Early School Access and Educational Attainment: Evidence from China's School Starting Age Reform

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Substantial Attention to School Starting Age

Mothers' burdens block South Korea plan to lower school entry age

Proposal aimed at increasing population dropped amid fierce public backlash

A push to raise the school starting age to 6 sounds like good news for parents, but there's a catch

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Fears that raising school starting age to six will dumb down children

The drive to raise the school starting age has gained cross-party support, giving Nicola Sturgeon enough votes to push it through

ANDREW MILLIGAN/REUTERS

A drive to raise the starting age to six in Scotland's schools has been condemned by a teaching union and an academic who warned that it would "dumb down" early-years education.

Effects on Educational Attainment

Research Question

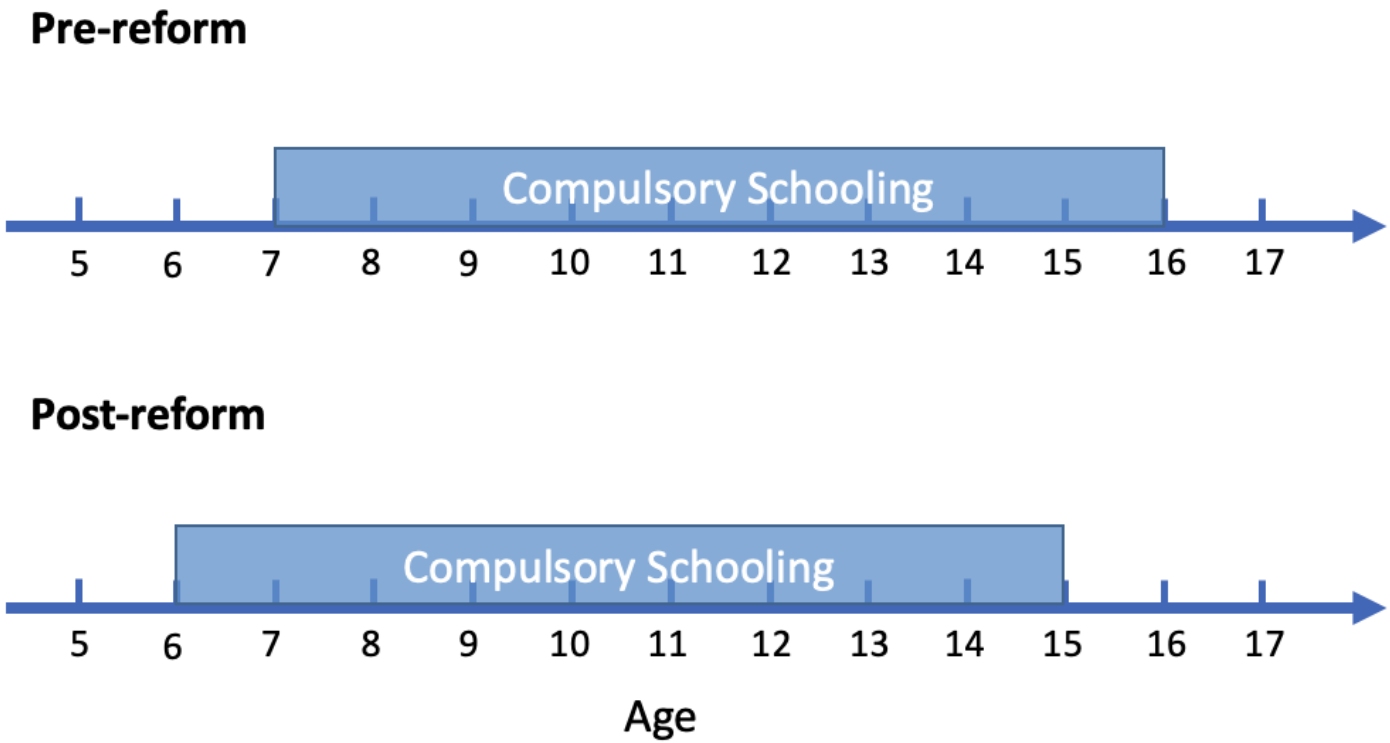
- How does changing the statutory school starting age affect educational attainment?

Statutory school starting age might affect educational attainment

- Learning capacity differs by age
  - Persists through human capital formation (Cunha and Heckman, 2007)
  - Effects on test scores (Fletcher and Kim, 2016; Rosa et al., 2019)
- Changes in the allocation of caregivers' time and household income
- Lower opportunity cost of getting the same years of schooling

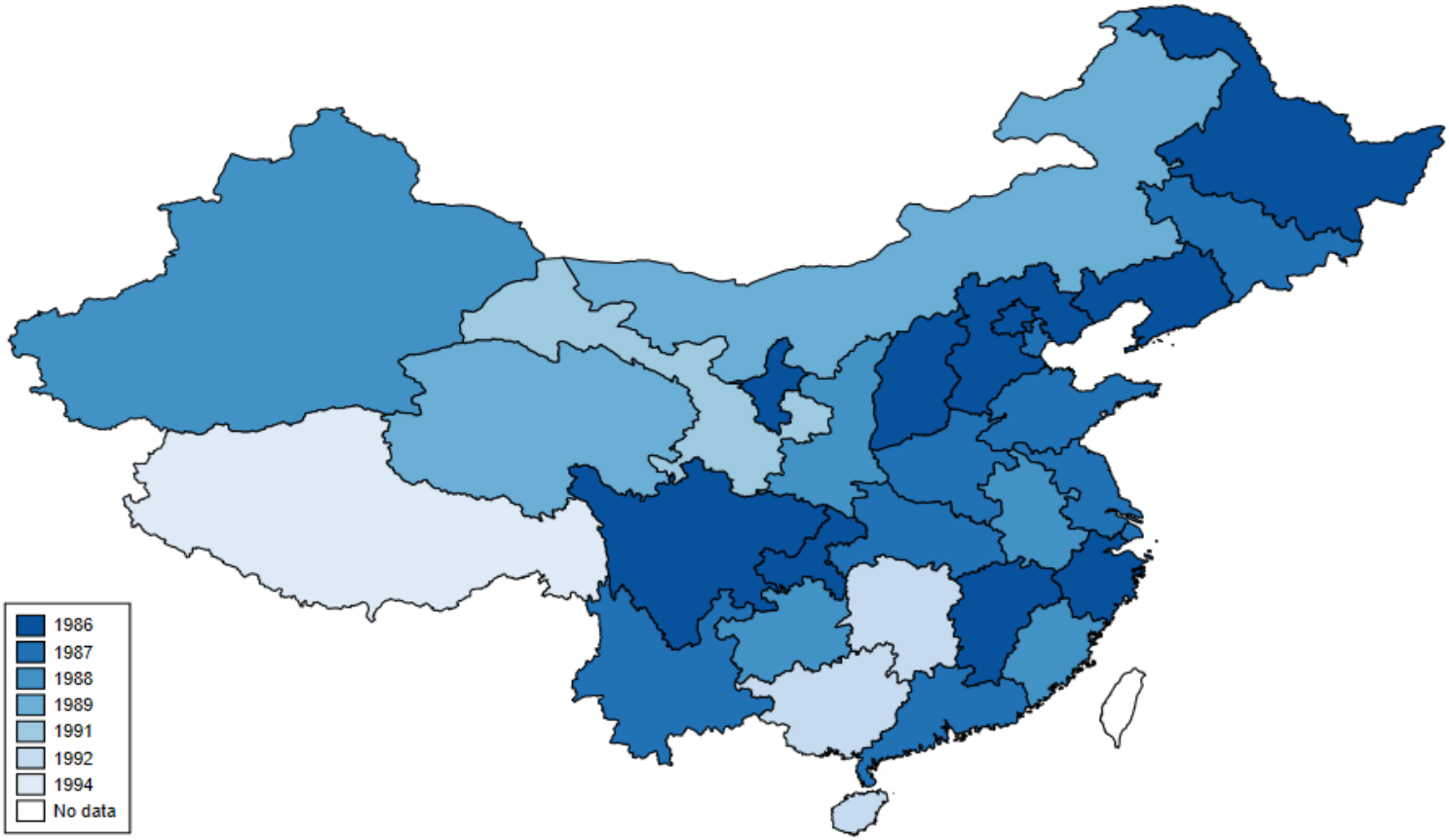
This Paper: China's School Starting Age Reform

- Lowered the statutory primary school starting age from 7 to 6
- Unchanged birth date cutoff for enrollment
- Unchanged required years of schooling



This Paper: A Natural Experiment in China

Variation in province-level adoption dates between 1986 and 1994



Preview of Findings

Method

- Province-level variation in adoption dates
- Callaway and Sant'Anna difference-in-differences estimator

Main Results

- The reform increased high school graduation by over 5 pp
  - $\sim$20% increase relative to the pre-reform mean
  - Similar effects for high school enrollment
  - No effects on primary school enrollment and compulsory schooling completion, as expected
- Magnitude is comparable to increasing the minimum school leaving age by one year in the US and Canada (Oreopoulos, 2006)

