

# The Long-Term Consequences of Children's Health and Circumstance

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# Pregnancy and Early Childhood are “Critical Periods” for Child Development

- Both nature (genes) and nurture (environment) *and their interactions* are important for child development.
- The environment affects gene expression through setting epigenetic “switches.”
- The environment may serve to either mitigate or reinforce differences.

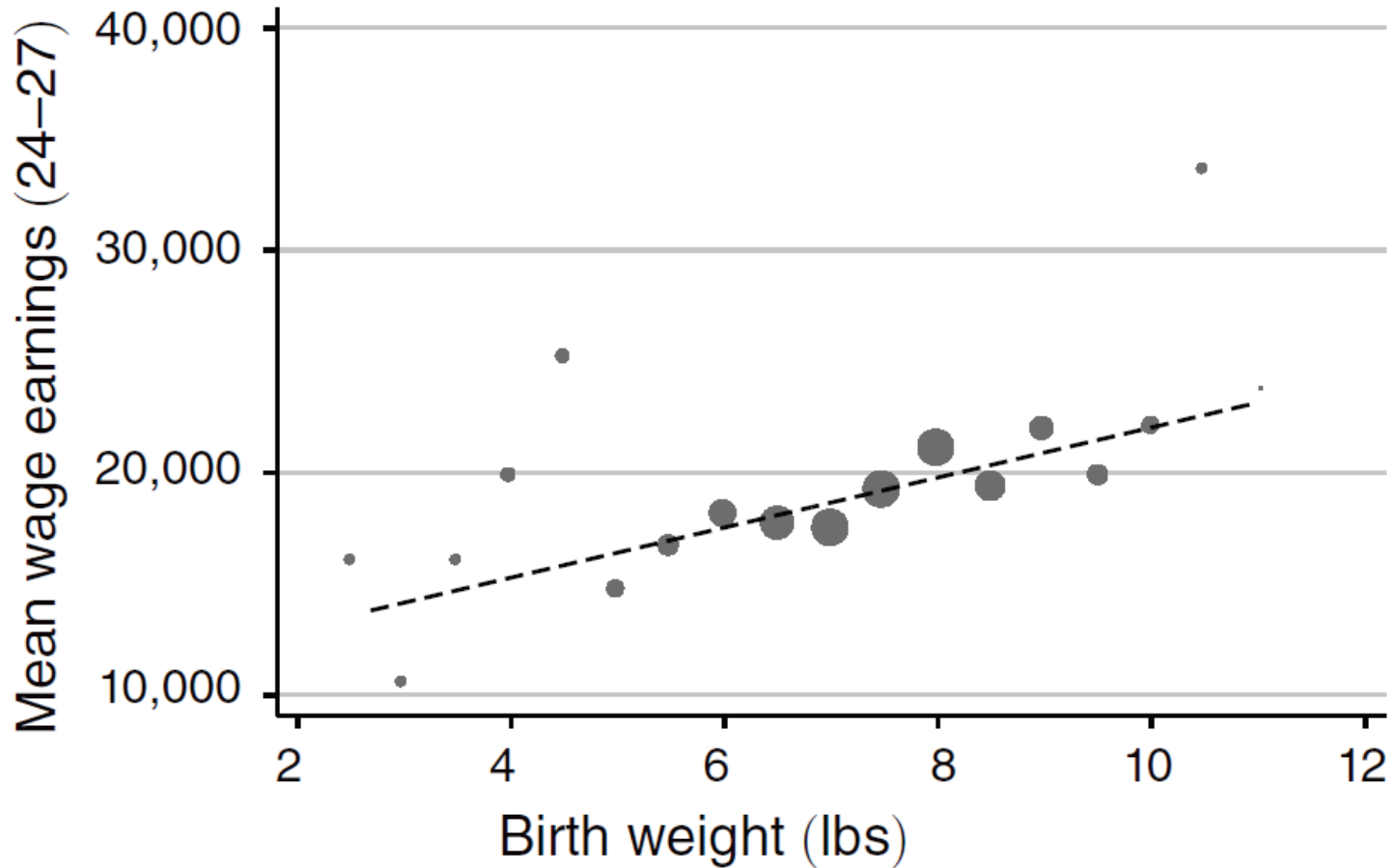
# Many studies link health at birth to future outcomes

- Health at birth is a marker for events in the fetal period.
- Much of this research focuses on birth weight as a summary measure of health at birth.
- Birth weight is relatively well measured and has been measured for a long time in diverse populations.

# We can examine the relationships between birth weight, and future earnings using cohort studies

- E.g. National Longitudinal Survey of Youth is a nationally representative longitudinal survey of Americans who were 14-21 in 1978.
- Children of NLSY women were surveyed starting in 1986.
- We can examine the relationship between birth weight, and the earnings of these children at ages 24-27.

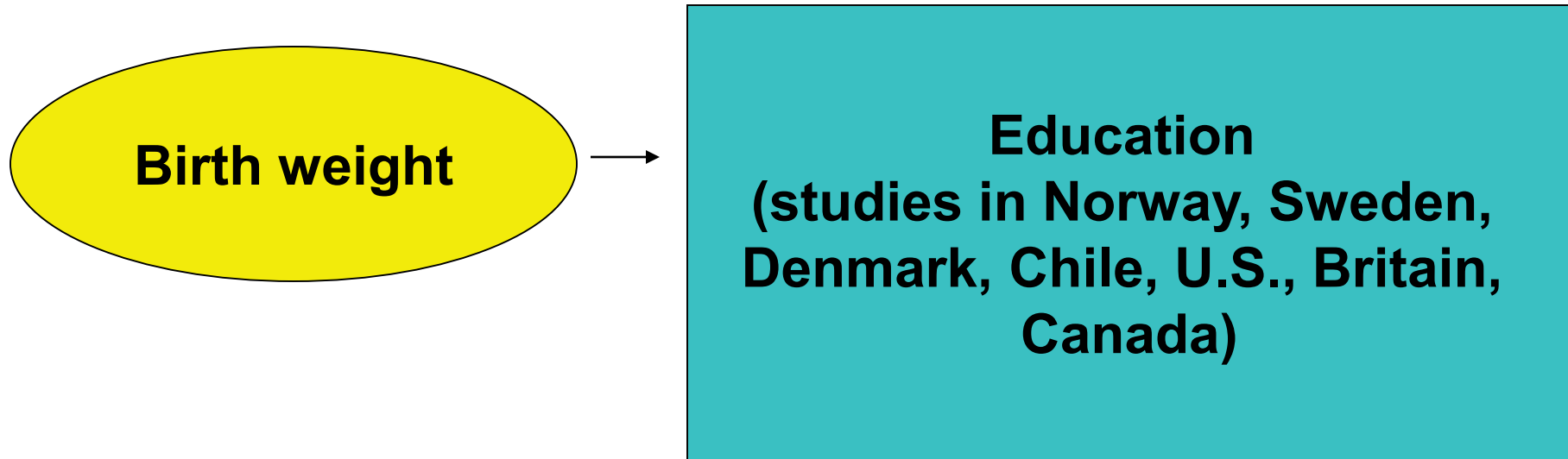
# Birth weight and Young Adult Earnings, NLSY



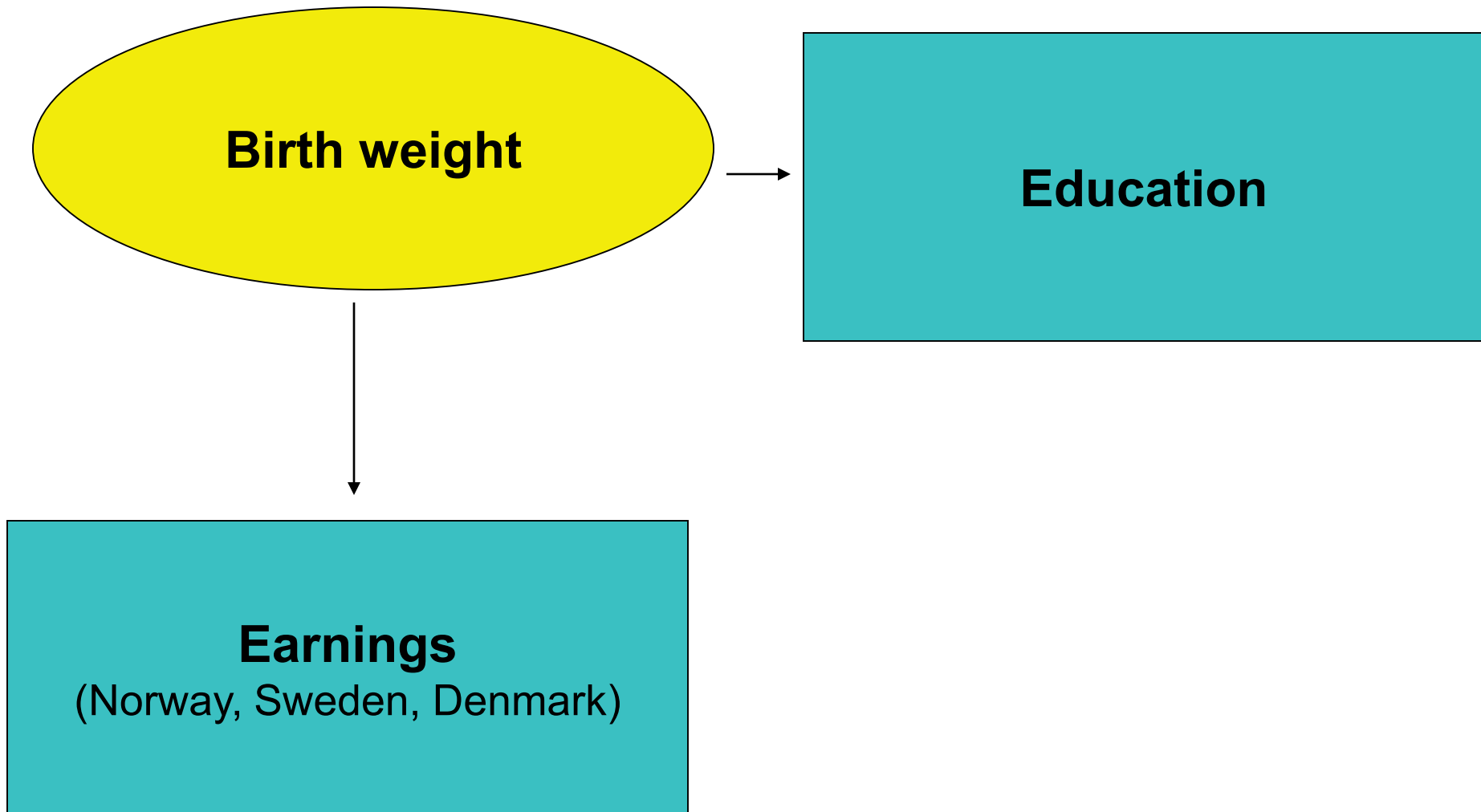
# One way to control for other factors that may affect outcomes is to use sibling or twin comparisons

- Siblings are a natural “control” group
- They share common aspects of family background.
- In the case of twins, family background is extremely similar though parents may still treat individual children differently.

