinois	Math, Science, Social Studies	1984
Indiana	Math, Science, English	1985
Kansas	Math, Science, Social Studies	1985
Kentucky	Math, English	1983
Louisiana	Math, Science, Social Studies, English	1985
Maine	Math, Science, Social Studies	1985
Maryland	Math	1985
Mississippi	Math, Science, English	1985
Missouri	Math, Science, Social Studies, English	1984
Nevada	Math	1982

Curriculum Reforms: States, Subjects and Years of Adoption

Table A1 cont.

New Hampshire	Math, Science, Social Studies	1985
New Mexico	Science	1983
North Carolina	Math	1983
North Dakota	Math, English	1980
Ohio	Math	1984
Oklahoma	Math, Science, Social Studies	1983
Oregon	Math, Science	1984
Pennsylvania	Math, Science, Social Studies, English	1985
Rhode Island	Math, Science, Social Studies	1985
South Carolina	Math, Science	1983
South Dakota	Math, Science, Social Studies	1985
Tennessee	Math, Science	1983
Texas	Math, English	1984
Utah	Math, Science, Social Studies	1984
Vermont	Math, Science, Social Studies, English	1985
Virginia	Math, Science	1984
Washington	Math	1985
West Virginia	Math, Science	1981
Wisconsin	Math, Science, Social Studies, English	1985

Minimum Courses Required for High School Graduation



- **Primary Sources:**

- ▶ Vital Statistics Natality Records (1982 to 2015).
- ▶ For mechanisms: American Community Survey (2000-2005) and 2000 Census.

Data

- **Sample:**

- ▶ High School cohorts graduating between 1982 and 1994.
- ▶ Concentrate on only black and white mothers (ages 18 to 49 years old).
- ▶ Outcomes of Interest: LBW ($BW < 2,500$ grams) and prematurity (Gestational Length < 37 weeks).
- ▶ More than 3.7 and 16.7 million observations for black and white mothers, respectively.

Summary Statistics

Table 1: Summary Statistics

	Blacks		Whites	
	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform
	Mean (Standard Deviation)			
	(1)	(2)	(3)	(4)
Panel A: Controls				
Mother Age	25.956 (5.394)	25.259 (5.384)	27.977 (5.267)	27.339 (5.358)
Birth Order	2.615 (1.603)	2.641 (1.647)	2.275 (1.401)	2.245 (1.415)
Child Male	0.508 (0.500)	0.508 (0.500)	0.513 (0.500)	0.514 (0.500)
More than High School	0.401 (0.490)	0.436 (0.496)	0.570 (0.495)	0.611 (0.488)
Pupil/Teacher Ratio	18.307 (1.636)	17.525 (2.135)	18.345 (2.266)	17.848 (2.623)
State Unemployment Rate (%)	8.518 (2.350)	6.273 (1.354)	8.267 (2.346)	6.208 (1.429)
Panel B: Birth Outcomes				
Low Birth Weight	0.102 (0.303)	0.099 (0.299)	0.041 (0.198)	0.044 (0.205)
Premature	0.157 (0.364)	0.151 (0.358)	0.076 (0.264)	0.084 (0.278)
Sample Size	1,678,763	2,039,850	8,150,397	8,545,102

Empirical Methodology

To evaluate the effects of curriculum reforms (changes to the minimum number of core courses required for a high school diploma) on infant health, we estimate the following equation

$$Y_{isc} = \gamma_0 + \gamma_1 CR_{sc} + X'_{isc} \gamma_2 + \lambda_s + \tau_c + \epsilon_{isc}, \quad (1)$$

- Y_{isc} is a birth outcome such as low birth weight or prematurity
- CR_{sc} is an indicator that takes the value of one if mother's high school entry cohort was exposed to curriculum reform.
- X'_{isc} is a set of observable characteristics.
- λ_s and τ_c denote state of high school attendance and cohort fixed effects, respectively and finally, ϵ_{isc} is the error term.