Contribution: Isolating the SSA Effects

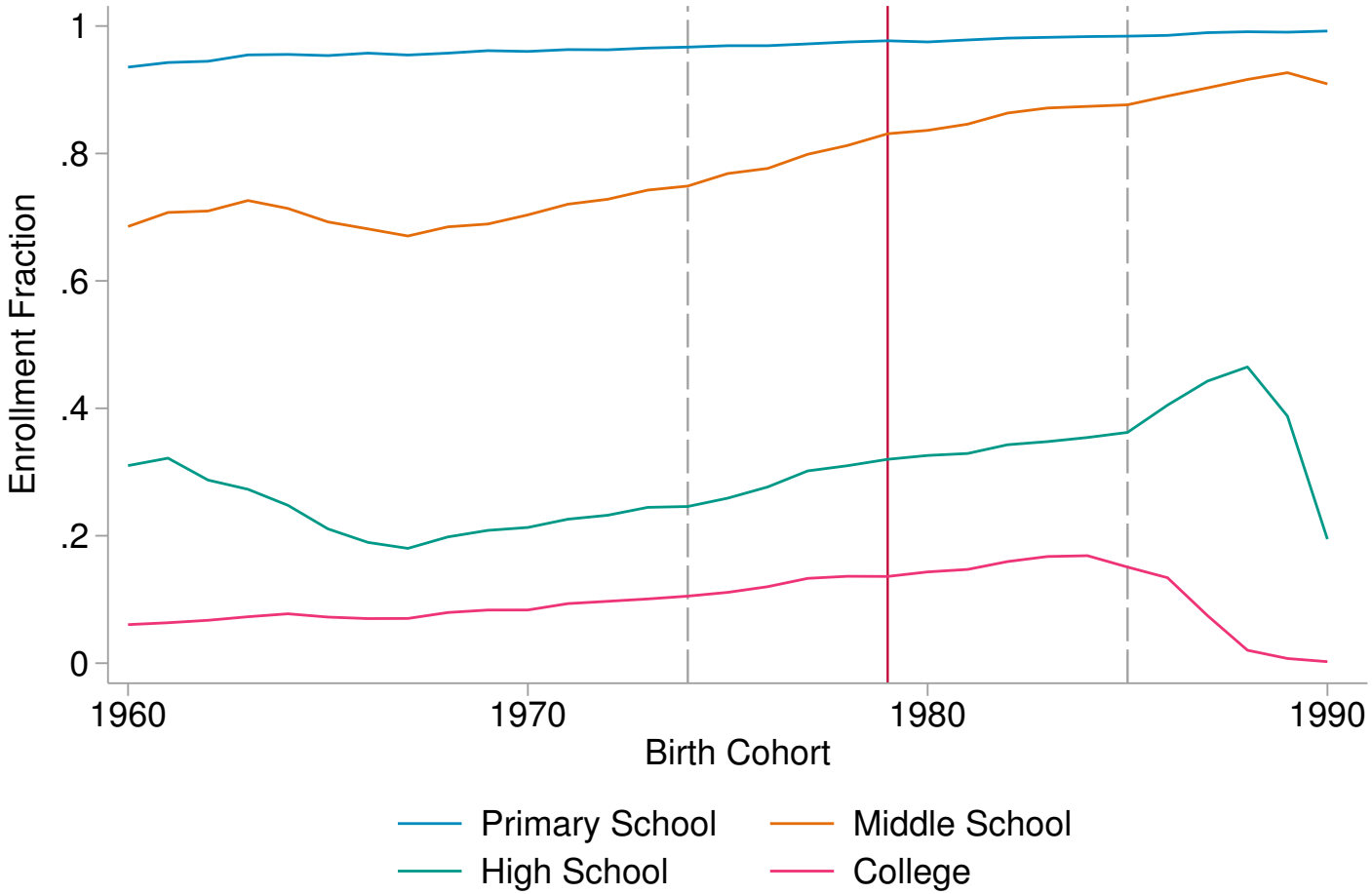
Prior studies cannot separate the SSA effects from other factors

- Long-run effects of school starting age policies literature
  - Identified based on changes in enrollment cutoff dates (Bedard and Dhuey, 2012; Fletcher and Kim, 2016)
  - Cannot separate the effects of starting school at an older age from the effects of being relatively older within the classroom
- A broader literature: returns to schooling
  - With minimum school leaving age, changing school starting age mechanically changes required years of schooling
  - Early childhood programs lower the access age to education and offer additional years of schooling
  - Cannot separate the effects of age from the length of schooling effects

This paper isolates the effects of SSA from relative age and length of schooling effects

China's Enrollment Rates in Schools

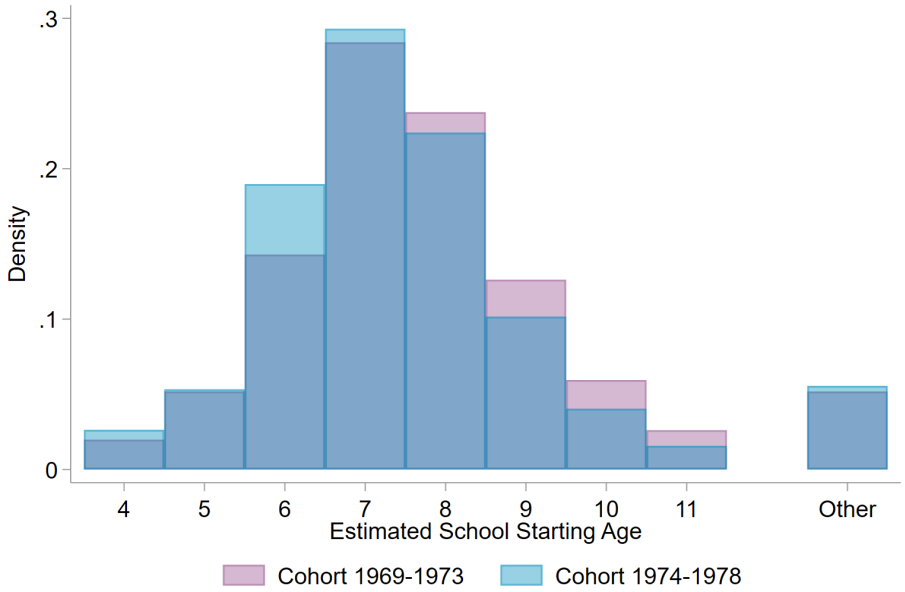
SSA reform was implemented during the late 1980s to early 1990s, a period with relatively low education levels



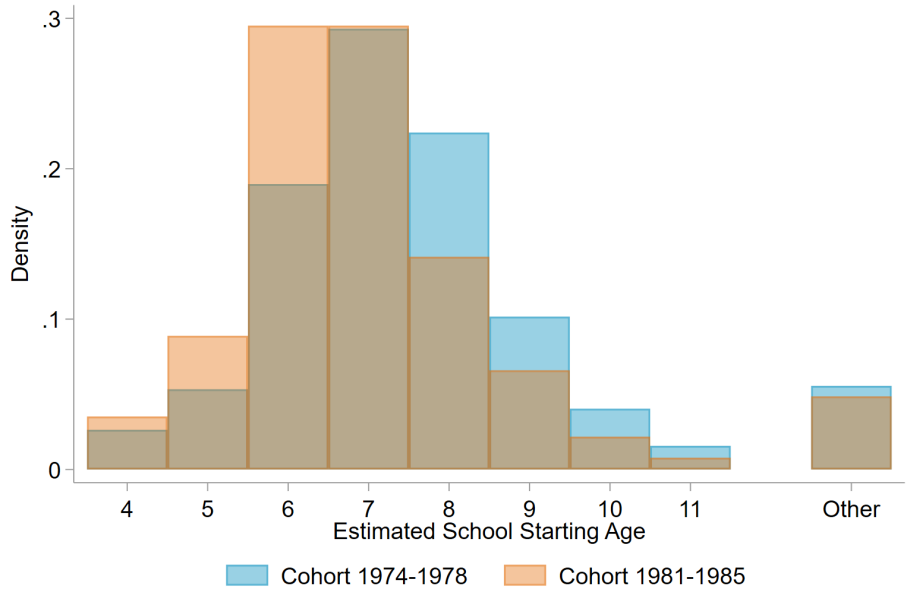
Data: China 2005 Census Microdata

The School Starting Age Reform

- "Children who have reached age 6 should enroll in school"
  - The previous policy specified age 7 as the school starting age
  - Age 7 rule was permitted in regions facing challenges
- The SSA reform lowered the actual age at school entry by 0.4 years



(a) Placebo



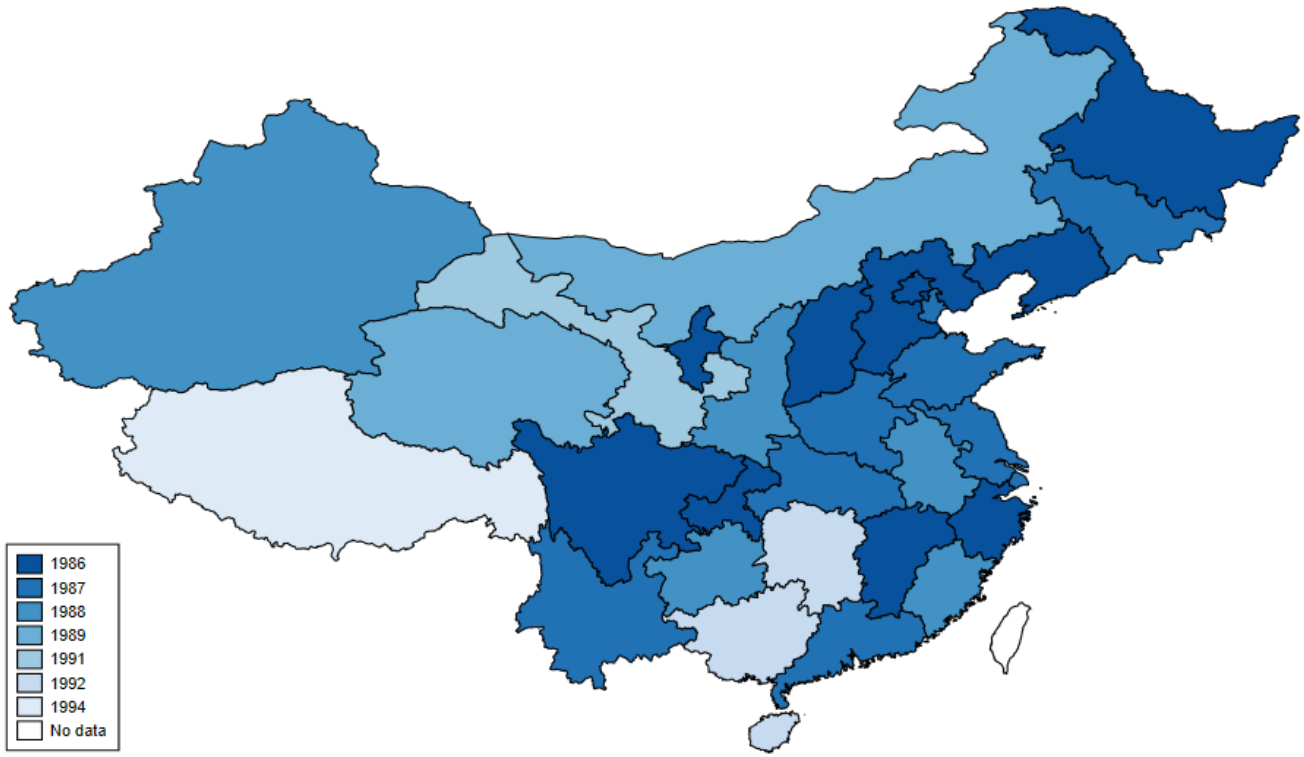
(b) SSA Reform

Data: China Family Panel Study 2010

▸ Historical Censuses

Province-Level Adoption of the SSA Reform

- All provinces gradually adopted the SSA reform between 1986 to 1994 school year