# Many large-scale sibling studies link birth weight to long term outcomes

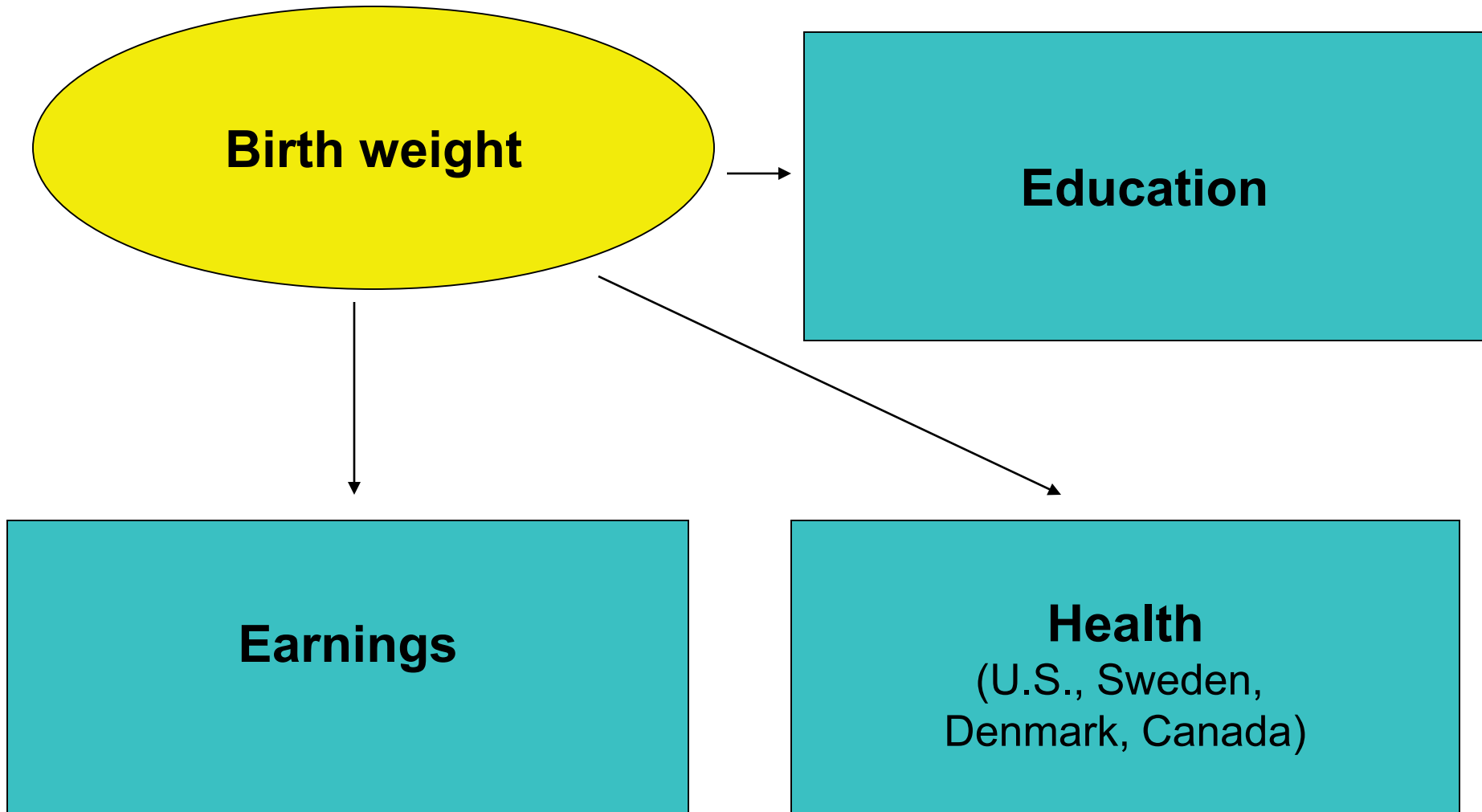


# Large scale sibling studies link birth weight to long term outcomes





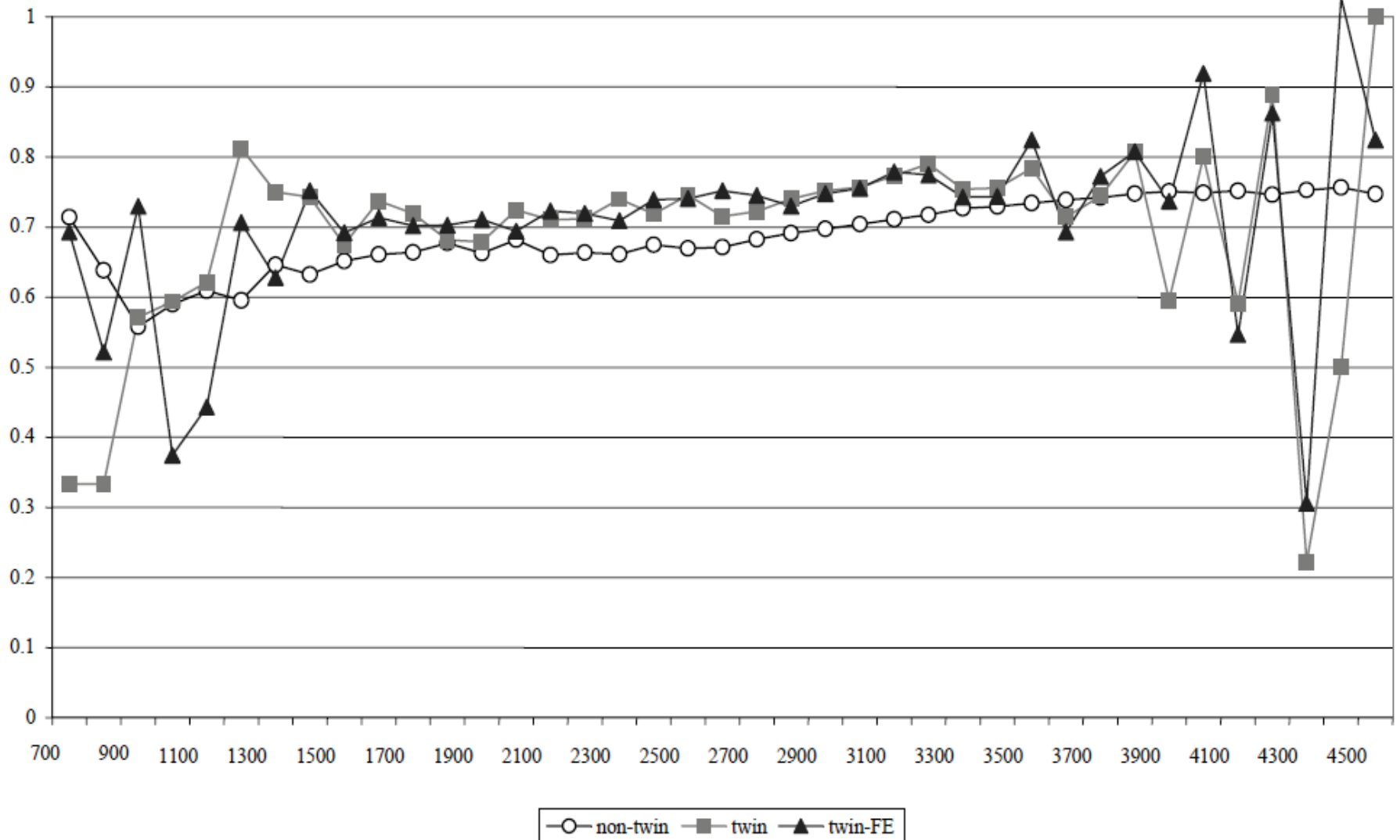
# Large scale sibling studies link birth weight to long term outcomes



# Black, Devereux, and Salvanes (2007)

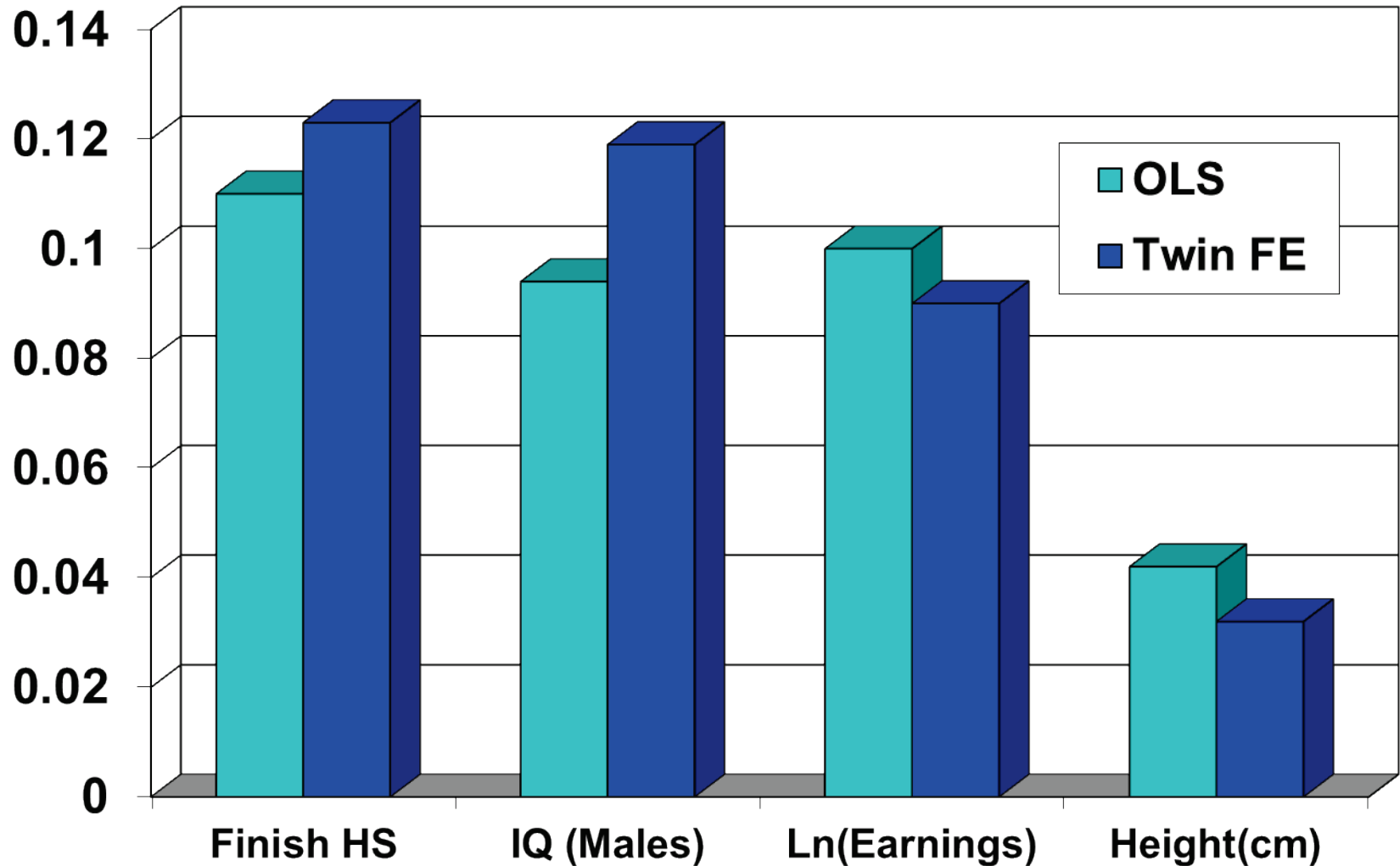
- One of the 1st studies to use twin/sibling comparisons to look at long-term outcomes.
- All Norwegian births from 1967-1997.
- Focus on twins.
- Match to Norwegian administrative data for 1982-2002 (i.e. records on educational attainment, earnings, etc.)
- For men, match to military records for 1984-2005 (IQ + height [for subset])

# High school Graduation by Birth Weight in Norway



- The graph shows that if you compare twins, a twin who was 3500 grams (~7.5 pounds) is about 10% more likely to finish high school than a twin who is 1900 grams (~ 4 pounds)

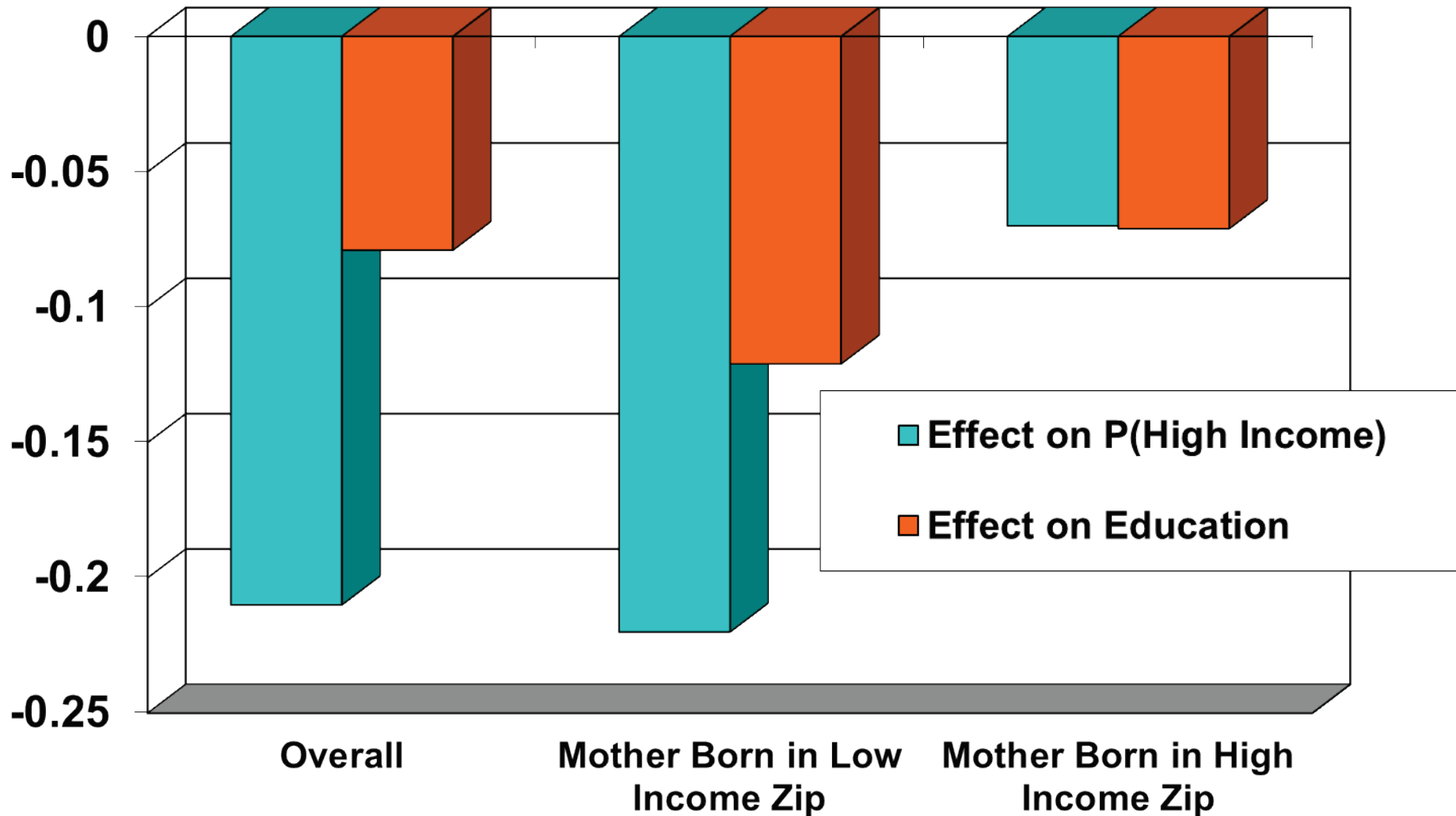
Effects are similar for IQ and earnings,  
smaller for height



## Currie and Moretti (2007) show similar long term effects of low birth weight using U.S. data

- Examine 3 generations of California births, grandmothers, mothers, and infants using linked birth certificates.
- Compare mothers who are sisters, where one sister is low birth weight and the other is not.
- The sister who was low birth weight has less education and is more likely to live in a high poverty zip code at the time of her own infant's birth.
- ***Effect varies with whether the sister was herself born in a high poverty zip code.***

# Effect of Maternal Low Birth Weight on Mother's Adult Outcomes at Time of Child's Birth

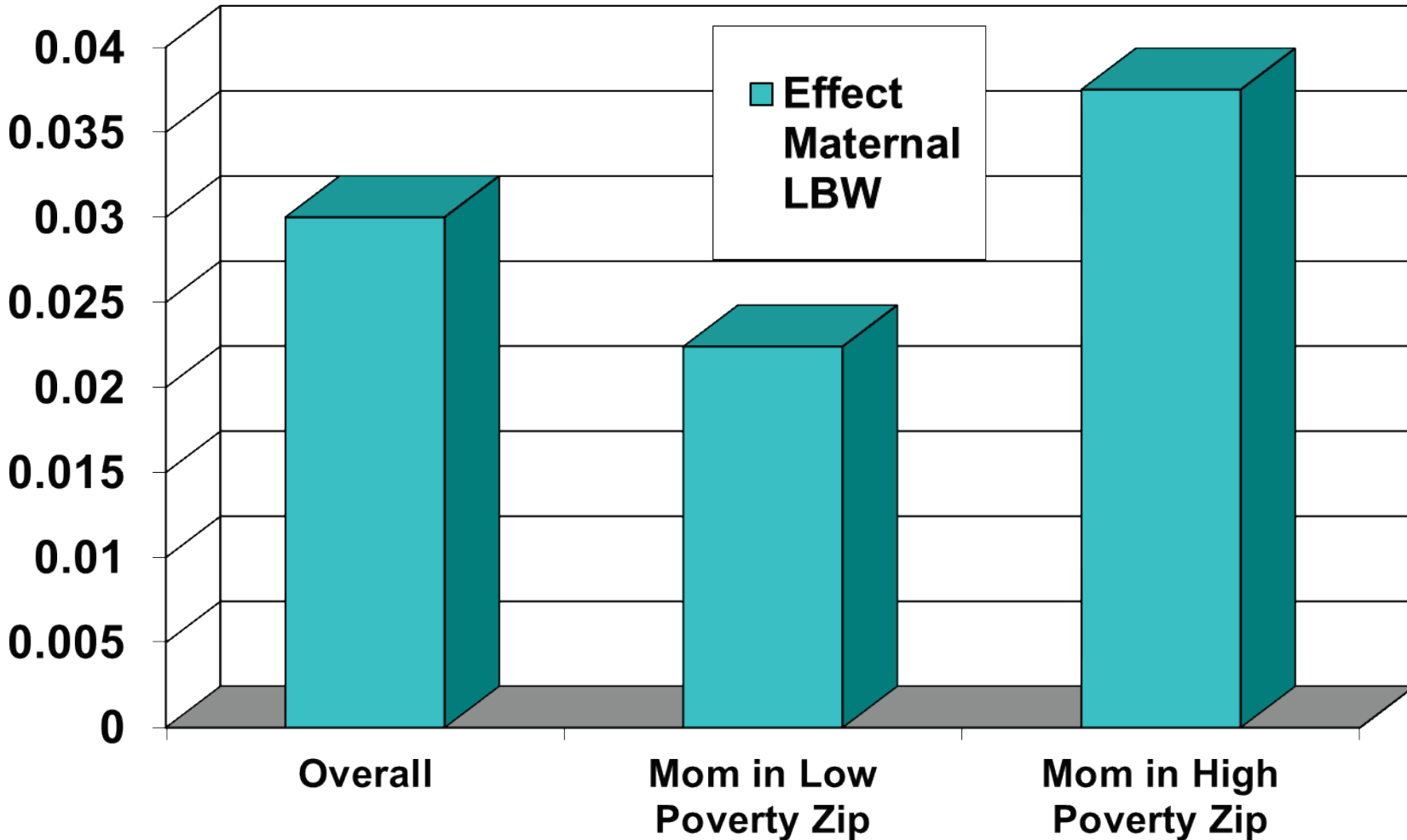


# Poor health at birth that is induced by the environment can be transmitted from one generation to the next

- This has been shown in animal studies.
- We can see this in the California data.
- We look at mothers who are sisters, and estimate the effect of mother's low birth weight on infant's low birth weight.