Empirical Methodology

- **Identifying assumption:** Parallel trends between treated and control states in infant health outcomes.
- To test this assumption, we also specify a modified version of equation (1) by leading leads and lags as

$$Y_{isc} = \gamma_0 + \sum_{k=-m}^m \delta_k 1\{K_{sc} = k\} + X'_{sc} \gamma_2 + \lambda_s + \tau_c + \epsilon_{isc}. \quad (2)$$

- The existence of any lag effects (δ_k for $k < 0$) is likely to invalidate our identification strategy.

Preliminary Checks

- Curriculum reforms did not have any impact on fertility.
- Curriculum reforms did not have any impact on maternal characteristics (e.g., mother's age at birth, marital status at birth; and child's gender).

Main Results-Black Mothers

Table 3: Effects of Curriculum Reforms on Infant Health Outcomes-Black Mothers

	Coefficient($\times 100$) (Standard Error)	
	(1)	(2)
Panel A:		
Exposed to Curriculum Reform (Weighted)	-0.358** (0.140)	-0.528*** (0.172)
Sample Size	3,718,613	3,676,196
Controls:		
Cohort Fixed Effects	Yes	Yes
State Fixed Effects	Yes	Yes
Mother/Child Characteristics	Yes	Yes
State Characteristics	Yes	Yes
Census Division-Specific Trends	Yes	Yes

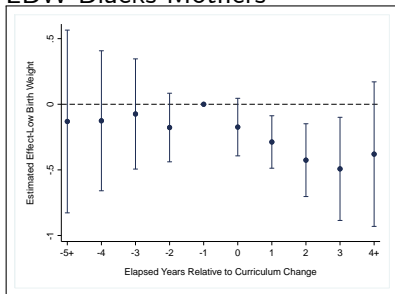
Main Results-White Mothers

Table 4: Effects of Curriculum Reforms on Infant Health Outcomes-White Mothers

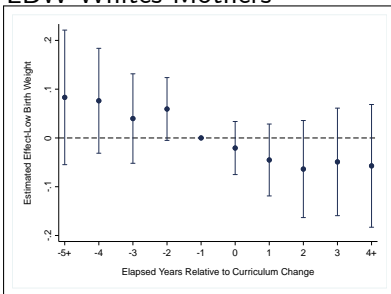
	Coefficient($\times 100$) (Standard Error)	
	(1)	(2)
Panel A:		
Exposed to Curriculum Reform (Weighted)	-0.031 (0.039)	-0.064 (0.070)
Sample Size	16,695,499	16,580,032
Controls:		
Cohort Fixed Effects	Yes	Yes
State Fixed Effects	Yes	Yes
Mother/Child Characteristics	Yes	Yes
State Characteristics	Yes	Yes
Census Division-Specific Trends	Yes	Yes

Dynamic Results-Low Birth Weight

LBW-Blacks Mothers

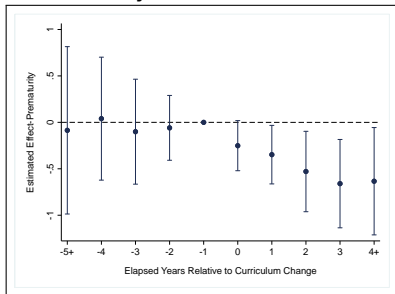


LBW-Whites Mothers

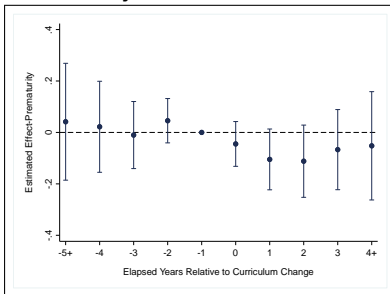


Dynamic Results-Prematurity

Prematurity-Blacks Mothers



Prematurity-Whites Mothers



Falsification: Mother's Education Less than 9th Grade

Table 7: Placebo Effects of Curriculum Reforms on Infant Health Outcomes-Mother's Education Less Than 9th Grade

	Blacks		Whites	
	Low Birth Weight	Prematurity	Low Birth Weight	Prematurity
	Coefficient($\times 100$) (Standard Error)			
	(1)	(2)	(3)	(4)
Exposed to Curriculum Reform (Weighted)	1.263 (1.422)	0.335 (2.150)	-0.176 (0.380)	-0.242 (0.564)
Sample Mean-Pre-Reform (%)	14.78	20.30	7.33	9.57
Sample Size	53,595	52,384	347,878	342,352
Controls:				
Cohort Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Mother/Child Characteristics	Yes	Yes	Yes	Yes
State Characteristics	Yes	Yes	Yes	Yes
Census Division-Specific Trends	Yes	Yes	Yes	Yes

Math Reforms?