- Very little variation in adopting timing explained by changes in pre-reform province characteristics

Data: Adoption dates from provincial legislature, compiled by Chen and Park (2021)

▸ Random Adoption

Separating the SSA Reform

from other Compulsory Education Law policies

SSA Reform is one policy within the Compulsory Education Law (CEL)

- CEL regulates various aspects of compulsory education
- Other CEL policies include
  - Primary school and middle school are compulsory
  - Regulations on costs, school finance, infrastructure, teacher training, employment restrictions
- Provinces set one effective date for all CEL policies

SSA reform can be separately identified by comparing in-school cohorts with underaged cohorts

- Other CEL policies affected all children of school age and below
- SSA reform only affected children who were underaged
- Assume exposure to other CEL policies independent of SSA reform

▸ PS Enrollment ▸ CS Completion

Intuition for Identifying the SSA Reform

Cohort (k) \ Treatment Timing Group (g)	1979	1980	1981	1982	1984	1985
1974	CEL other	CEL other	CEL other	CEL other		
1975	CEL other	CEL other	CEL other	CEL other		
1976	CEL other	CEL other	CEL other	CEL other	CEL other	
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1979	CEL other + SSA	CEL other	CEL other	CEL other	CEL other	CEL other
1980	CEL other + SSA	CEL other + SSA	CEL other	CEL other	CEL other	CEL other
1981	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other	CEL other	CEL other
1982	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other	CEL other
1983	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other	CEL other
1984	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other
1985	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA	CEL other + SSA

Row: birth cohort

Column: provinces with the same adoption year; treatment timing groups are defined using the provinces' initial SSA exposed cohorts

Data

- Adoption dates documented in provincial legislature on "Decisions about Compulsory Education Law" (compiled by Chen & Park, 2021)

- Educational attainment observed in the 2005 China 1% Census microdata for individuals exposed to the CEL and aged at least 20 at the time of the survey
  - Estimating sample includes 408,265 individuals
    - Born before the first province adopted the SSA reform
    - Started school after the end of the Cultural Revolution
    - Exclude residence of provinces where the majority of the population is non-Han Chinese
  - This paper focuses on high school enrollment and graduation
    - HS is the first post-compulsory level education
    - HS graduates earned 80% more than MS graduates

▸ Migration & Mortablity

Dynamic Effects of the SSA Reform Over Time

Traditional Model

- The effects of the SSA reform might change over time
  - Parents need time to learn about the new rules
  - Teachers need time to adjust teaching methods
  - Increased school cohort size dilutes educational resources

Dynamic Effects of the SSA Reform Over Time

Traditional Model

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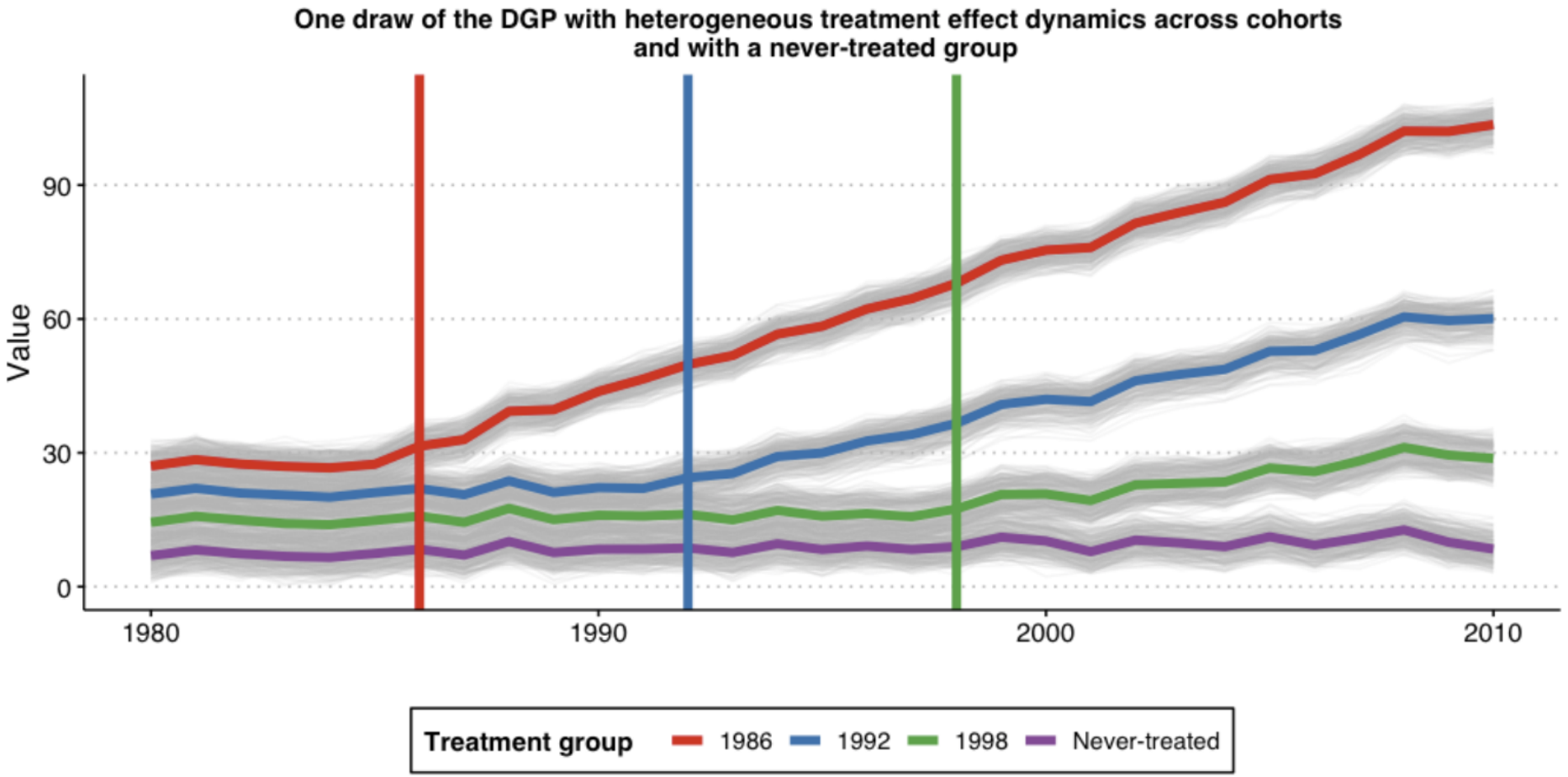
  - Parents need time to learn about the new rules
  - Teachers need time to adjust teaching methods
  - Increased school cohort size dilutes educational resources
- Traditional model estimates a linear regression with cohort and province fixed effects (TWFE event-study regression)

$$y_{j,k} = \sigma_k + \lambda_j + \sum_{e=-5}^{6} \delta_e \mathbf{1}(\tau_{j,k} = e) + \epsilon_{j,k}$$

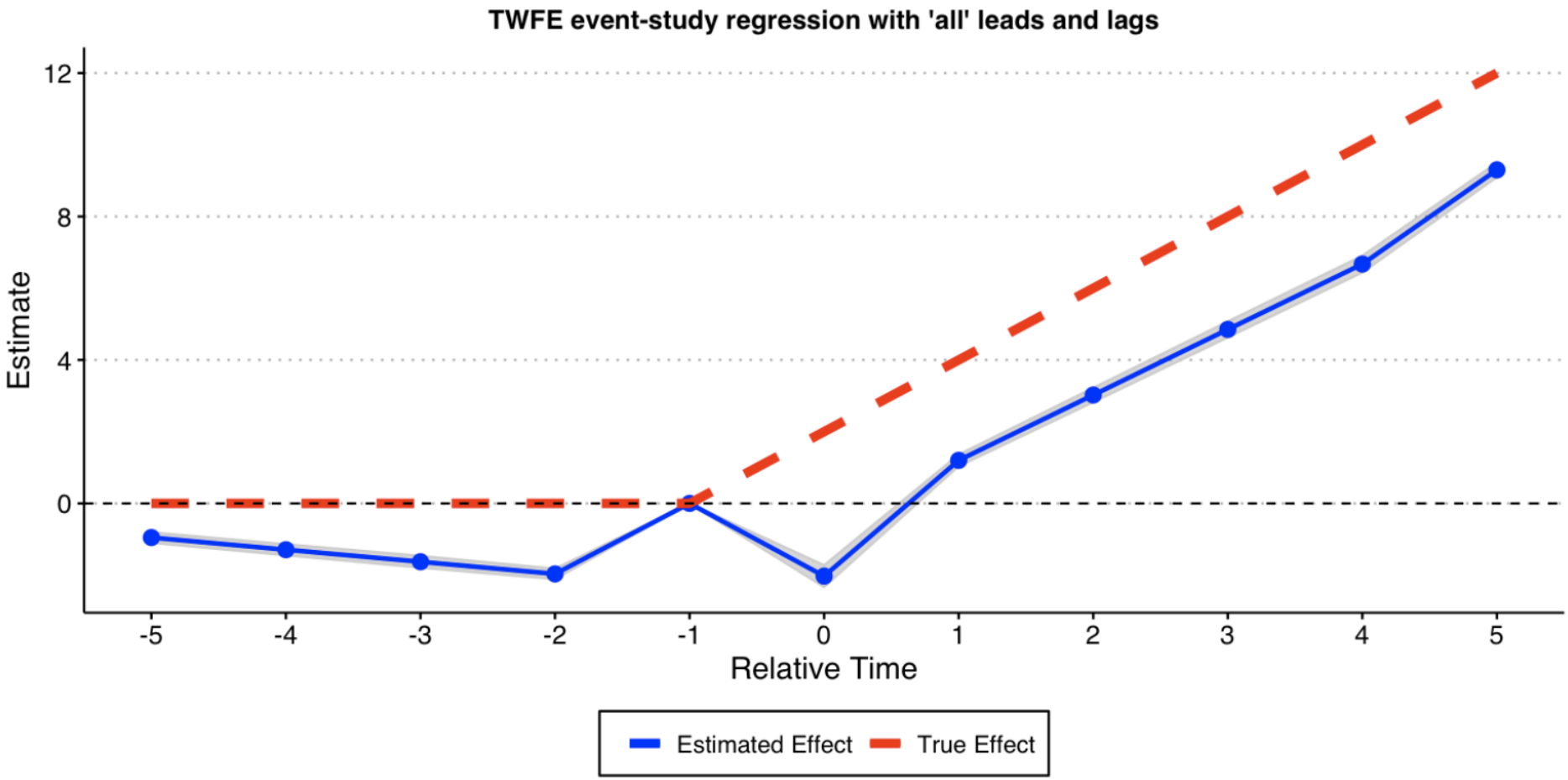
  - $y_{j,k}$ = educational attainment for cohort k in province j
  - σ_k = cohort fixed effect
  - λ_j = province fixed effect
  - $\tau_{j,k}$ = relative time to treatment (event time)
  - $\epsilon_{j,k}$ = error term
- Traditional model may be biased in settings with heterogeneous treatment effects dynamics (Sun and Abraham, 2021)