# Estimated Effect of Mother's Low Birth Weight on Infant's P(LBW) by Characteristics of Current Maternal Residence

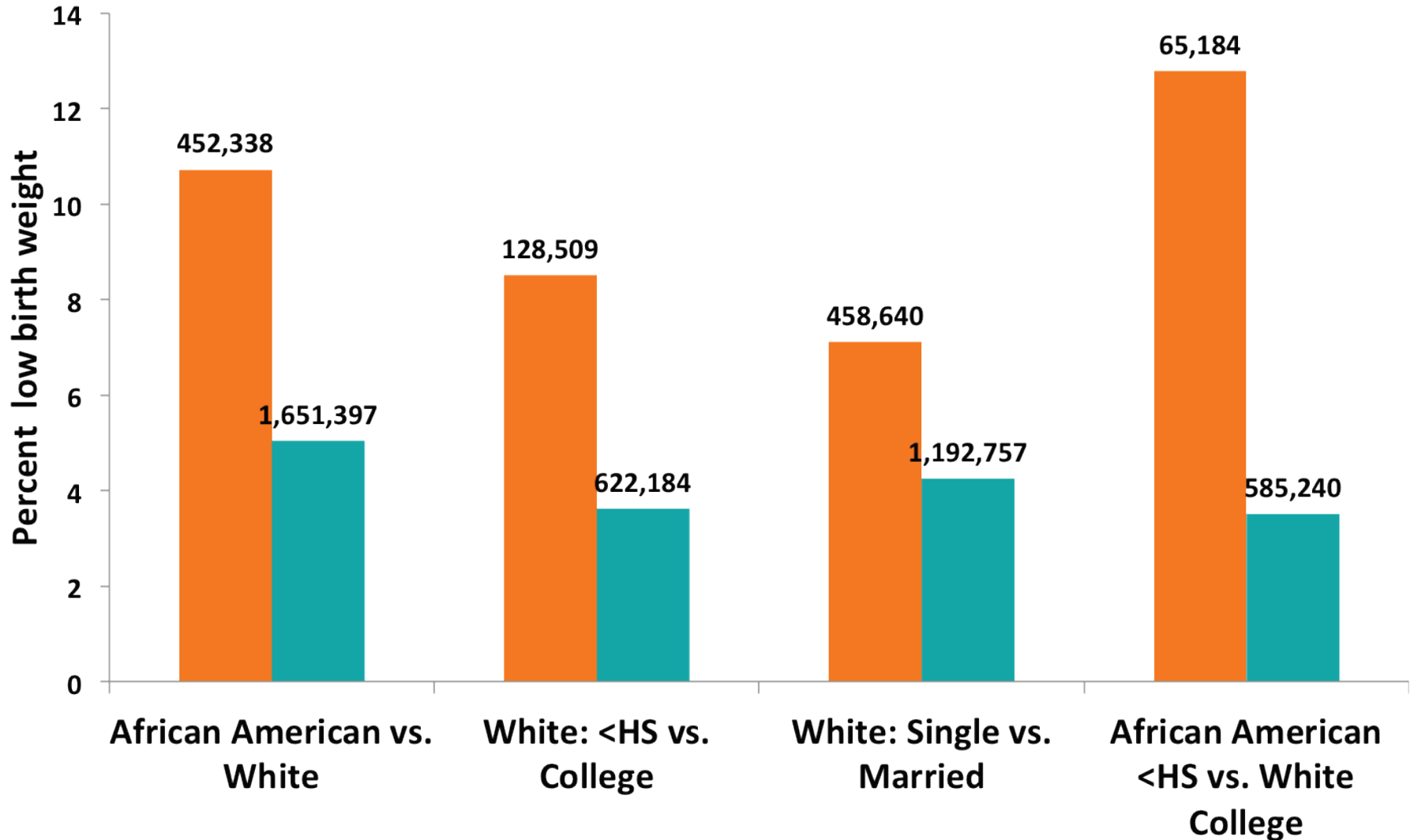


# Summary so far...

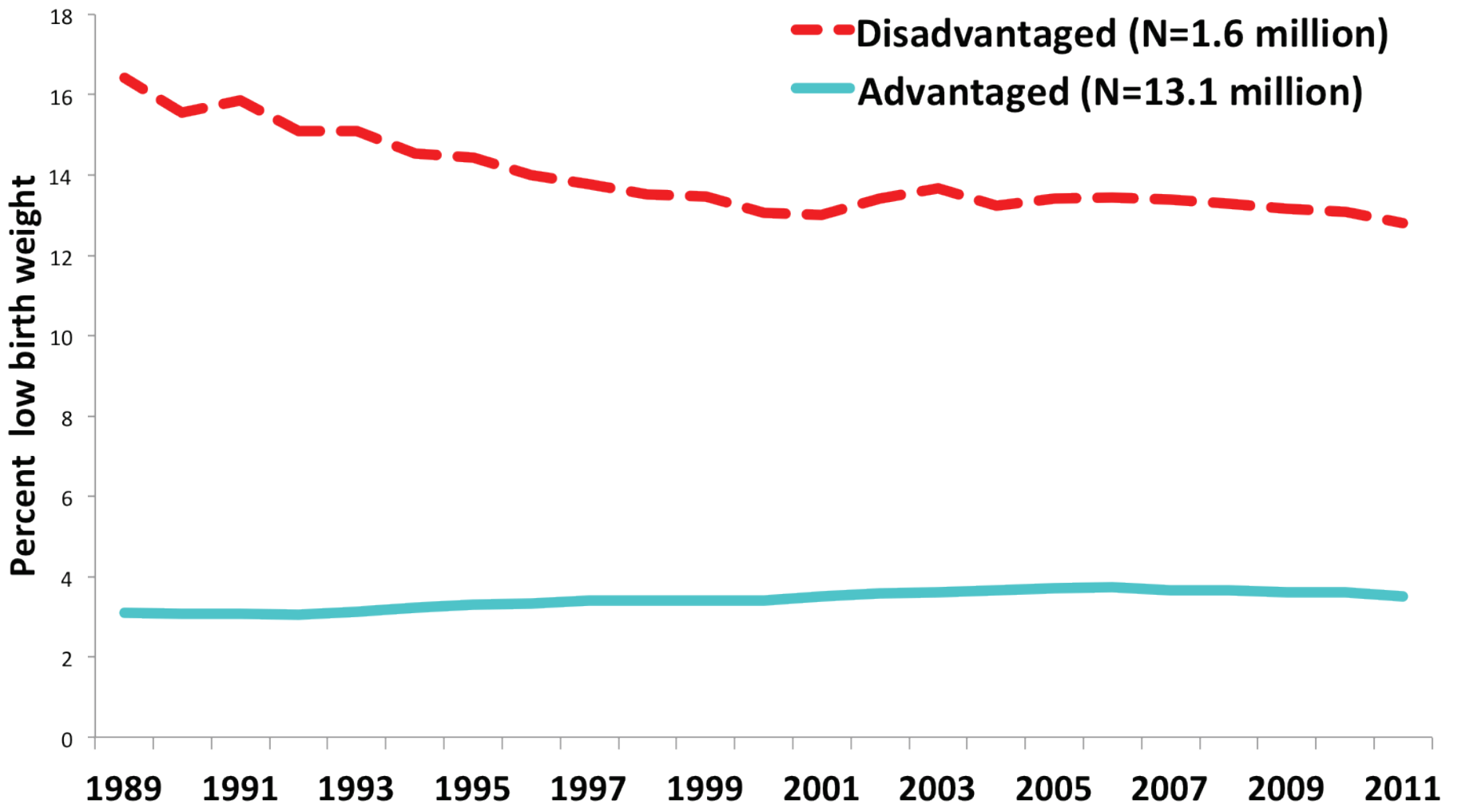
- Health at birth is an important aspect of child development which predicts future outcomes including earnings, employment, education, and the health of the next generation.
- Given this evidence, large inequalities in health at birth are disturbing.

# Percent of U.S. Infants with Birth Weight <2500g, by Maternal Characteristics, 2011

(36 states, age 19-39, single births only)



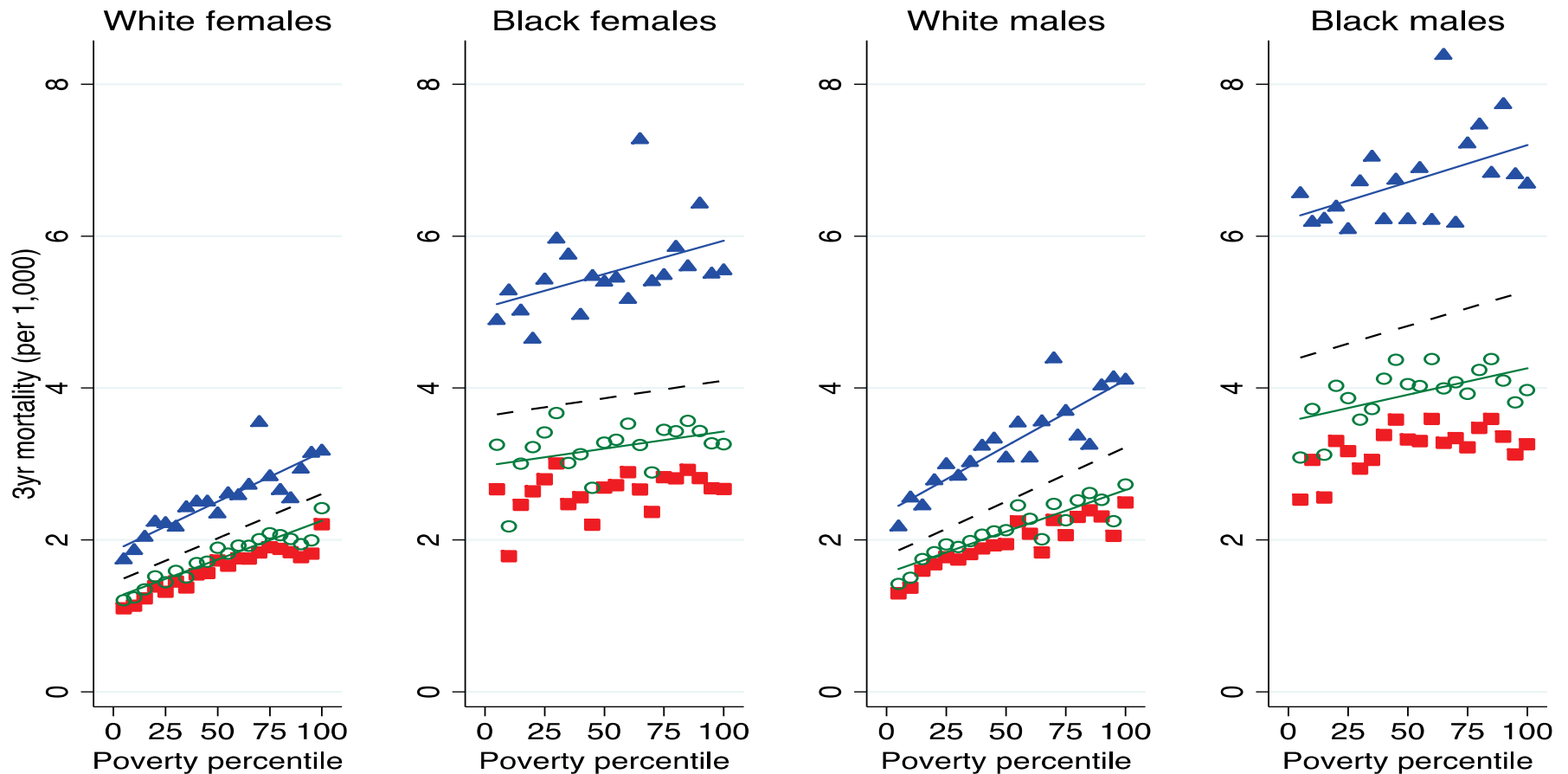
# Inequalities are Narrowing as Shown by Trends in Percent Low Birth Weight by Maternal SES



# 3-Year Mortality Rates Across County Groups Ranked by Poverty Rates, by Race and Gender.

(Blue triangle=1990, Green Circle=2010, Red Square=2010 with multiple race)

(A) Age 0-4



# Summary for Under Fives

- Strong reductions in mortality between 1990 and 2010.
- Very large reductions for African Americans (even larger if we include those who report multiple race.)
- Reductions are larger in the poorest counties **implying decreasing inequality in mortality.**

# These time trends pose a puzzle

- Child health is strongly linked to socioeconomic status.
- Inequalities in economic status have increased over time, especially in the U.S.
- Yet inequalities in child health have been decreasing.

# What factors can account for reductions in inequality among infants and children?

Possible factors:

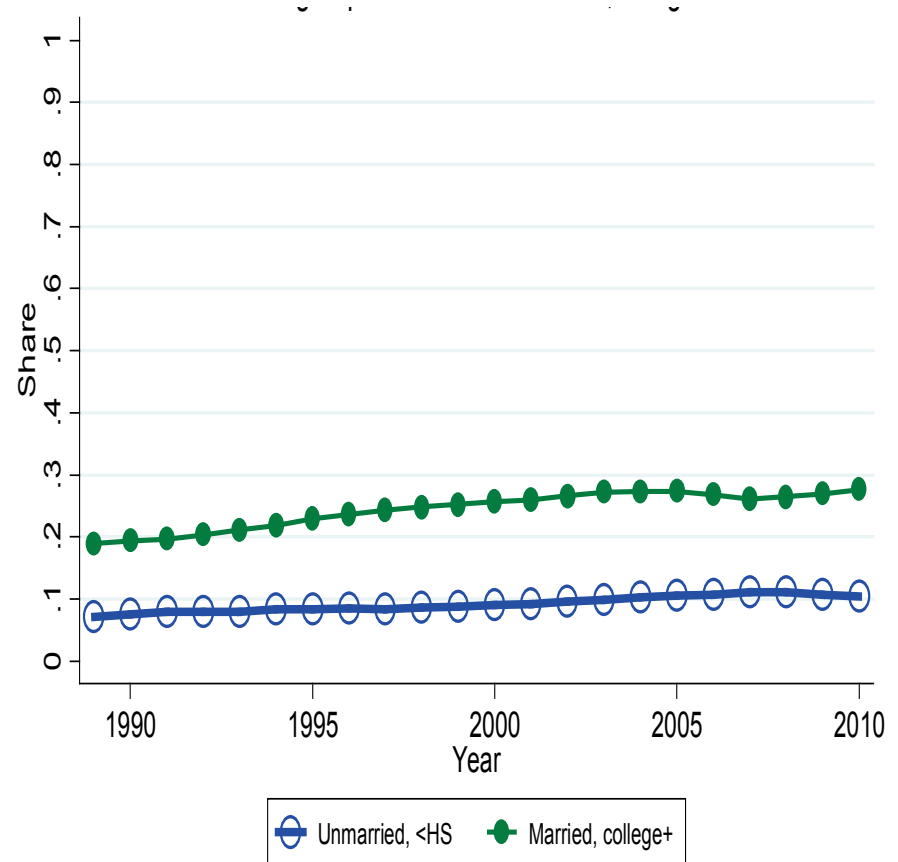
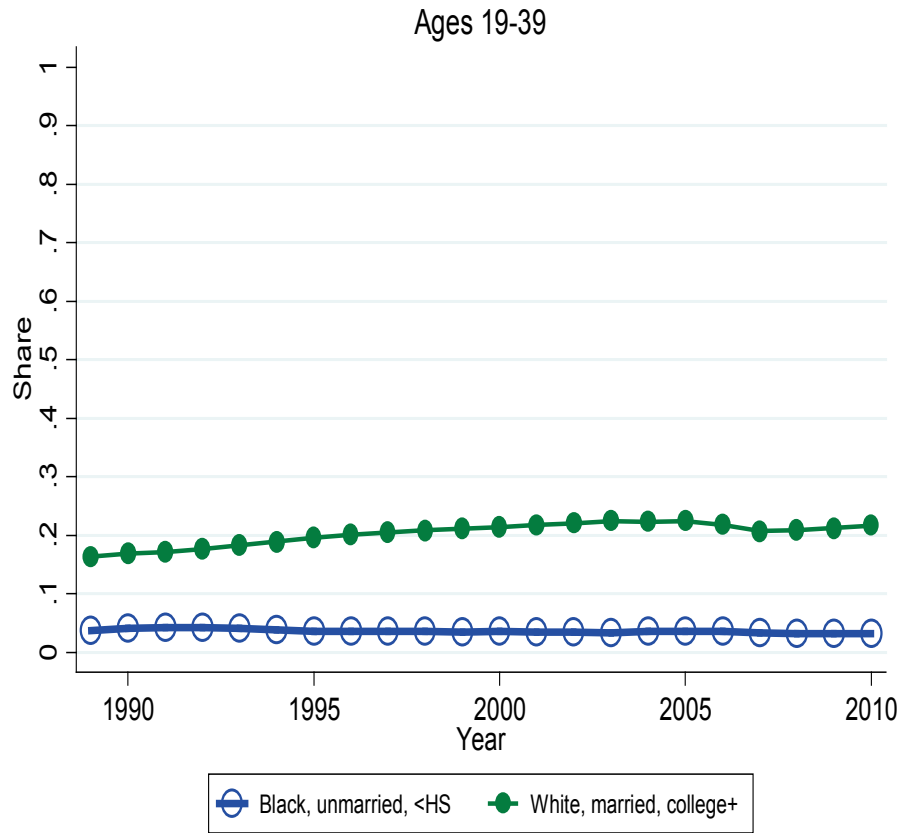
- Changes in fertility
- Improvements in medical care
- Long term improvements in maternal health
- Changes in maternal health behaviors
- Reductions in Pollution



# Could the trend be due to changes in fertility?

- If the most disadvantaged women (conditional on race, marital status, and education) have become less likely to give birth, then this would tend to reduce the gap in health at birth.