- We attempt to disentangle subject-specific reform effects.
- Math has been the pivotal subject of curriculum reforms.
- Include controls for the total minimum number of courses required in other subjects.

Math Reforms?

Table 9: Effects of Math Curriculum Reforms on Infant Health Outcomes-Controlling for Non-Math Reforms

	Blacks		Whites	
	Low Birth Weight	Prematurity	Low Birth Weight	Prematurity
	Coefficient($\times 100$) (Standard Error)			
	(1)	(2)	(3)	(4)
Exposed to Math Curriculum Reform (Weighted)	-0.369*** (0.125)	-0.593*** (0.183)	-0.008 (0.041)	-0.016 (0.081)
Non-Math Reforms	0.004 (0.018)	0.026 (0.028)	-0.006 (0.004)	-0.016*** (0.005)
Sample Size	3,713,702	3,671,424	16,611,751	16,497,561
Controls:				
Cohort Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Mother/Child Characteristics	Yes	Yes	Yes	Yes
State Characteristics	Yes	Yes	Yes	Yes
Census Division-Specific Trends	Yes	Yes	Yes	Yes

Mechanisms

- Potential Channels-presumably through increase in cognitive skills
 - ▶ Prenatal care utilization.

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 - ▶ Prenatal care utilization.
 - ▶ Changes in health behaviors (proxied by smoking during pregnancy).
 - ▶ Educational attainment.
 - ▶ Economic outcomes (proxied by a weighted average of family income, receipt of public assistance and labor force participation).

Mechanisms

Table 8: Mechanisms

	Smoked During Pregnancy	More than High School	Economic Self- Sufficiency Index (z-score)
	Coefficient (Standard Error)		
	(1)	(2)	(3)
Panel A: Black Mothers			
Exposed to Curriculum Reform (Weighted)	-0.005* (0.003)	0.001 (0.007)	0.081*** (0.0025)
Sample Mean-Pre-Reform	11.56%	46.09%	0.049
Sample Size	2,526,003	2,526,003	91,978
Panel B: White Mothers			
Exposed to Curriculum Reform (Weighted)	-0.008** (0.003)	0.003 (0.004)	-0.004 (0.012)
Sample Mean-Pre-Reform	12.92%	62.02%	0.064
Sample Size	11,275,633	11,275,633	542,607

Social Gain Calculation

- The annual societal cost associated with prematurity was \$51,600 per infant in 2005 (Institute of Medicine of the National Academies, 2007).
- Using only information from black mothers, we find that 8,789 fewer infants were born premature as a result of curriculum reforms. This decrease corresponds to a total social gain of approximately \$568 million (in 2017 dollars).
- This is probably a lower bound estimate as we do not consider LBW infants in the cost calculation (most premature infants are also of low birth weight).

Racial Inequality at Birth

- Finally, to examine the role of curriculum reforms in closing the black-white gap in infant health, we estimate the following equation by pooling all black and white mothers

$$Y_{isc} = \gamma_0 + \gamma_1 CR_{sc} + \gamma_2 CR_{sc} * Black\ Mother + \gamma_3 Black\ Mother + X'_{isc} \gamma_4 + \lambda_s + \tau_c + \epsilon_{isc} \quad (3)$$

- The ratio γ_2/γ_3 represents the change in racial gap.
- The curriculum reforms may have closed the black-white gap in infant health by around 3 percent.

Conclusion

- This paper examines the impacts of curriculum reforms on birth outcomes by exploiting the differences in the timing of curriculum adoption.
- To the best of our knowledge, this is the first paper relating mother's coursework in school to child quality.
- Curriculum reforms appear to be effective in lowering the incidence of low birth weight and prematurity for black mothers.
- There is suggestive evidence of effects driven by math reforms.
- Mechanisms-reduced smoking and improved economic outcomes.