Visualize the Potential Biases - DGP



Source: Online Documentation by Callaway and Sant'Anna (2022)

Visualize the Potential Biases - Estimates



Source: Online Documentation by Callaway and Sant'Anna (2022)

Potential Heterogeneous Dynamics of the SSA Reform

- Dynamic effects of the SSA reform over time
  - Parents need time to learn about the new rules
  - Teachers need time to adjust teaching methods
- SSA reform treatment effect dynamics might differ between early and late-adopting provinces
  - Parents in late-adopting provinces may be more informed by the Ministry of Education's advocacy events
  - Educators in late-adopting provinces may be better prepared due to nationwide school principal training programs and research institutes
- Require a method allowing heterogeneous treatment effect dynamics across provinces with different adoption years
  - Callaway and Sant'Anna difference-in-differences

Callaway and Sant'Anna DiD

Average Treatment Effects on the Treated (ATT)

- Separately identifies the treatment effects for different cohorts in provinces with different adoption years by making 2x2 comparisons

$$\widehat{ATT}(g,k) = \frac{1}{N_g} \sum_{j:G_j=g} [Y_{j,k} - Y_{j,g-1}] - \frac{1}{N_{\mathcal{G}_{comp}}} \sum_{j:G_j \in \mathcal{G}_{comp}} [Y_{j,k} - Y_{j,g-1}]$$

  - $Y_{j,k}$: educational attainment for cohort k in province j
  - $Y_{j,g-1}$: final cohort not exposed to SSA in province j
  - $G_j = g$: treatment group, provinces with initial SSA exposed cohort g
  - $\mathcal{G}_{comp} = \{g' : g' < k\}$: comparison group, provinces not-yet-adopted the policies by year k
- Key identifying assumption: parallel trends assumption
- Visualize an example: average treatment effect for the 1981 cohort in treatment timing group 1979

Example: ATT(1979,1981)

Cohort (k) \ Treatment Timing Group (g)	1979	1980	1981	1982	1984	1985
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Callaway and Sant'Anna DiD

Event-study estimates and inference

- Separately identifies the SSA treatment effects for different cohorts in provinces with different adoption years by making 2x2 comparisons
- Aggregate into event-study estimates using a weighted average
  - Visualize an example: estimated effect for event time $e = 0$, the initial SSA reform exposure cohort
- Inference using Wild bootstrap procedure clustered by province
  - Address multiple testing using sup-t simultaneous confidence bands

Event Time Zero

Cohort (k)	Adoption Timing Group (g) 1979	1980	1981	1982	1984	1985
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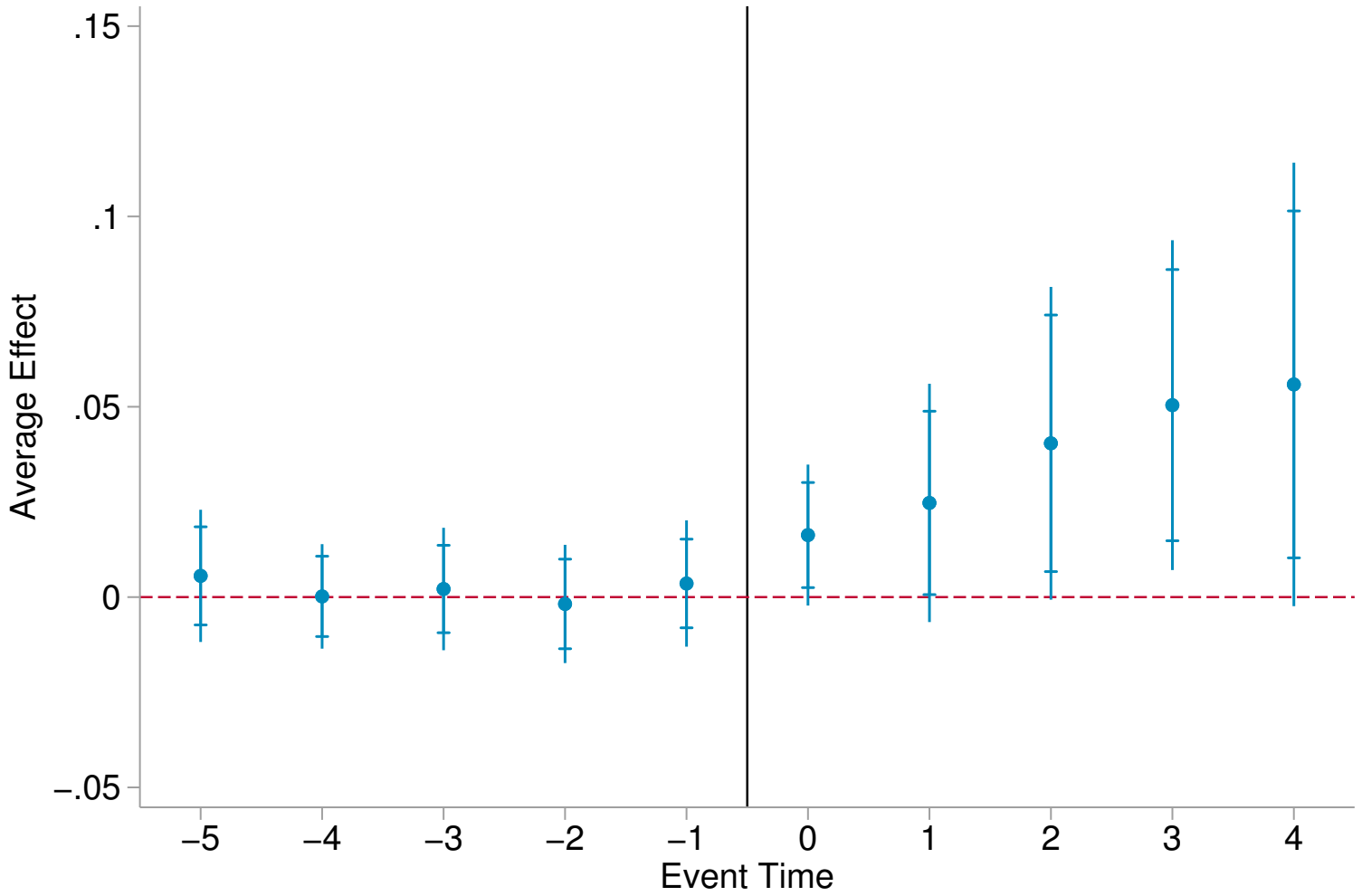
SSA Reform Increased High School Graduation Rate



Notes: the pre-reform mean is 0.279

▸ TWFE

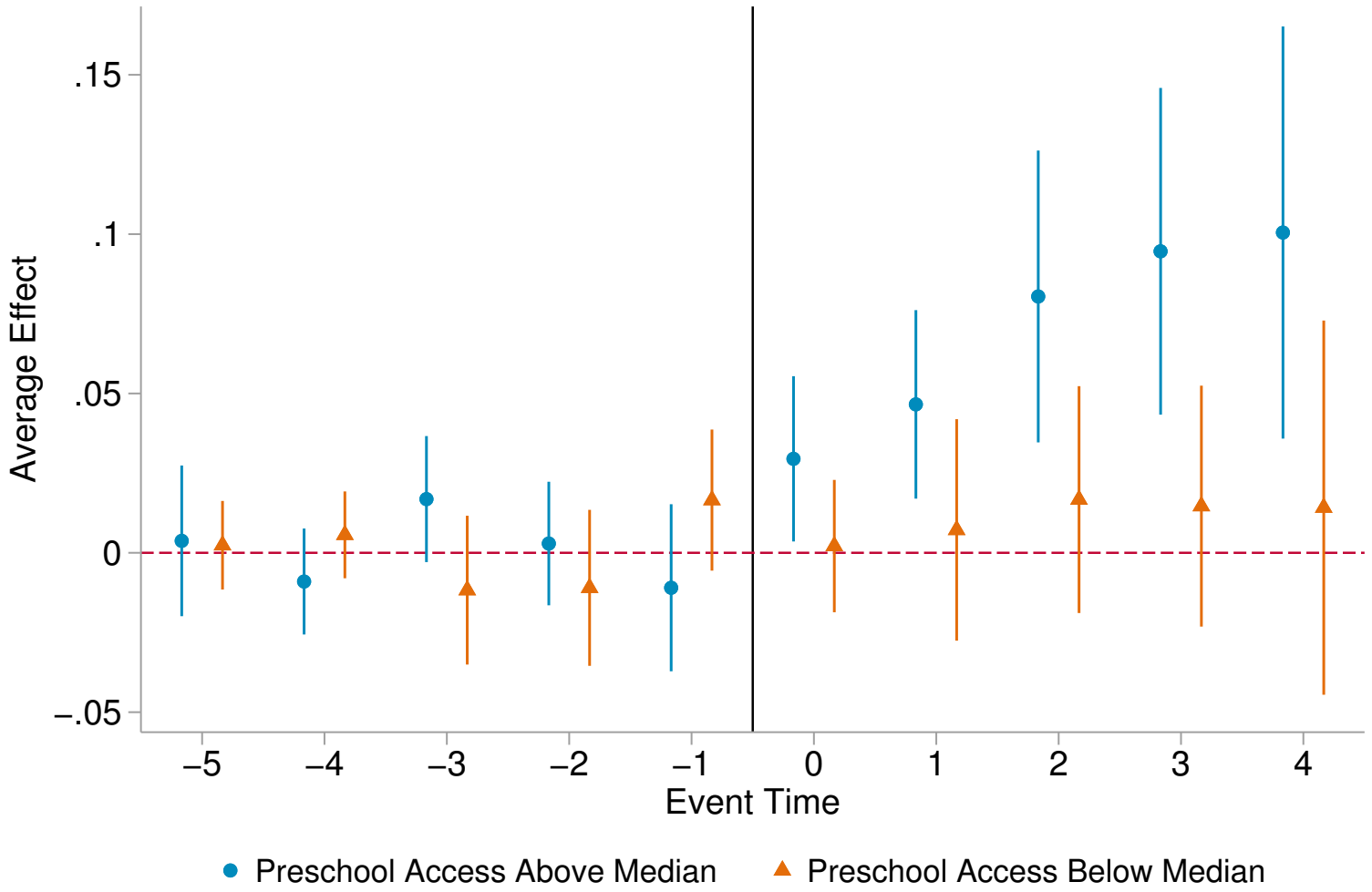
SSA Reform Increased HS Grad Rate by 5 pp