# However, share of births in the most disadvantaged groups is constant or declining over time



Age 19-39

# What about Improvements in Medical Care For Pregnant Women and Children?

- U.S. greatly expanded public insurance for pregnant women and young children beginning in the late 1980s.
- Currie and Gruber (1996a,b) show that this had an impact on medical care and health at birth for infants and children.
- More recent research shows long term effects on the health of children (Wherry et al. 2015; Wherry and Meyer, forthcoming; Kowalski et al. 2015)

Figure 1D: Medicaid/SCHIP Eligibility by Child Age Group  
Texas

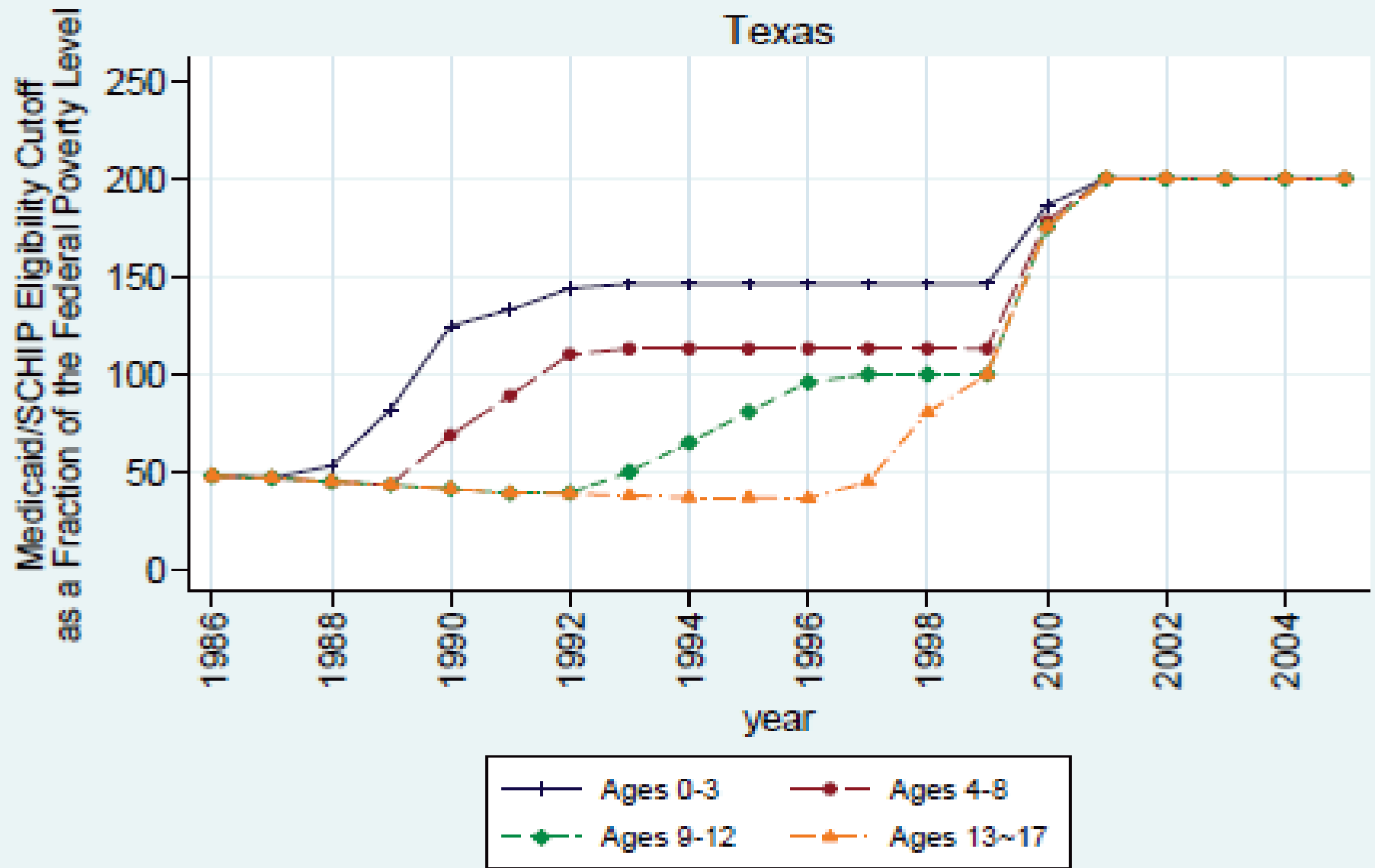
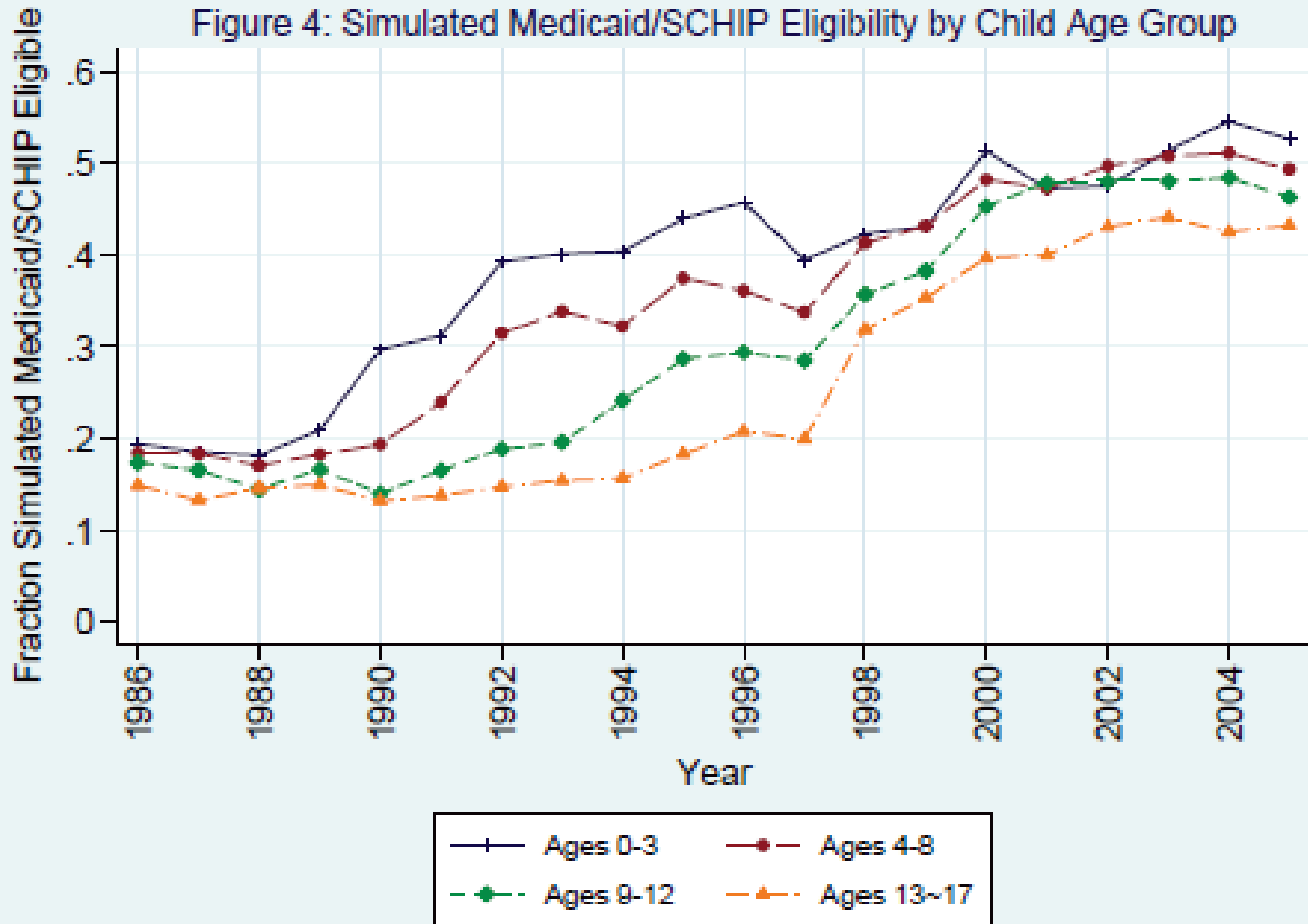
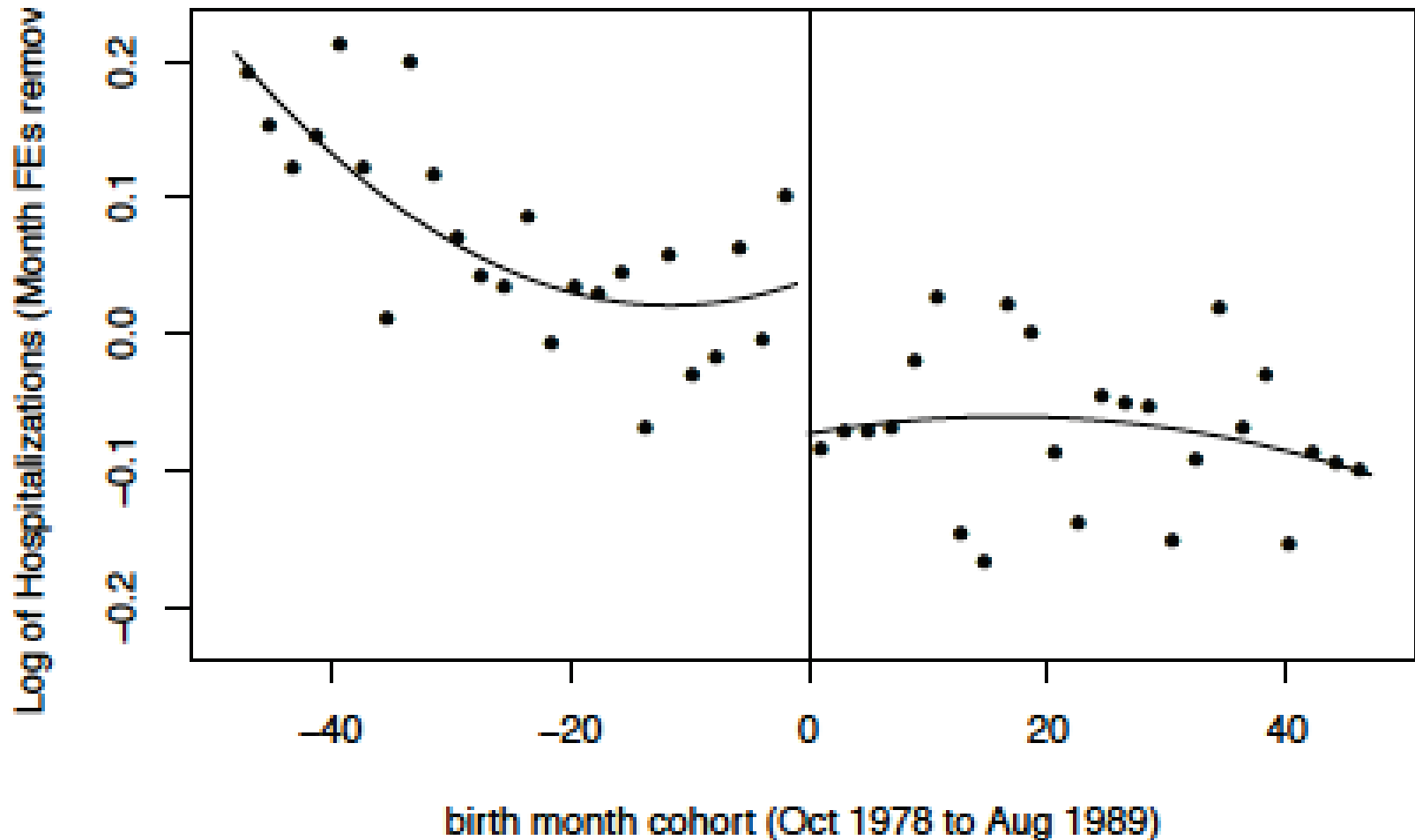


Figure 4: Simulated Medicaid/SCHIP Eligibility by Child Age Group



Wherry et al. (2015) show drop in 2009 hospitalizations for chronic illness in black children born after Sept. 1, 1983



# Further improvements in health care might also improve outcomes

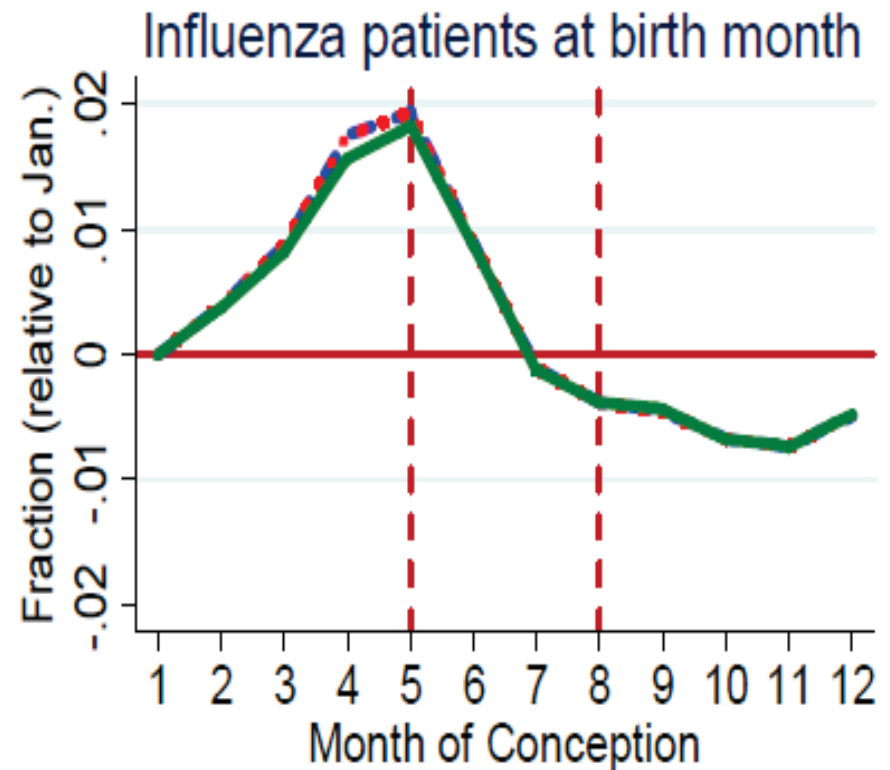
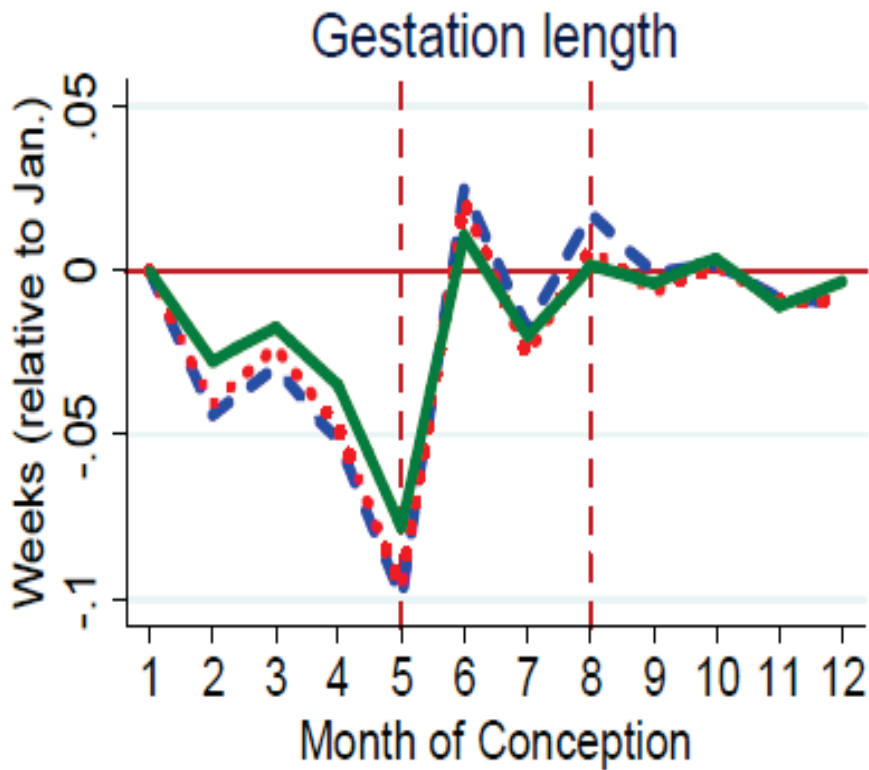
- Vaccination for influenza is one example.
- Vaccination rates for pregnant women have been increasing over time, especially following the H1N1 epidemic of 2009, but are still ~50%, leaving room for improvement.
- By increasing inflammation, influenza is thought to trigger preterm labor.

# Currie and Schwandt (2013) investigate the effects of influenza on pregnancy outcomes

- Birth data for Pennsylvania 1989-2011, New Jersey 1989-2008, New York city 1994-2004
- Data allows us to link births to the same mother
- CDC weekly influenza surveillance reports: fraction of patients in 1800 reporting centers who were diagnosed with influenza.

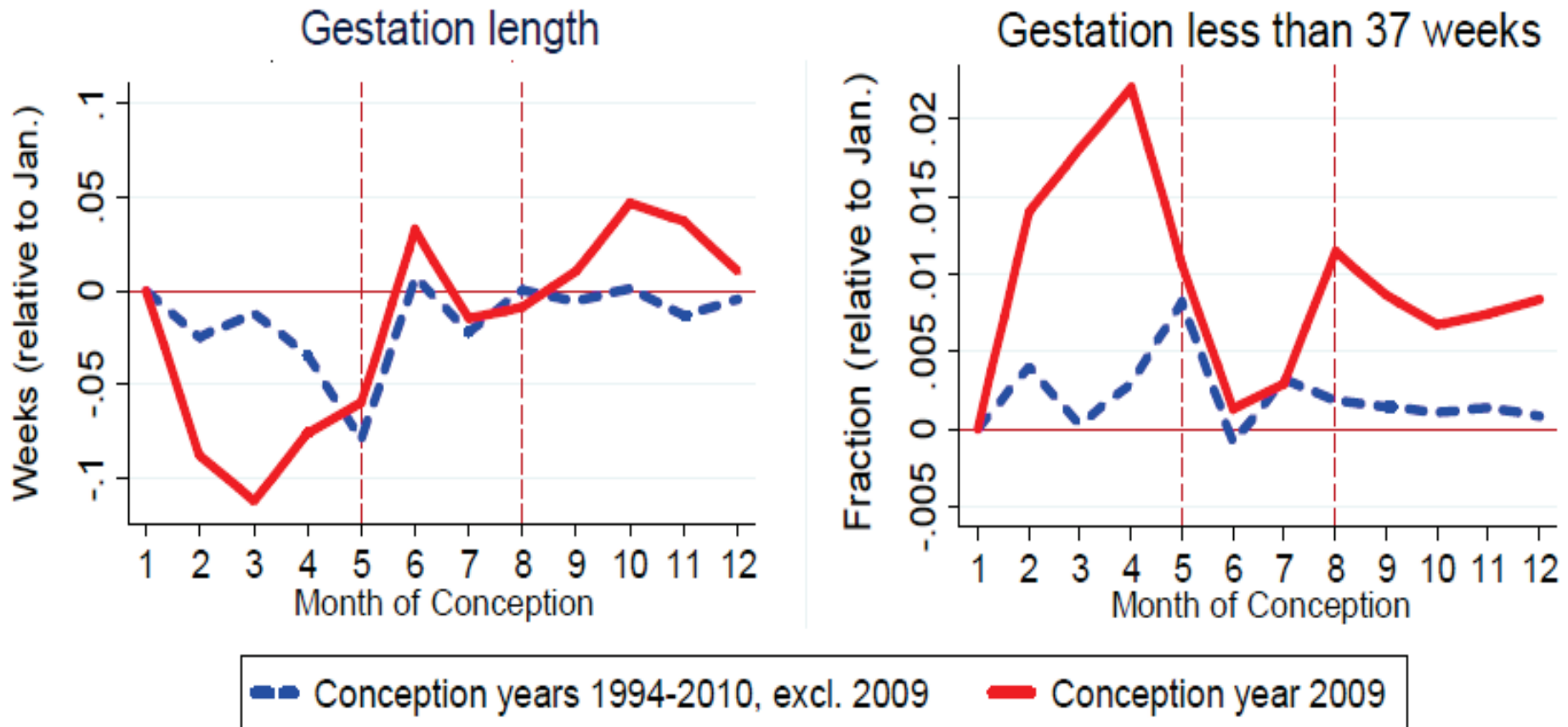


Babies conceived in May are more likely to be premature. The spike in influenza cases corresponds to the spike in prematurity



--- OLS    ..... OLS+controls    — Within mother

During the 2009 H1N1 epidemic, the spikes in both prematurity and influenza cases were earlier and larger

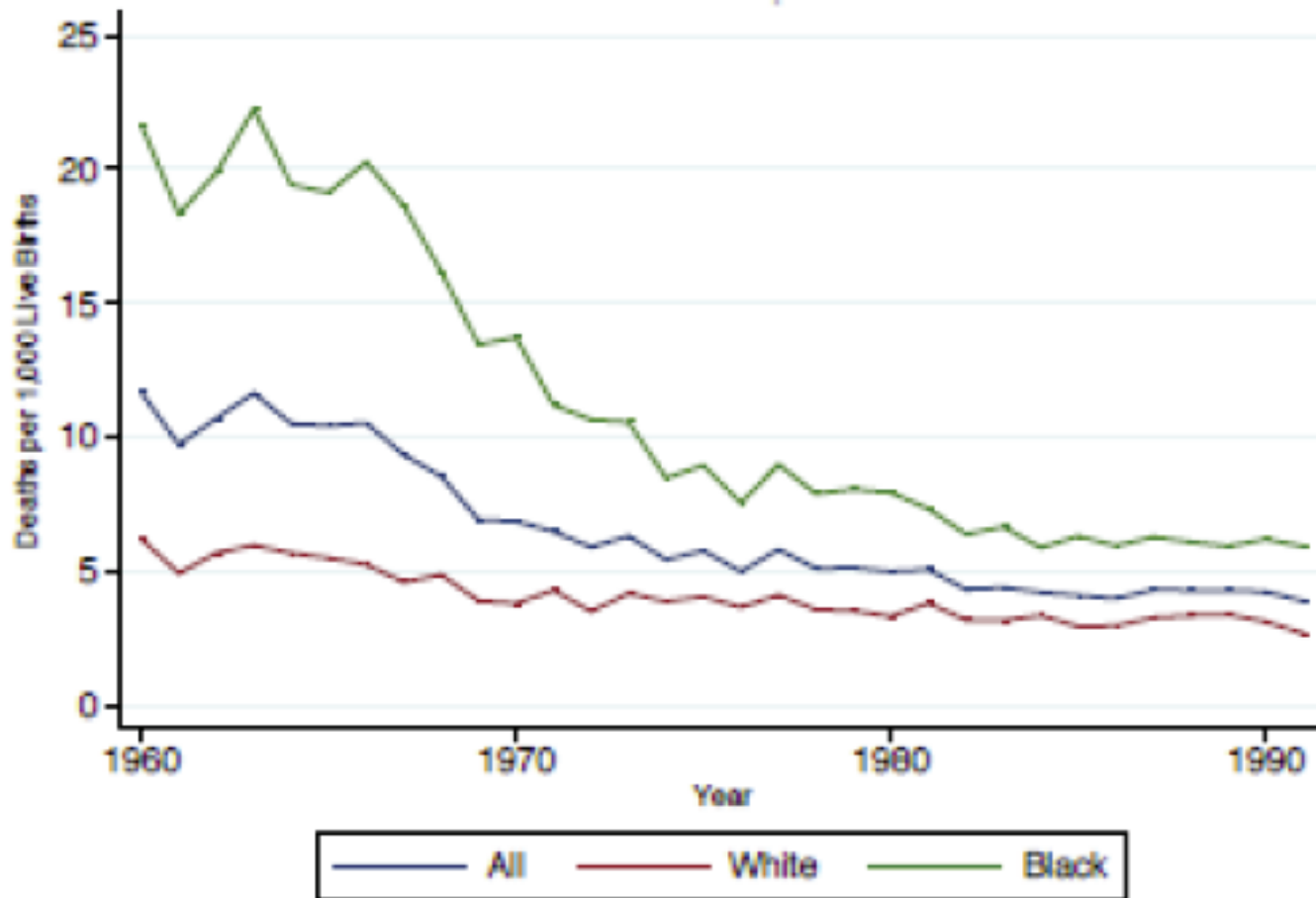


# Could improvements in mother's early life health underlie improved infant health?

- Healthier children become healthier adults
- Healthier adults have healthier babies
- Racial inequalities in early life health were reduced dramatically for mothers born in the 60s and 70s.
- One marker of the health environment is the post neonatal death rate (deaths after 1 month). E.g. high death rates imply a lot of disease so survivors may be less healthy.

# Disparities fell especially sharply in the south

(Figure shows post-neonatal death rates for Georgia)



# Almond, Currie, and Hermann (2011)

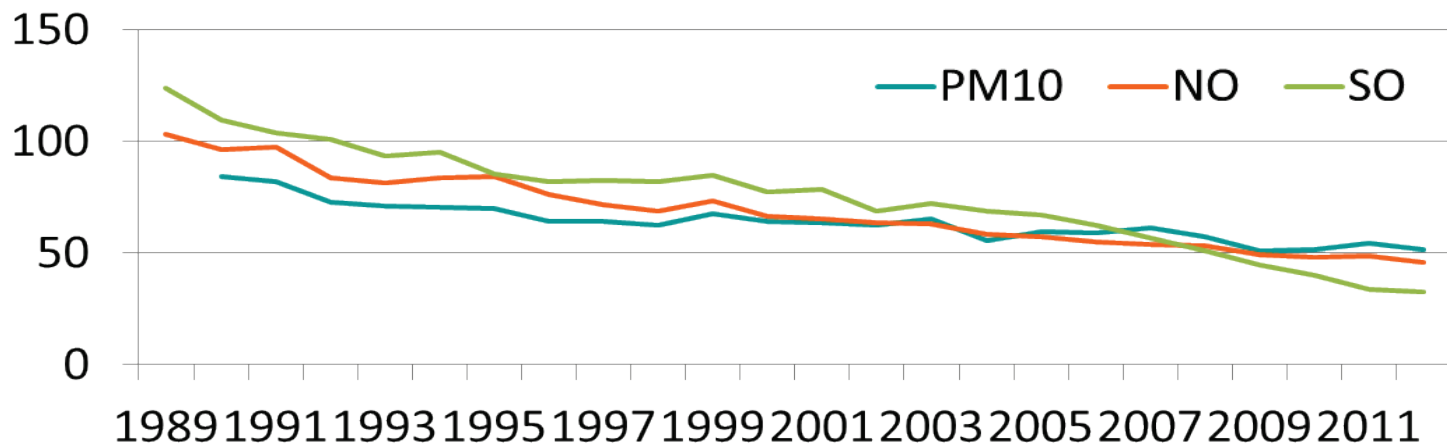
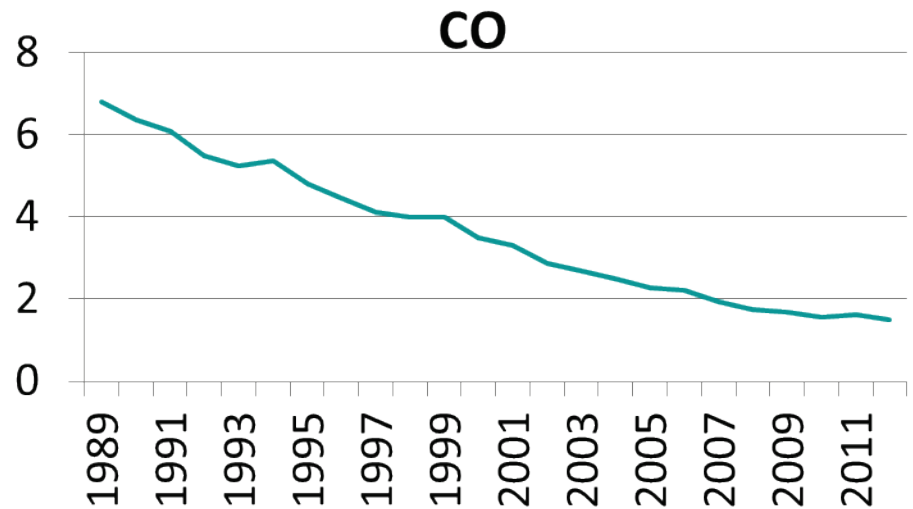
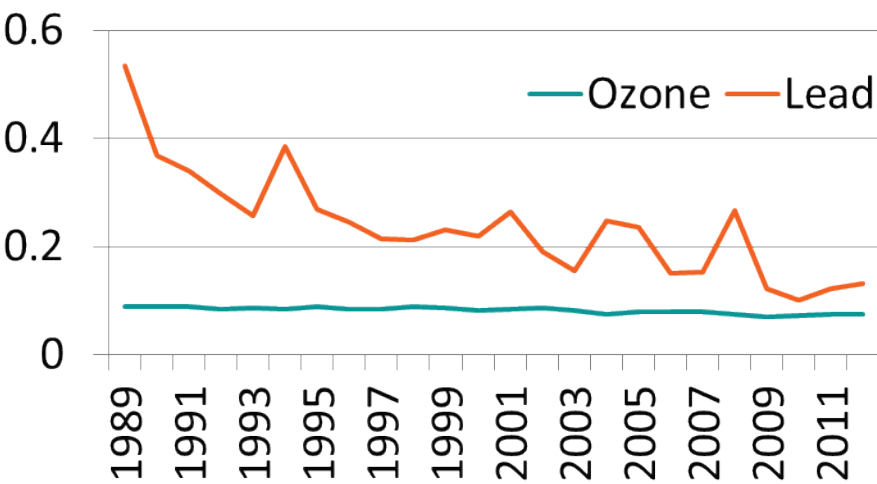
- Examine the effect of the post-neonatal environment on maternal health and infant health.
- The post-neonatal mortality rate (PNMR) is a proxy for the disease environment.
- Use 1989-2006 national vital statistics natality data (birth certificates).
- Define cells by the mother's state and year of birth, age, race, and the child's state and year of birth.