- Implies increased years of schooling by at least 0.15 years
- Magnitude compared to other interventions
  - Similar to a one-year increase in the minimum school leaving age in the US and Canada
  - Approx 40% of early childhood education programs in the US
  - Account for 18% of the total impact of adopting CEL policies in China

Robustness Checks

- Estimates are robust to alternative specifications
  - Alternative weights
  - Alternative sample restrictions
- Not seem to be driven by alternative explanations
  - Increase in education supply
  - Explicit age rule
  - Strengthened enforcement of other CEL policies
  - Other social and education reforms, including One-Child policy, primary school curriculum reform, college expansion

Larger Effects in Provinces with More Resources



High School Graudation

Note: above-median pre-reform mean 0.336, below-median 0.225

Additional Results

Additional heterogeneity analyses on high school graduation

- No visual differences by gender
- No visual differences by birth month
- Larger effects for Han-Chinese

Other outcomes

- Similar effects on high school enrollment
- Suggestive evidence on delayed marriage for women
- Correlational evidence on increased college enrollment

Future plan

- Earnings, occupation, marriage, and fertility using China Census microdata 2010 and 2015
- Parental labor supply and household income using Chinese Household Income Project 1988

▸ Additional hetero ▸ Additional outcomes

Conclusion

- Estimate the effects of changing the statutory school starting age on educational attainment using a unique SSA reform in China
- First paper to isolate the effect of SSA independent of other factors
- SSA reform increased high school graduation by over 5 pp
  - $\sim$20% increase relative to the pre-reform mean
  - Larger effects in more resourceful provinces
- Policy implication for developing countries seeking to reform school entry policies

Thank you!

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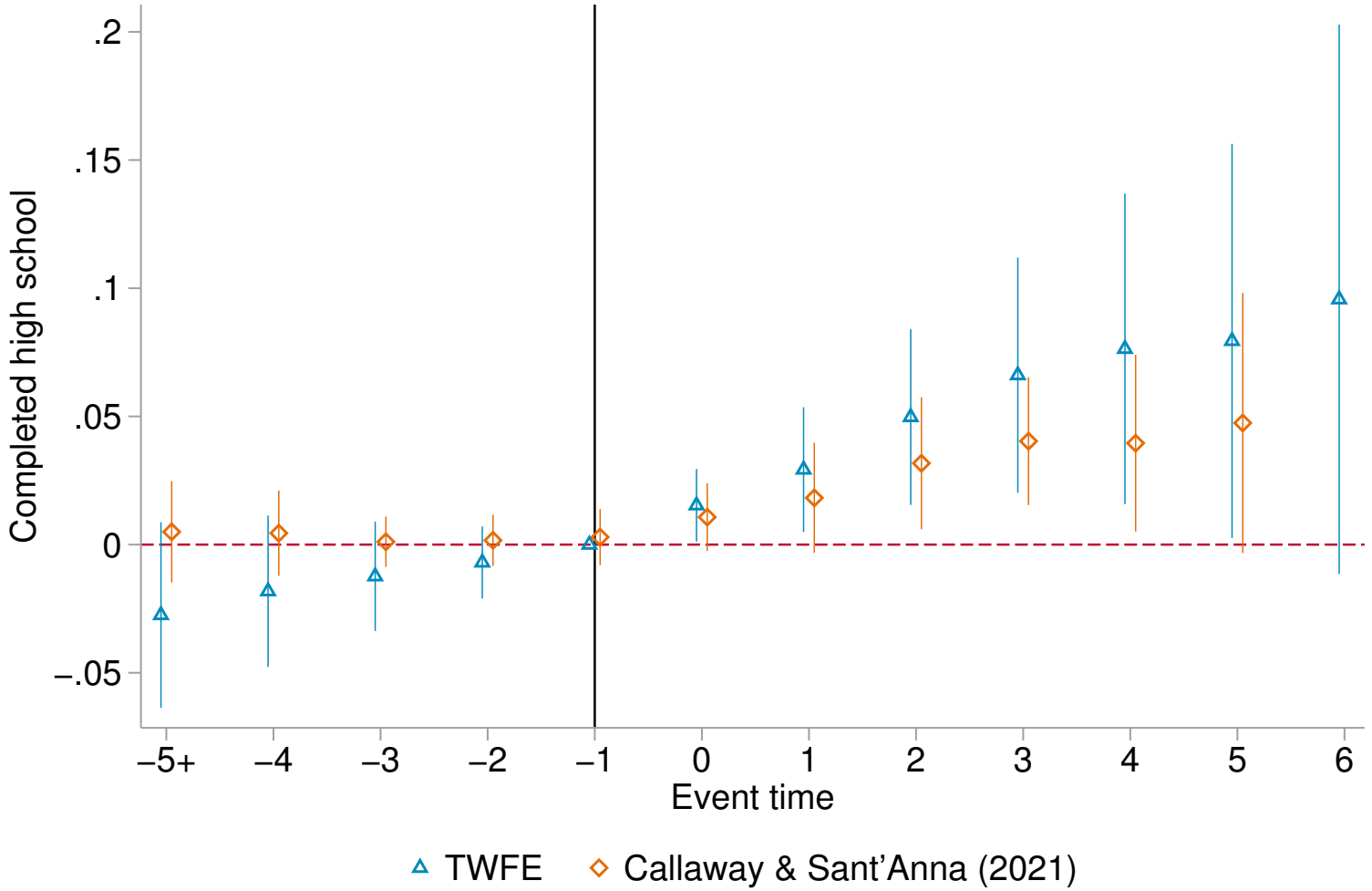
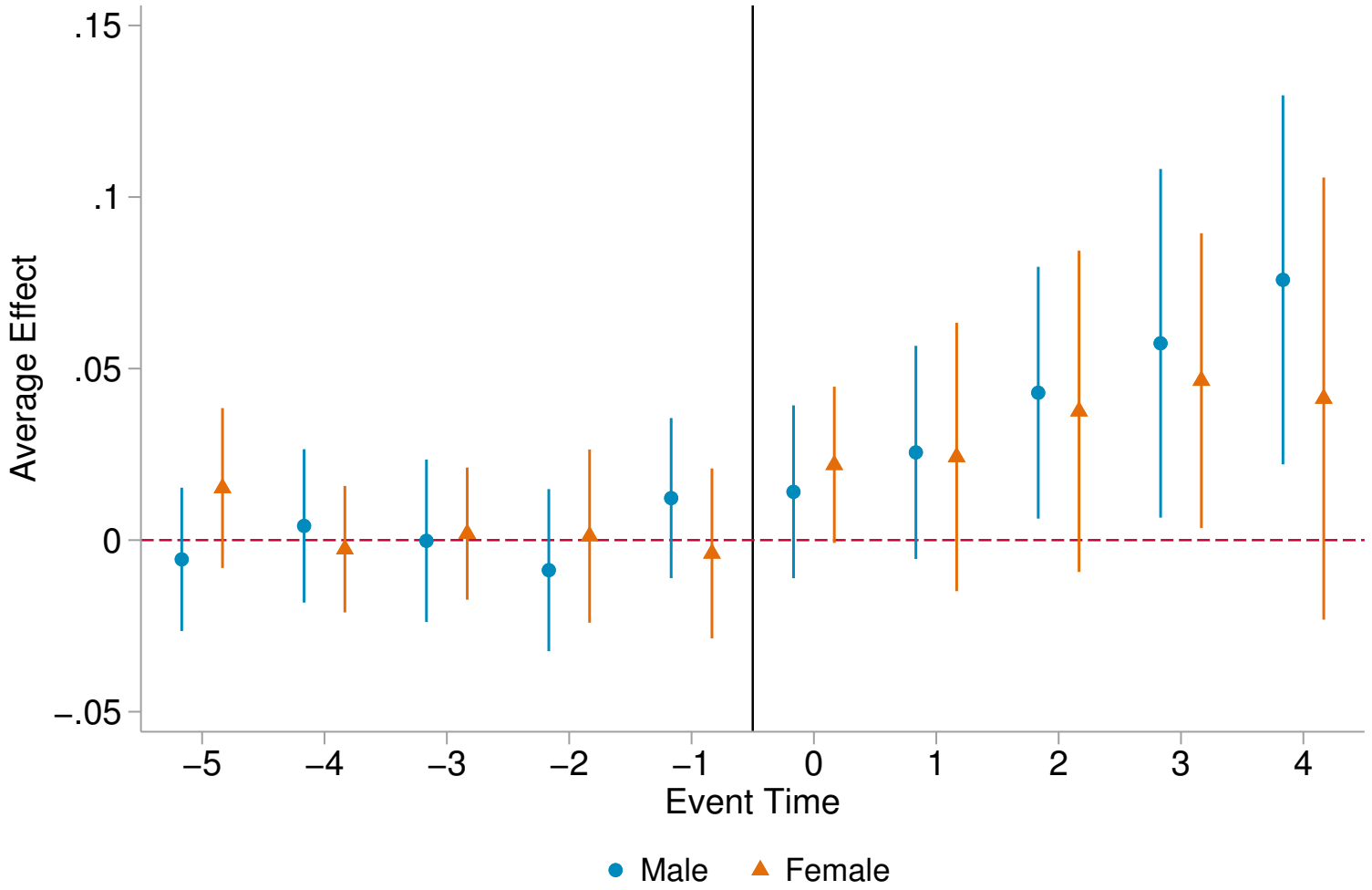
TWFE estimates vs. CSDID estimates