- Estimates suggest that an additional post-neonatal death per 1,000 in the year after the mother's birth is associated with an overall 1.8% higher probability of the mother having diabetes at the time she gives birth.
- The rate is 3.5% higher for black mothers and 1.4% higher for white mothers.
- Suggests that poor conditions in early childhood contribute to worse maternal health in ways that can affect child outcomes.

# Could reductions in pollution have reduced disparities?



# Criterion Air Pollutants have fallen, 1989-2012

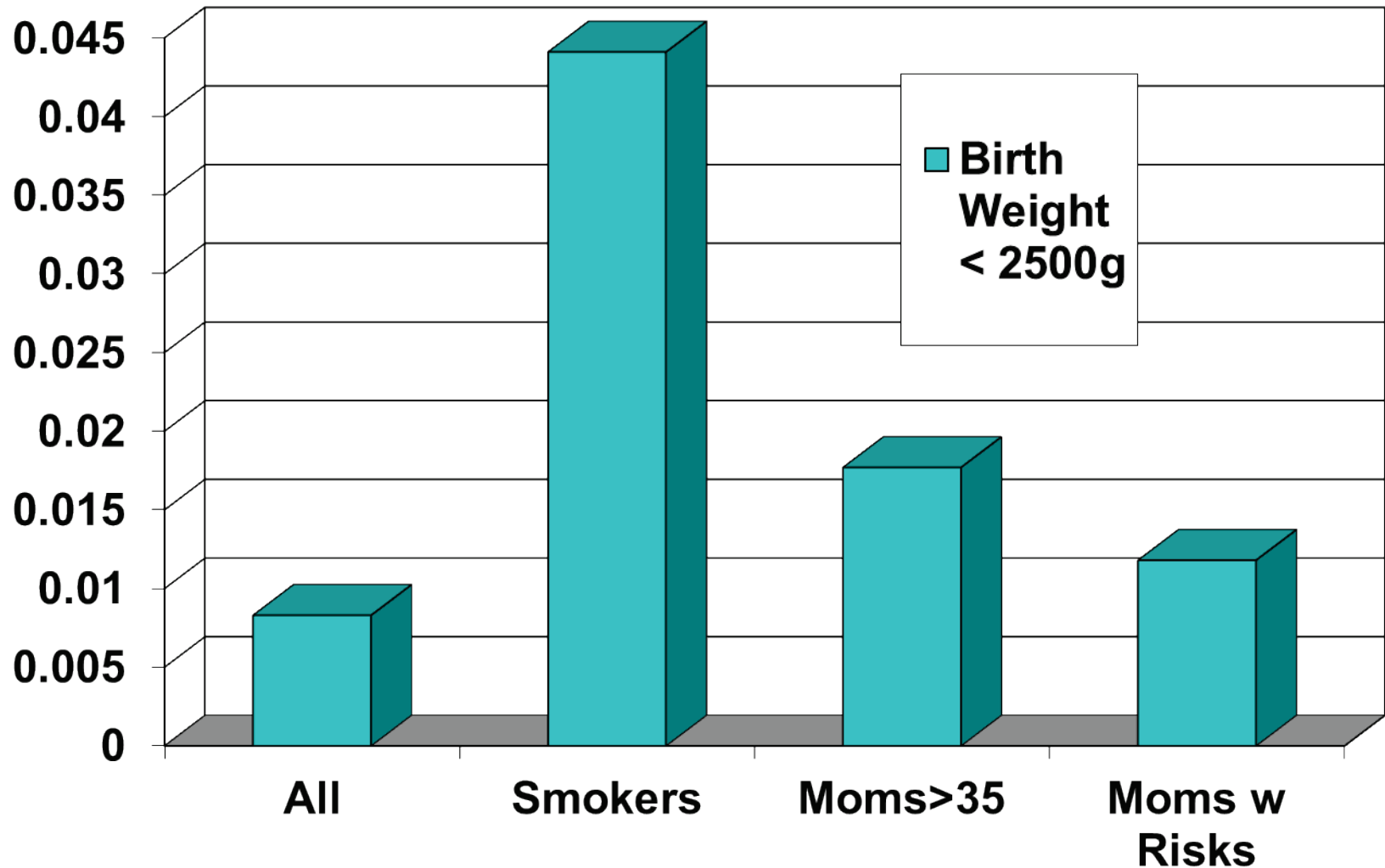




# These pollutants have been linked to infant health

- E.g. Currie, Schmeider, and Neidell (2009) look at 1.5 million New Jersey births between 1989 and 2003.
- A confidential version of the birth records data allows us to link siblings and to geocode.
- Select mothers who live <10km from fixed air quality monitors and compare the health of siblings born exposed to differing amounts of air pollution in utero.

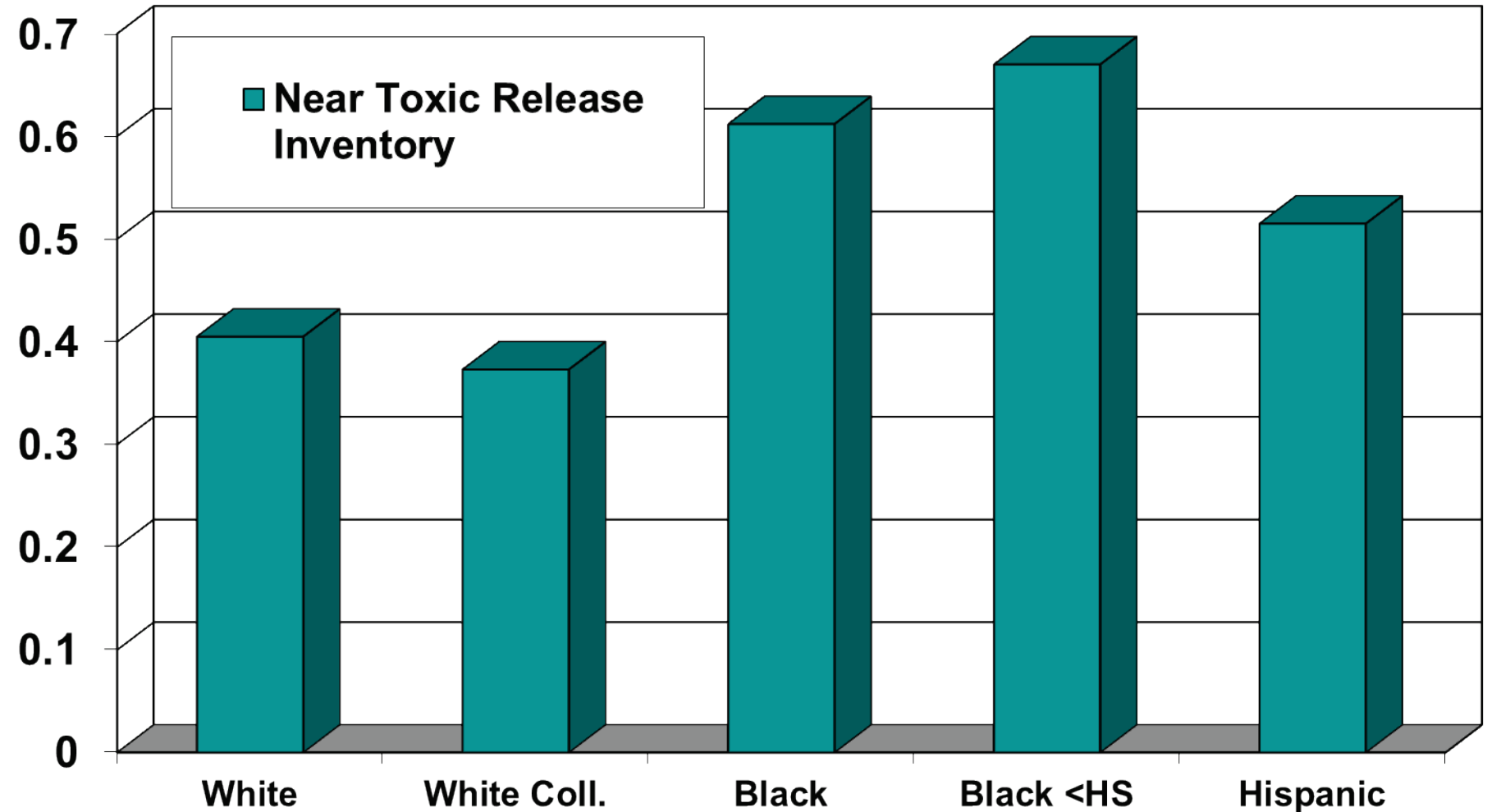
# Effect of a 1 Unit Change in CO (Mean=1.6, SD=13) on Incidence of Low Birth Weight



# Disadvantaged mothers are more likely to be exposed to pollution

- More likely to live near busy roads.
- More likely to live near Superfund sites.
- More likely to live near factories that emit toxic releases.
  - E.g. Currie (2011) examines all births in 5 large states and finds that African-American women are more likely to live near these sites.

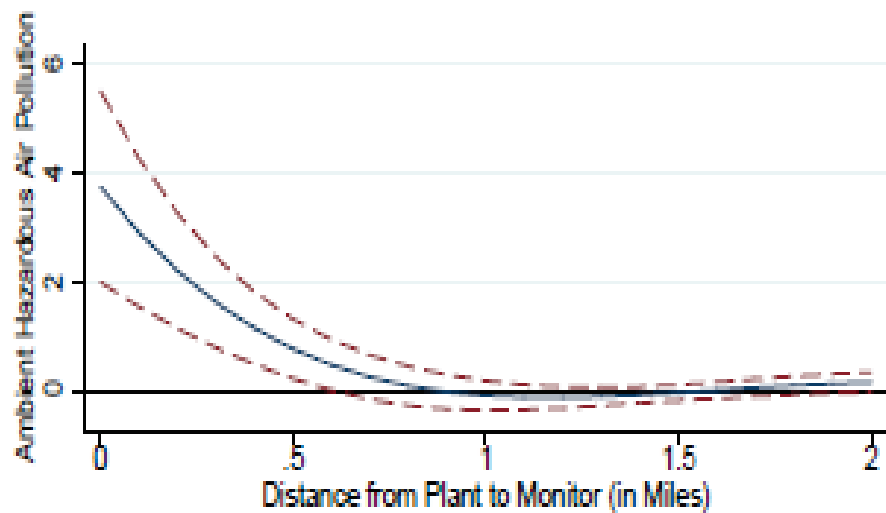
There are large differences by race/ethnicity and education in the probability of being <1.24 miles (2000m) from a site



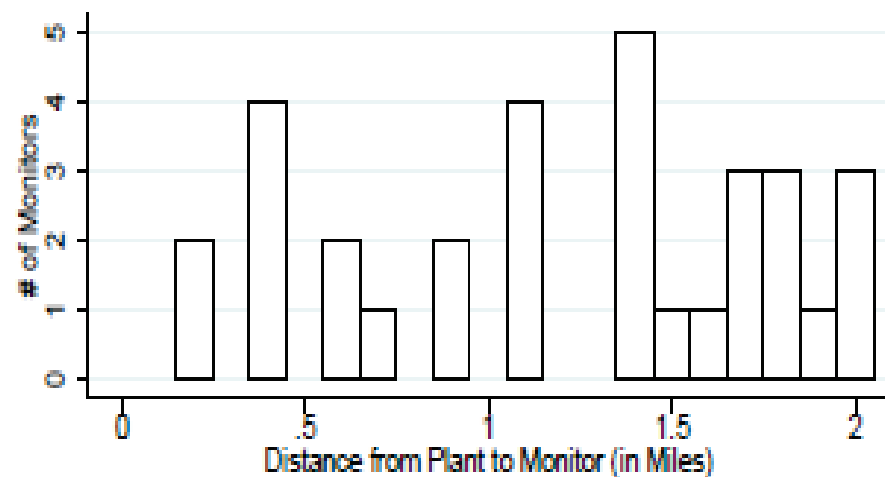
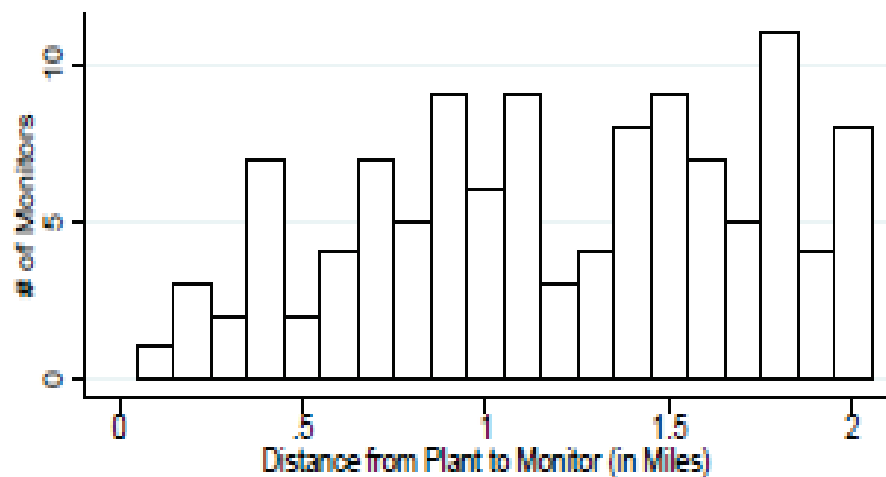
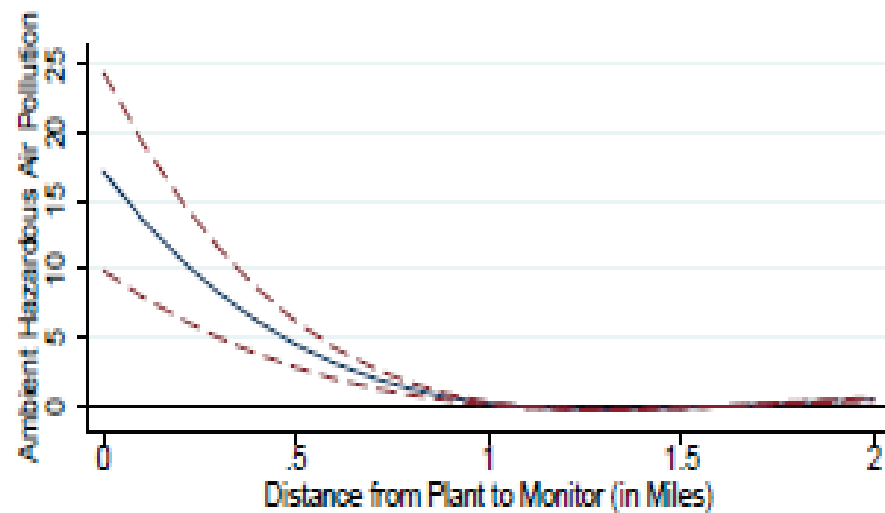
# Currie, Davis, Greenstone, and Walker (2015) show that many toxics can be detected up to 1 mile from a plant

- The U.S. EPA only began monitoring non-criterion hazardous air pollutants (HAPs) in 1998 and has added monitors over time. By 2003, there were 84 different HAPs being monitored in our study states.
- In order to explore how pollution changes with distance from a plant, we standardize each pollutant to have mean 0 and std. dev. 1.
- Match monitoring stations and plants, keeping monitor-plant pairs if plant ever reported emitting the pollutant.
- Graph detected levels of pollution by distance to plant.

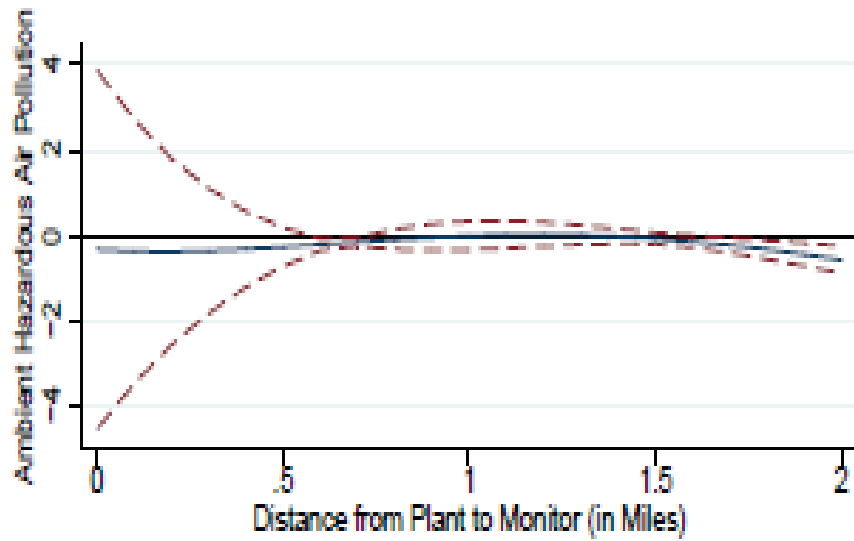
## Benzene



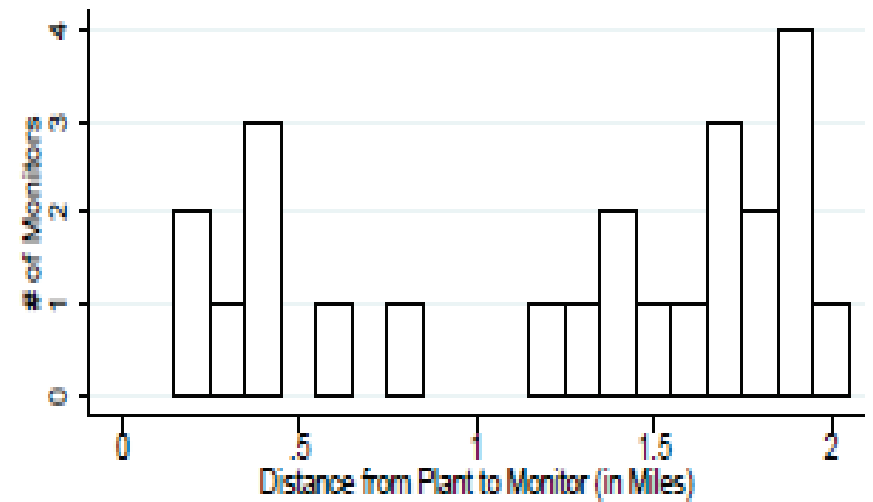
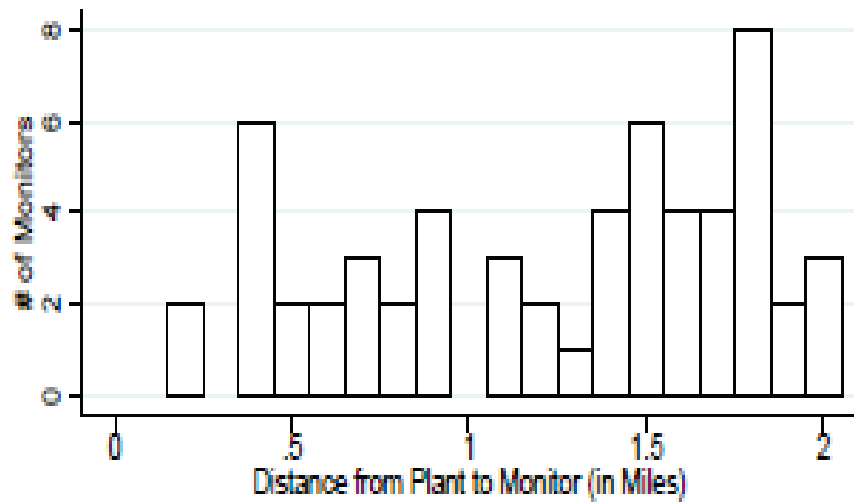
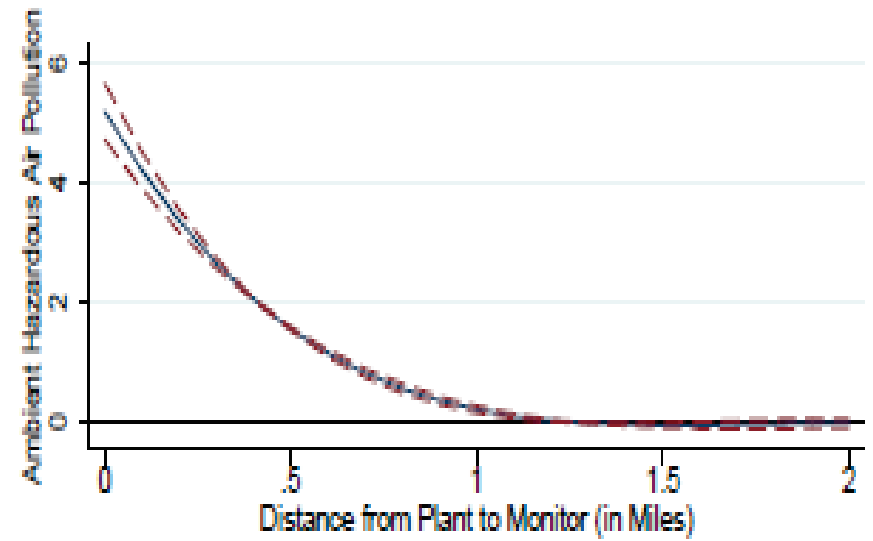
## Cumene



## Methylene chloride



## Nickel

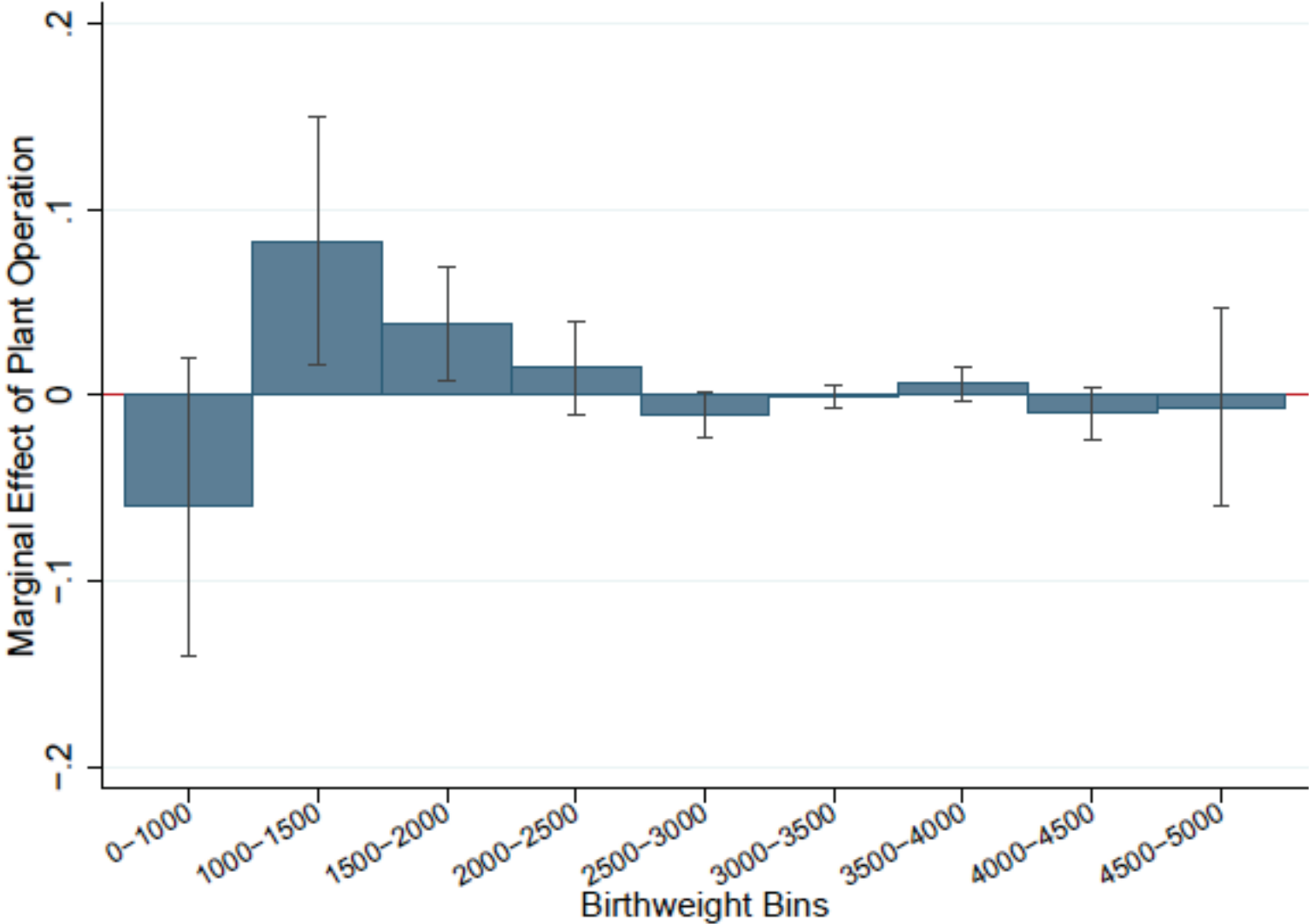


# We examine effects of the opening and closing of plants on birth outcomes

- Study is based on birth records from 5 large states (1989-2003) linked to information about openings and closings of 1600 plants that are known to have emitted toxic chemicals.
- We compare infants within 1 mile of operating plants to those 1-2 miles from an operating plant.
- A key assumption is that the economic effects of plant openings and closings are similar in the two distance bands.



# Estimated Effects of Residence <1 Mile from an Operating Plant on the Incidence of Low Birth Weight



# Implications

- A plant opening increases low birth weight by .01-.02 on a baseline of .09 near plants.
- Using the actual distribution of maternal locations, we estimate that ~6% of the gap in LBW between white college educated mothers and black high school dropout mothers could be due to differential exposure to toxic releases.

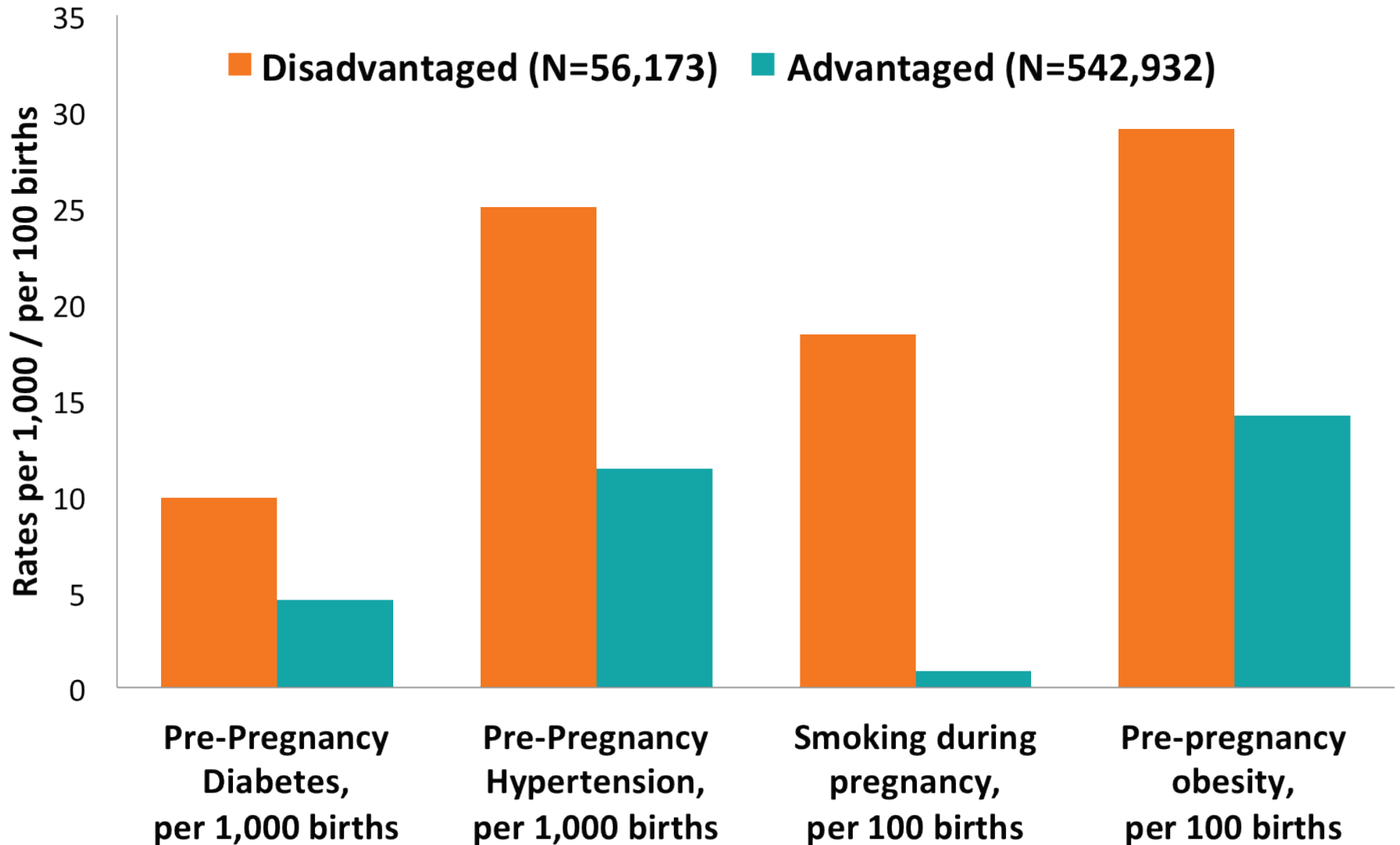
# Have reductions in unhealthy behaviors contributed to reduced inequality in health at birth?