High school Graduation

▸ Main Results

Heterogeneity - Gender

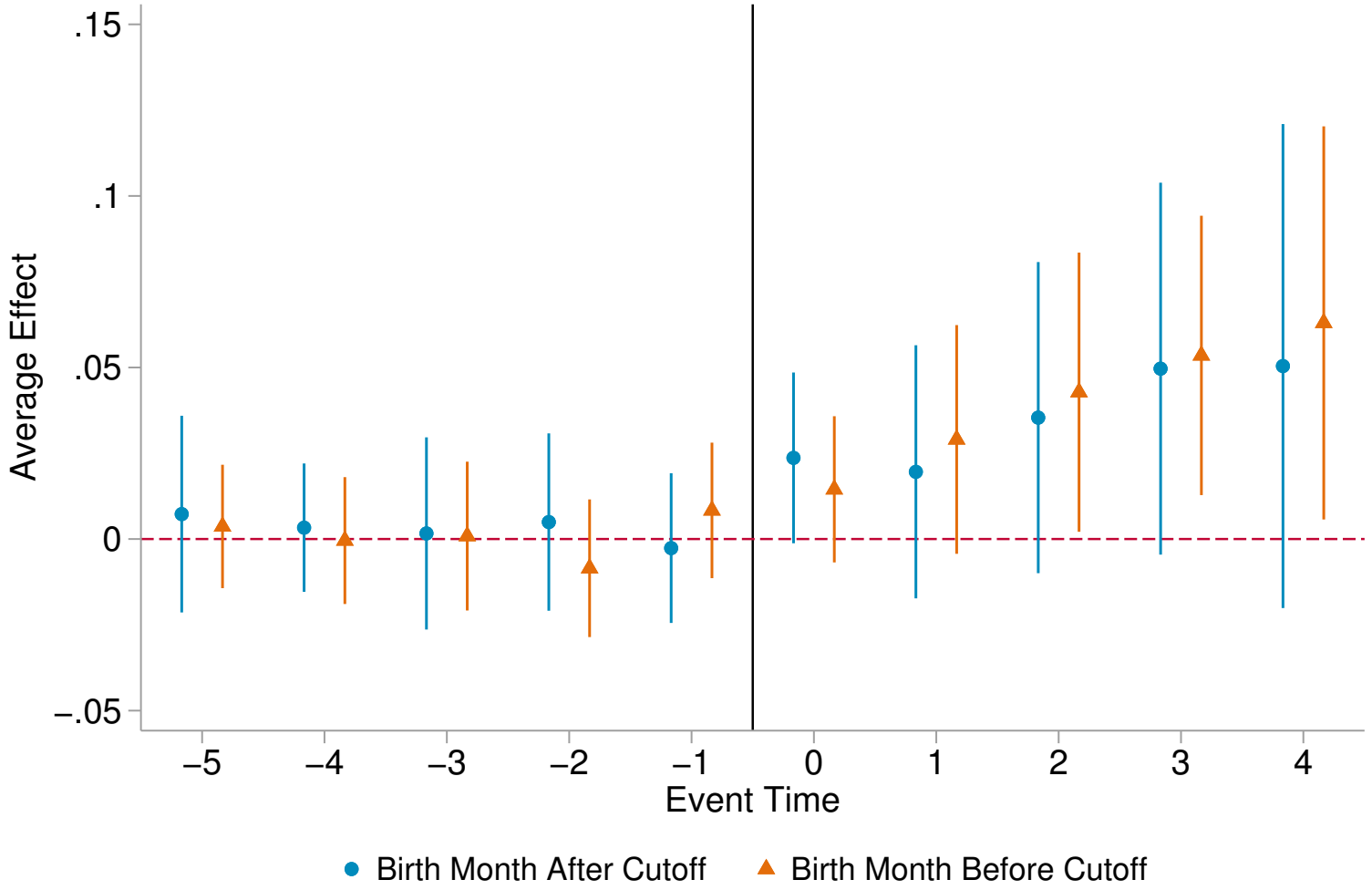


High school enrollment by gender

Notes: pre-reform mean for man is 0.303, woman is 0.265

▸ Back

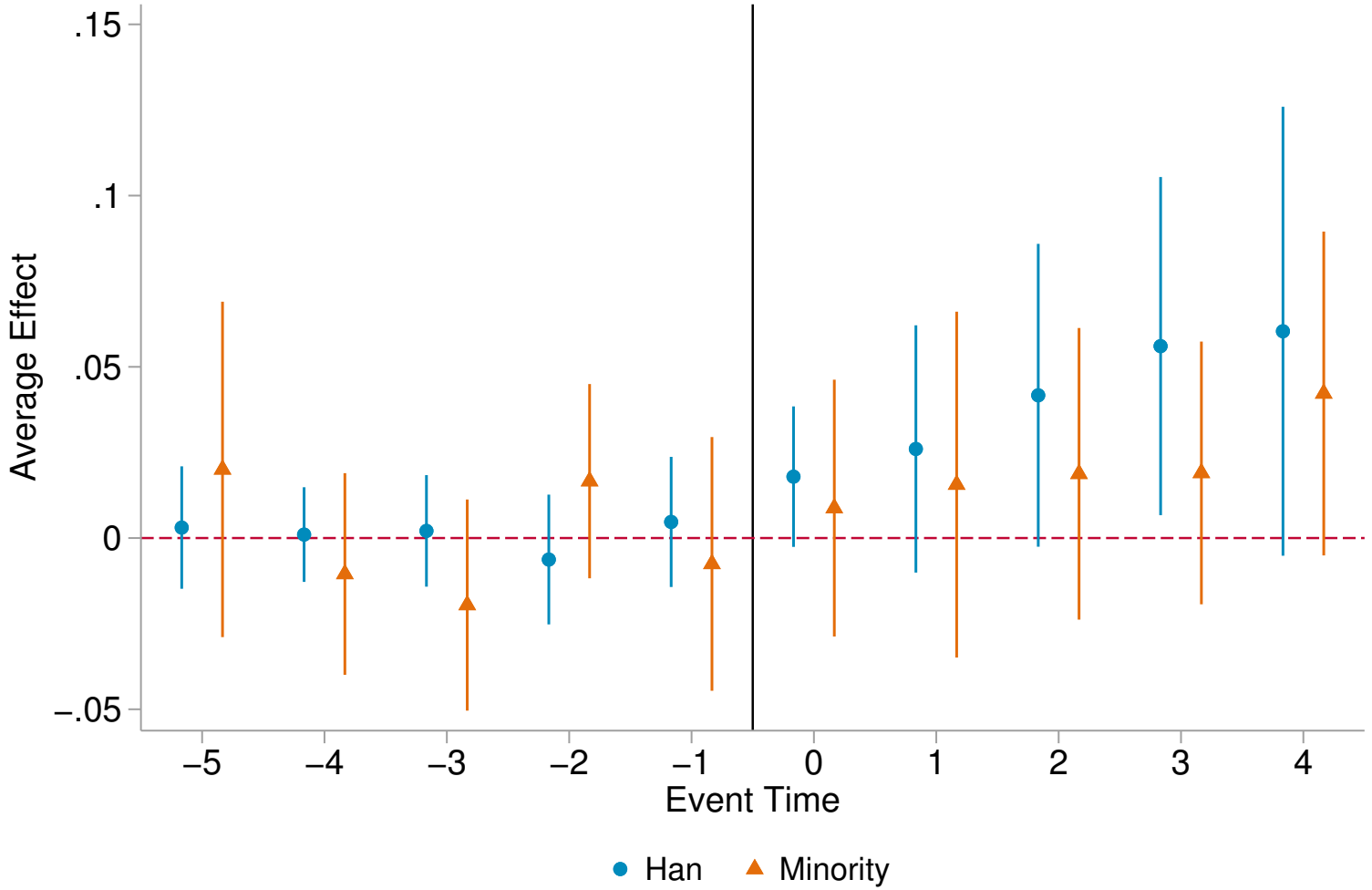
Heterogeneity - Birth month before/after cutoff



High school enrollment by birth month

Notes: pre-reform mean for birth month after cutoff date is 0.295, before cutoff date 0.276 ▸ Back

Heterogeneity - Ethnicity

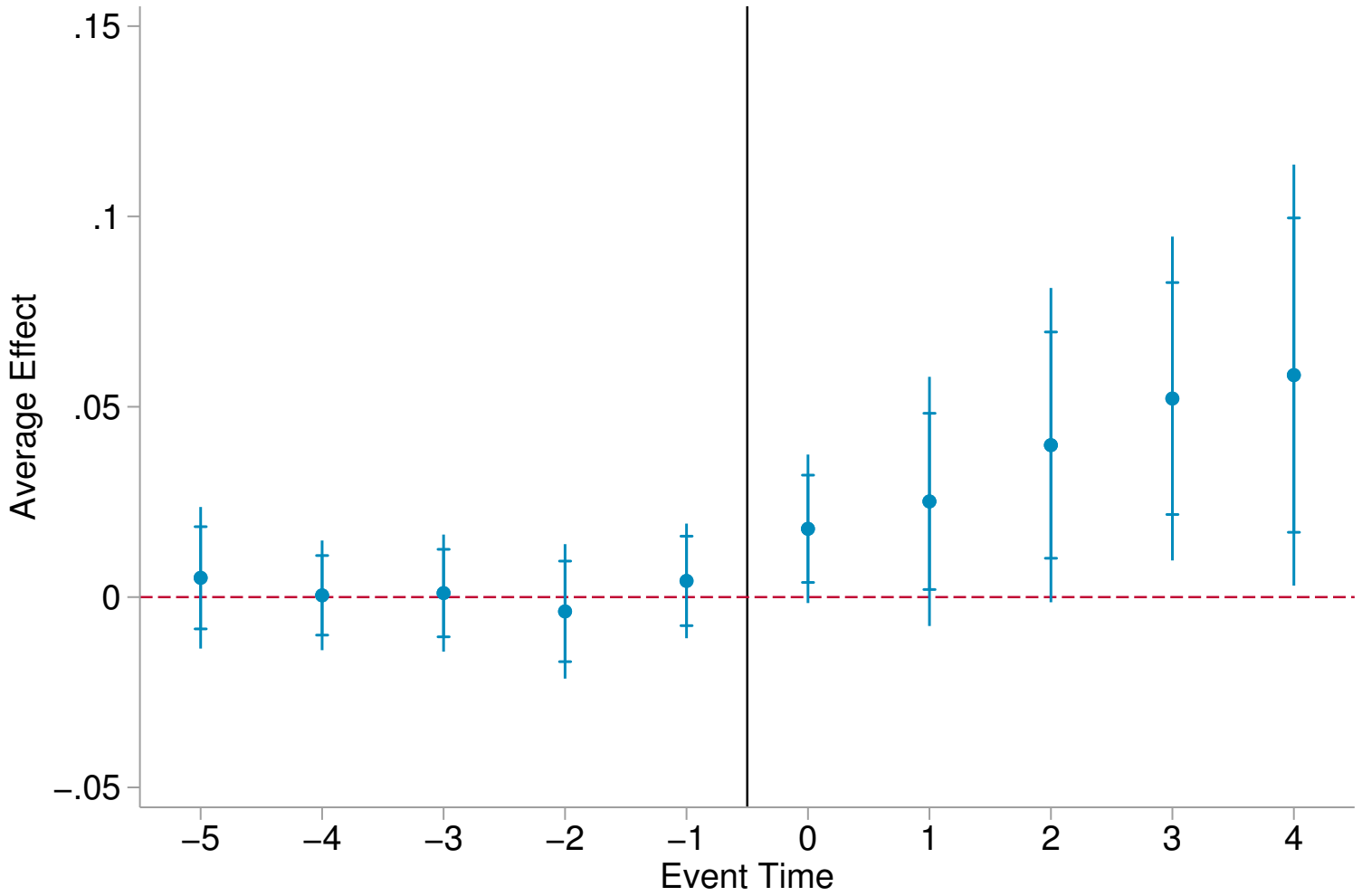


High school enrollment by ethnicity

Notes: pre-reform mean for Han is 0.297, and ethnic minority is 0.167

▸ Back

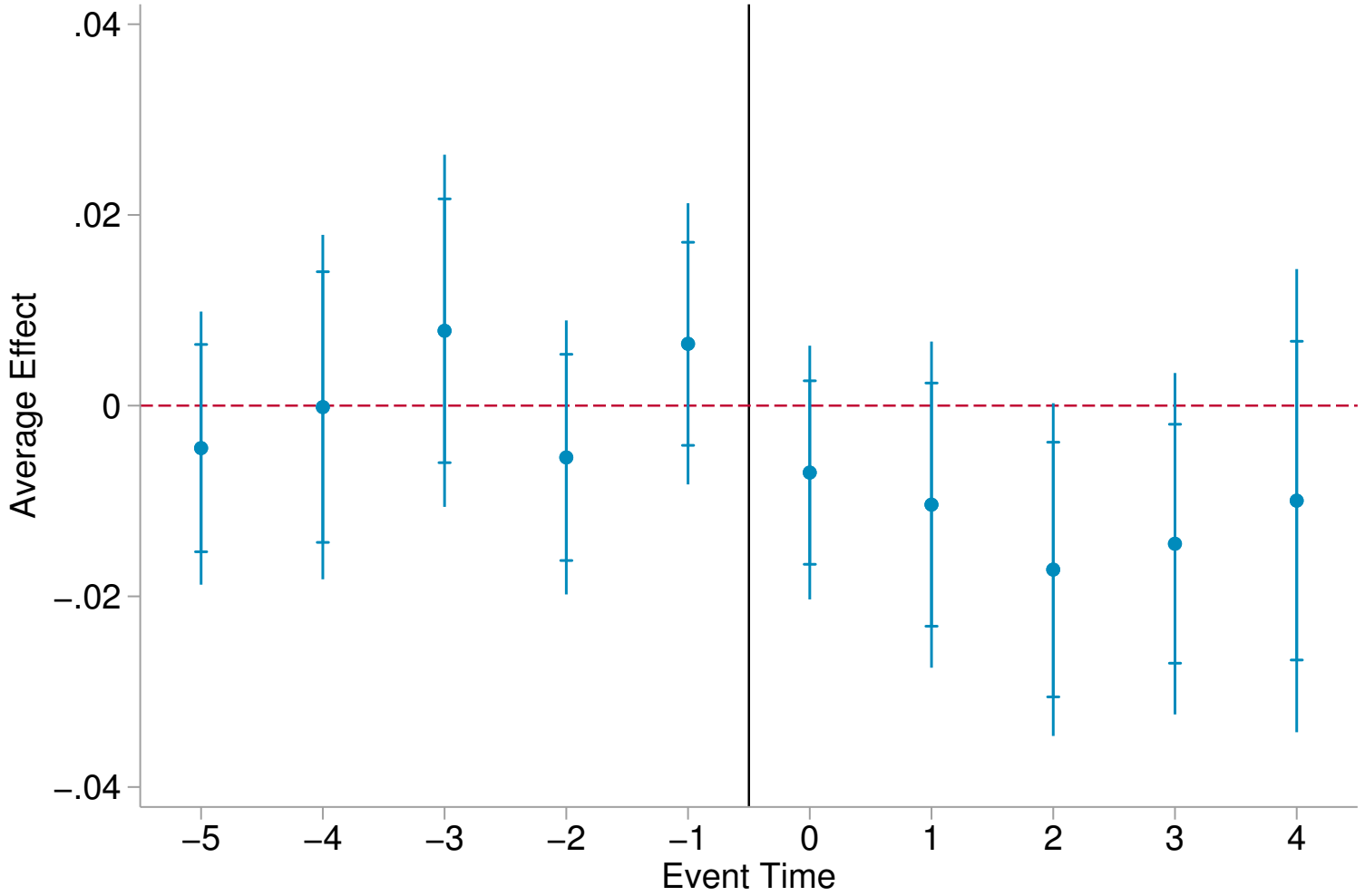
High School Enrollment



Notes: the pre-reform mean is 0.283

▸ Back

Marriage (Woman)

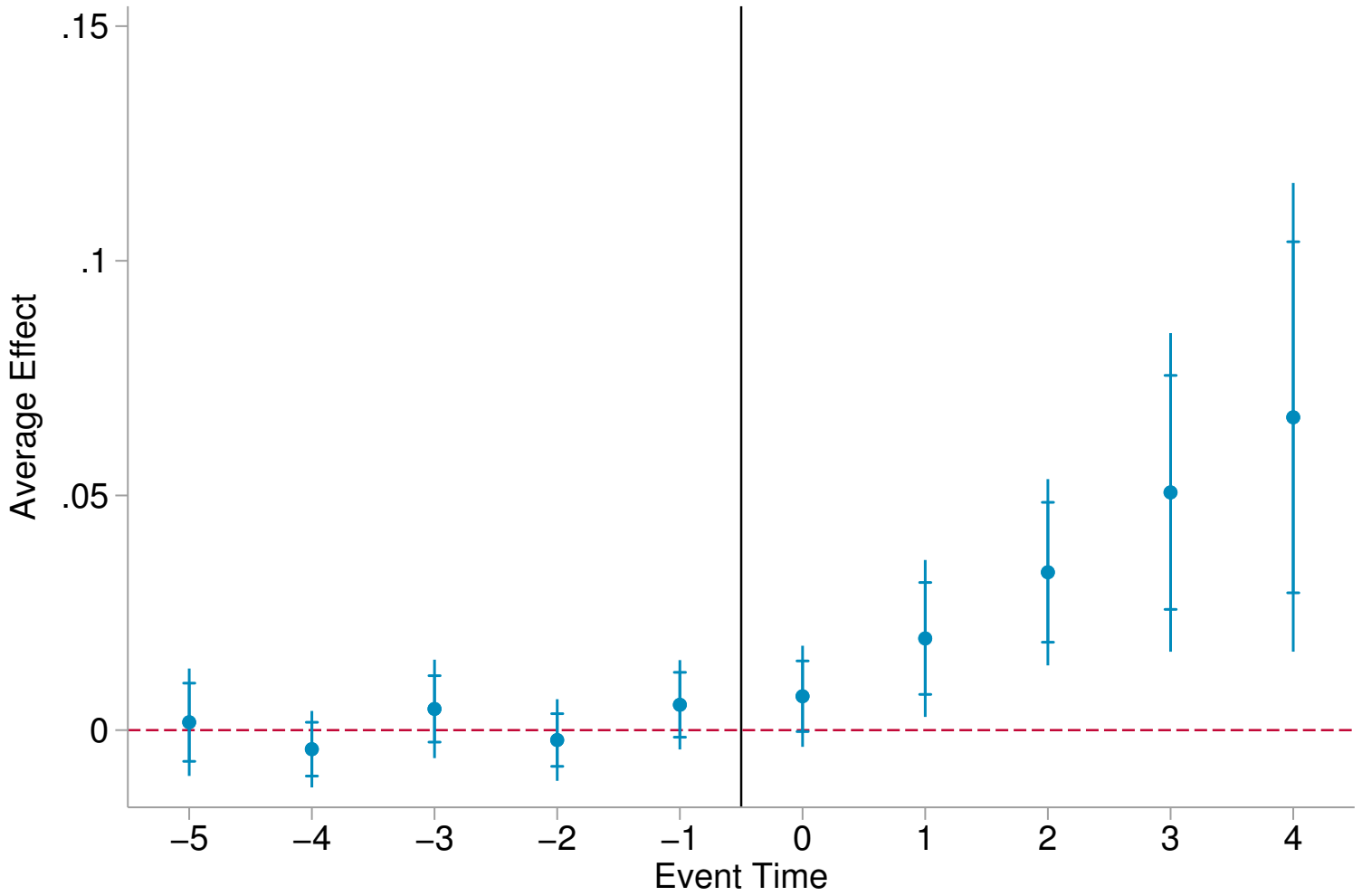


Married Before Age 20 - Woman

Notes: the pre-reform mean is 0.138

▸ Back

College Enrollment



Notes: the pre-reform mean is 0.122

▸ Back

SSA Reform Treatment Timing

	1984 level	1981-to-1984 change
Log population	-0.616*	0.255
	(0.351)	(0.376)
Percent female	0.084	0.649
	(0.783)	(0.969)
Birth rate (‰)	0.063	0.021*
	(0.066)	(0.011)
Primary student-teacher ratio	-0.368***	0.126**
	(0.108)	(0.060)
Secondary student-teacher ratio	-0.149*	-0.015
	(0.076)	(0.037)
Primary industry GDP share	0.141***	-0.014
	(0.045)	(0.020)
GDP per capita	-0.001	0.042
	(0.001)	(0.032)
OCP fine	-1.630	-0.008
	(0.959)	(0.018)
Observations	29	29
Adjusted R^2	0.483	0.054