Behaviors that can be measured on the birth certificate include:

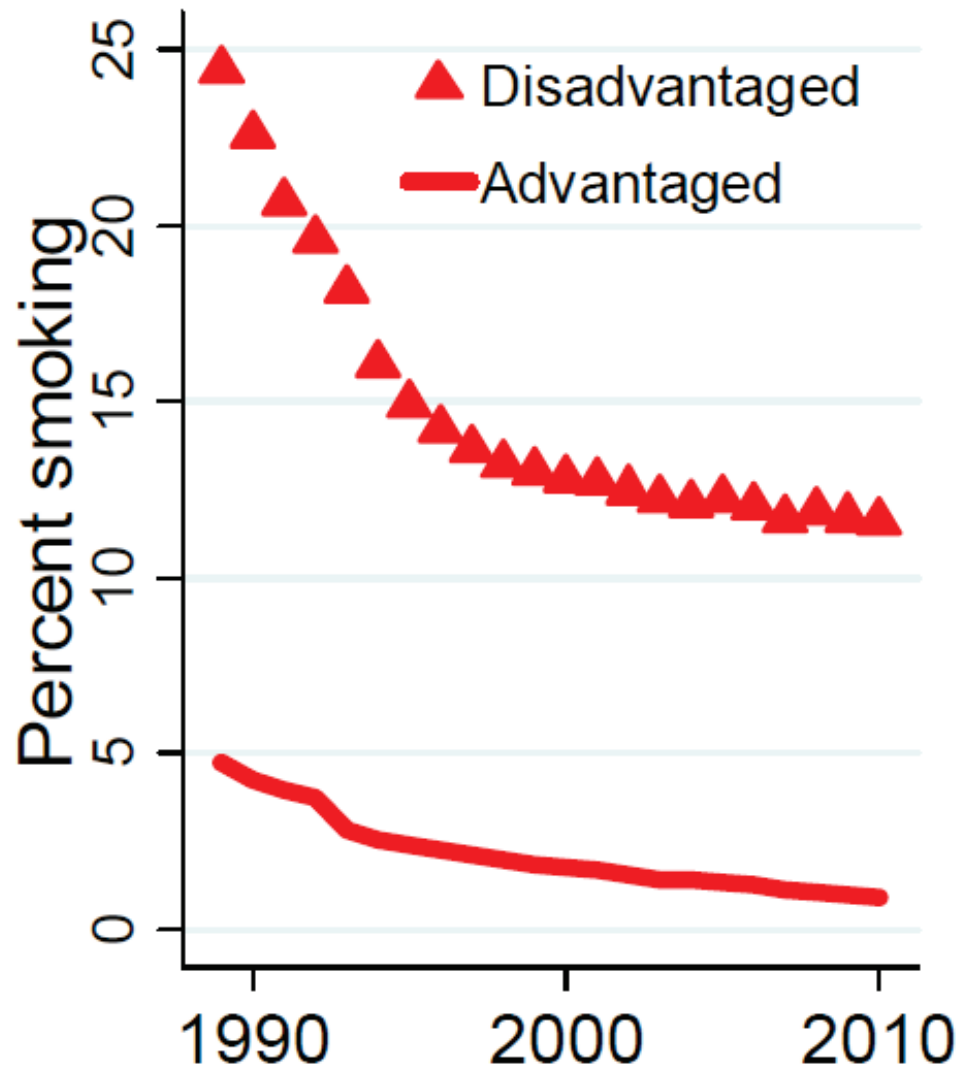
- use of prenatal care
- weight gain
- smoking

We can also observe obesity, hypertension, diabetes.

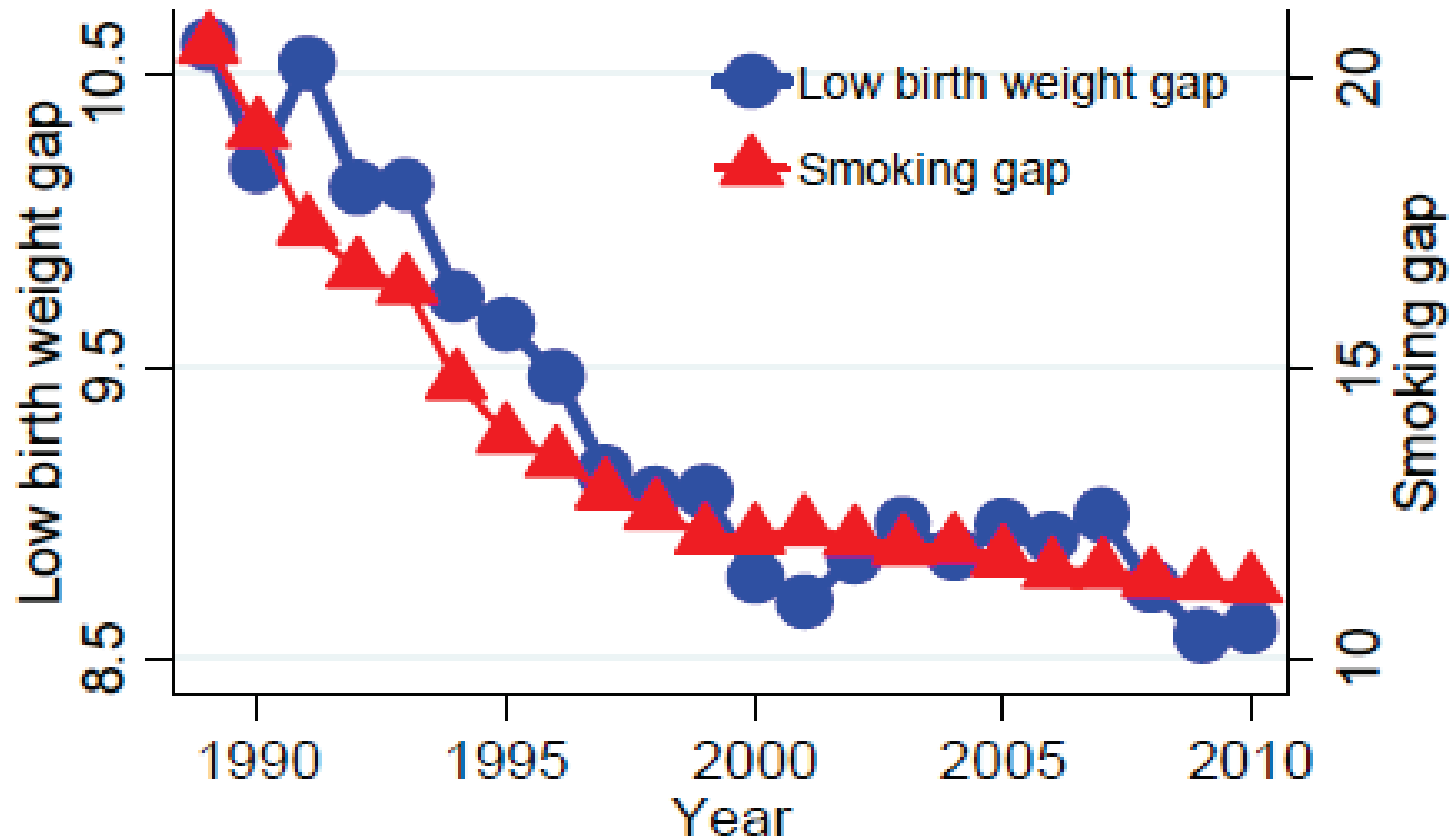
# Differences in Maternal Health and Behavior by Maternal SES, U.S. 2011



Disadvantaged women are more likely to smoke during pregnancy, but the gap is falling



# Reductions in smoking gaps track reductions in LBW gaps

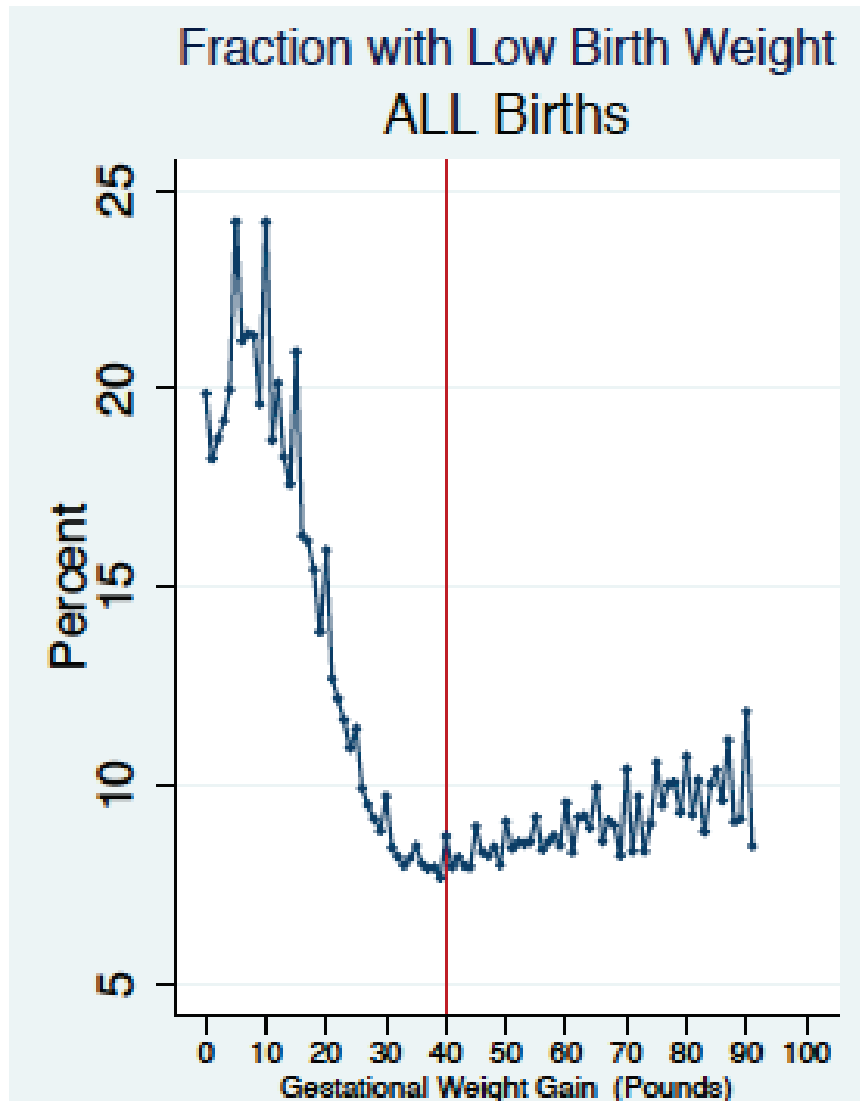


Notes: Singleton births, moms age 19-39 only. Excl.: CA, FL, GE, IN, MI, NY, SD

# Anti-smoking policies help to close the gap because disadvantaged pregnant women are more likely to smoke

- Cigarette taxes, and bans on smoking in the workplace are the main state-level anti-smoking policies.
- Regressions of the size of the smoking gap on indicators for these policies at the state-year level show statistically significant effects.

Other behavior trends are associated with worse outcomes, e.g. increases in extremes of weight gain during pregnancy

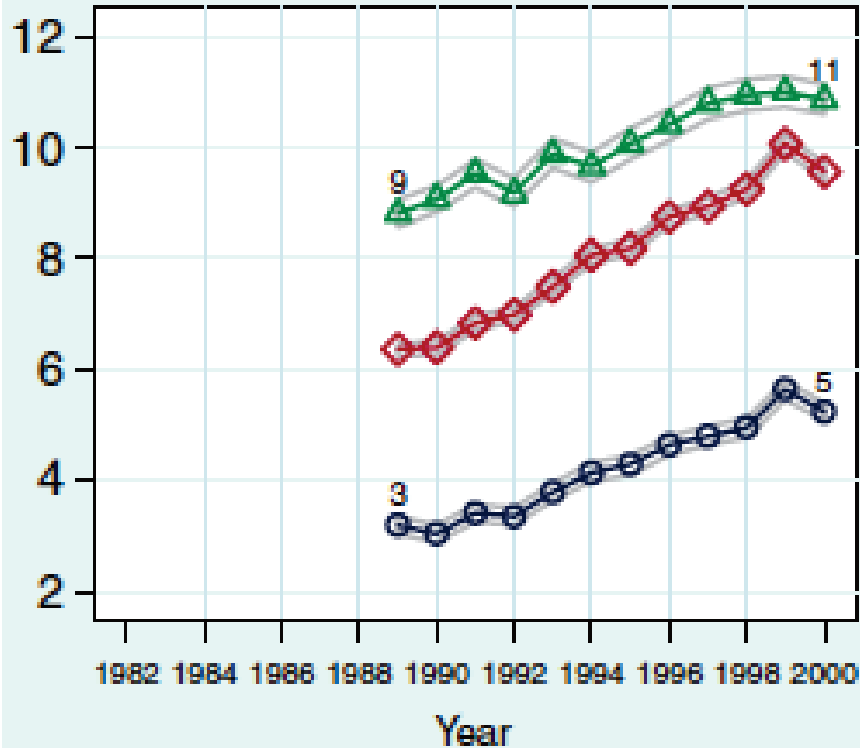




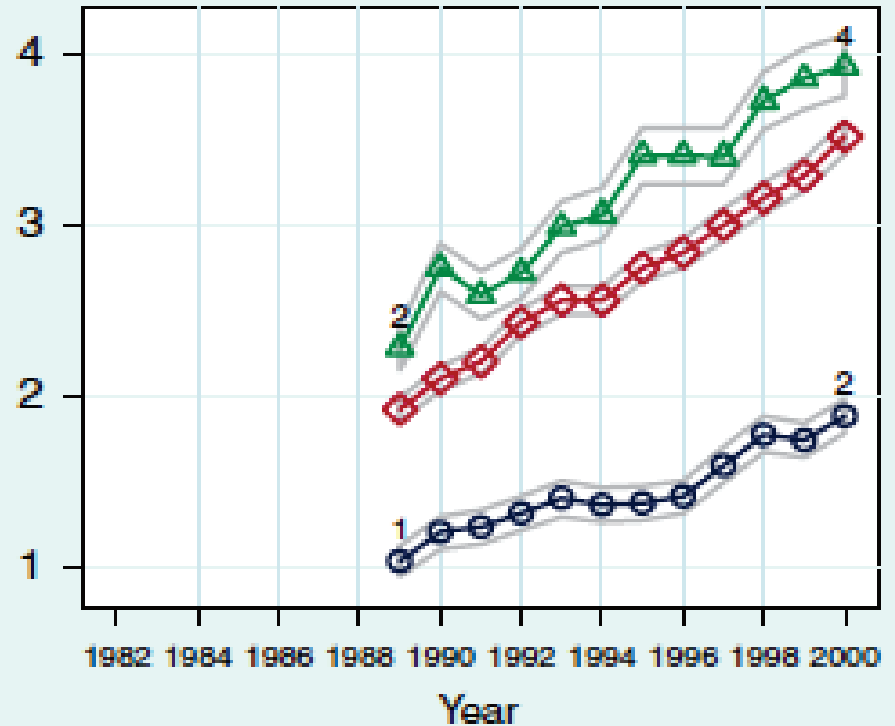
# Trends in Weight Gain During Pregnancy are Unfavorable

(Source: Lin, 2008; Green=<high school, Red=HS, Blue=College)

E : Weight Gain  $\leq$  15 Lbs



F : Weight Gain  $\geq$  60 Lbs



# What factors can account for reductions in inequality at birth in the face of increasing economic inequality?

Possible factors:

- Changes in fertility X
- Improvements in medical care ✓
- Long run improvements in maternal health ✓
- Reductions in Pollution ✓
- Changes in maternal health behaviors ✓
- Others ?

## Other policies with significant effects potential to equalize outcomes:

- Feeding programs (e.g. Almond, Hoynes, Schazzenbach, 2011)
- Income transfers (e.g. Dahl and Lochner, 2012))
- Child care (e.g. Conti et al. 2015)

# Conclusions

- Health at birth is strongly linked to socioeconomic status.
- Inequalities in economic status have increased over the last 25 years, especially in the U.S.
- Yet inequalities in the health of young children have been decreasing.
- Suggests that public policy can work with the family to improve the health of disadvantaged children even when family incomes are deteriorating.

## Policies that most responsible for reducing inequality in child health may include:

- Improvements in access to medical care
  - Both for mothers and children
- Reductions in pollution
- Reductions in smoking due to cigarette taxes, smoking bans, and other public policies.

Thank you!



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