▸ Map

SSA Reform Adoption Indicator

	1-year lag	2-year lag	3-year lag
Log population	0.203	0.050	-0.033
	(0.390)	(0.422)	(0.423)
Percent female	-0.048	-0.028	-0.016
	(0.030)	(0.026)	(0.033)
Birth rate (‰)	0.004	0.005	0.006
	(0.006)	(0.006)	(0.006)
Primary student-teacher ratio	0.002	0.006	0.008*
	(0.004)	(0.005)	(0.005)
Secondary student-teacher ratio	-0.002	-0.004	-0.001
	(0.004)	(0.005)	(0.005)
Primary industry GDP share	-0.001	-0.001	-0.000
	(0.002)	(0.002)	(0.002)
GDP per capita	-0.000	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)
OCP fine	-0.003	-0.000	0.000
	(0.011)	(0.012)	(0.012)
Observations	688	686	683
Province fixed effects	×	×	×
Year fixed effects	×	×	×

▸ Map

Migration & Mortality

Migration: different provinces between

- Birth province and age 3 residence: 0.8%
- Birth province and age 12 residence: 2%
- Birth province and permanent residence (Hukou): 5%

Data: China Family Panel Study 2010

Mortality: age-specific death rates in 2005

- 20-24 years: 0.0007
- 25-29 years: 0.0008
- 30-35 years: 0.0011

Data: WHO

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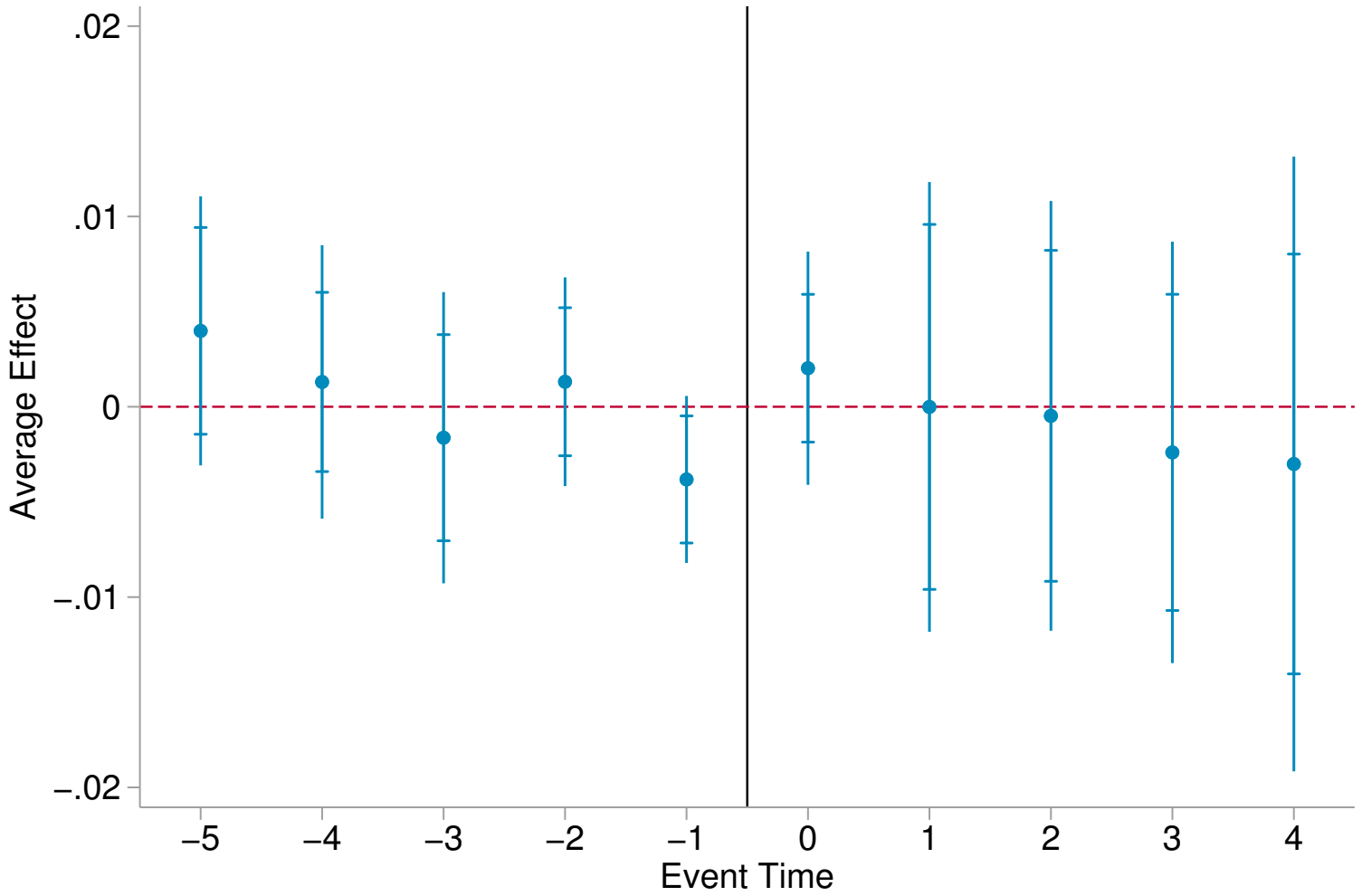
Primary School Enrollment



Notes: the pre-reform mean is 0.971

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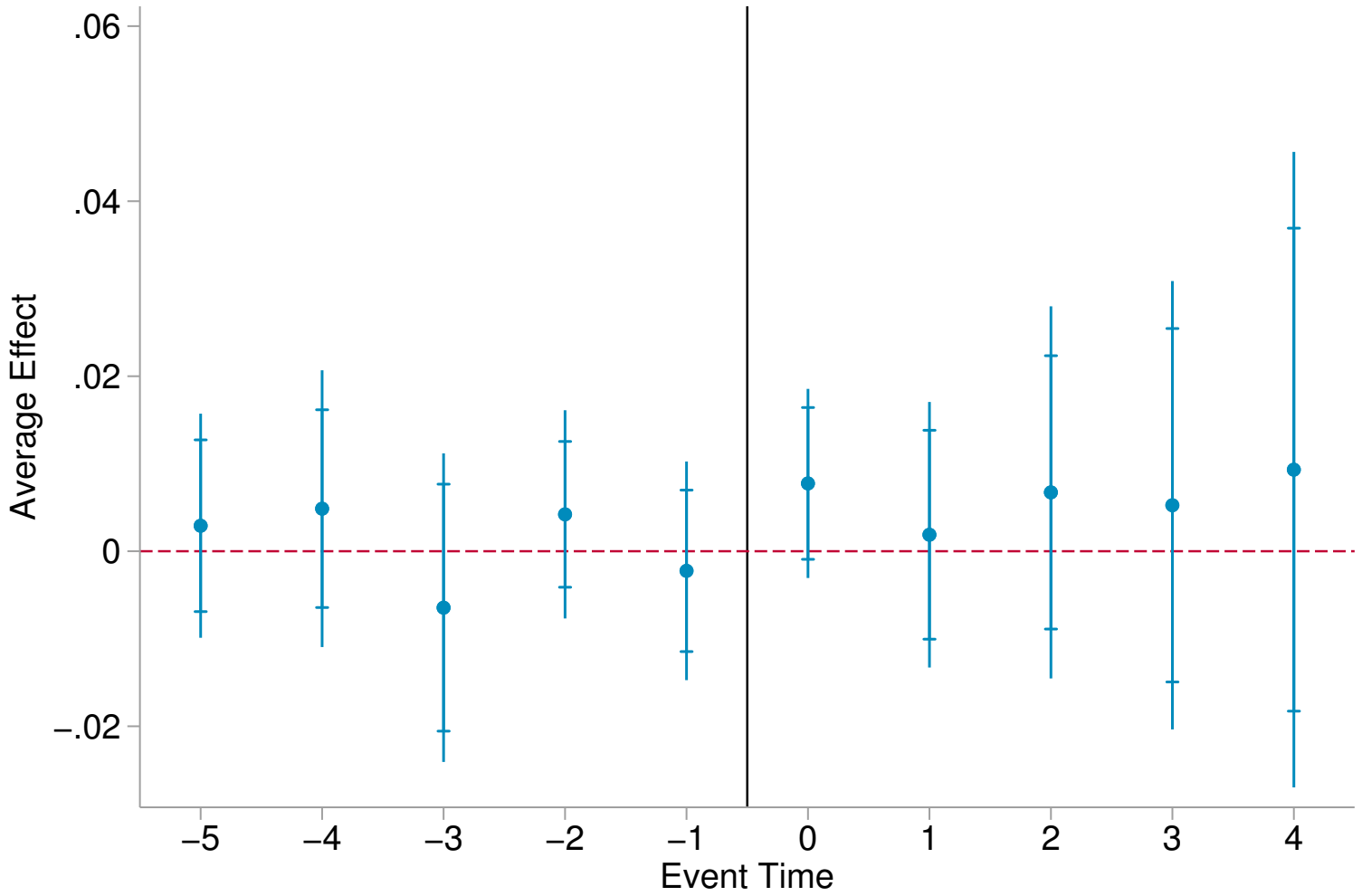
Middle School Completion



Notes: the pre-reform mean is 0.772

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First Stage - Historical Censuses

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