College Access and Attendance Patterns: A Long-Run View

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The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Motivation: Access to College in the U.S.

U.S. higher education policy objective: access

- Attendance determined by student characteristics
- Recently: increased importance of family characteristics
  - Belley & Lochner, 2007; Lochner & Monge-Naranjo, 2011

Little historical evidence on access and attendance

- Broad suspicion of improved access
- Suspects: GI Bill, federal loans, declining discrimination

This Paper: History of Access & Attendance

Empirical component:

- Compile 42 data sources on college-going behavior
- Document changes over time, 1919–1979
  - 1950s: reversal in relative importance of family and ability
  - Timing, details of change rule out usual suspects

Quantitative model component:

- Driving force: rising demand for college
- Mechanism: selective admissions, dispersion in college quality
- Changing menu of quality available to students generates reversal

Outline

1. **Empirical Results**
2. **Brief History**
3. **Model**
4. **Results**

Data Sources

Collect studies and datasets that cover college attendance by student ability and/or family background

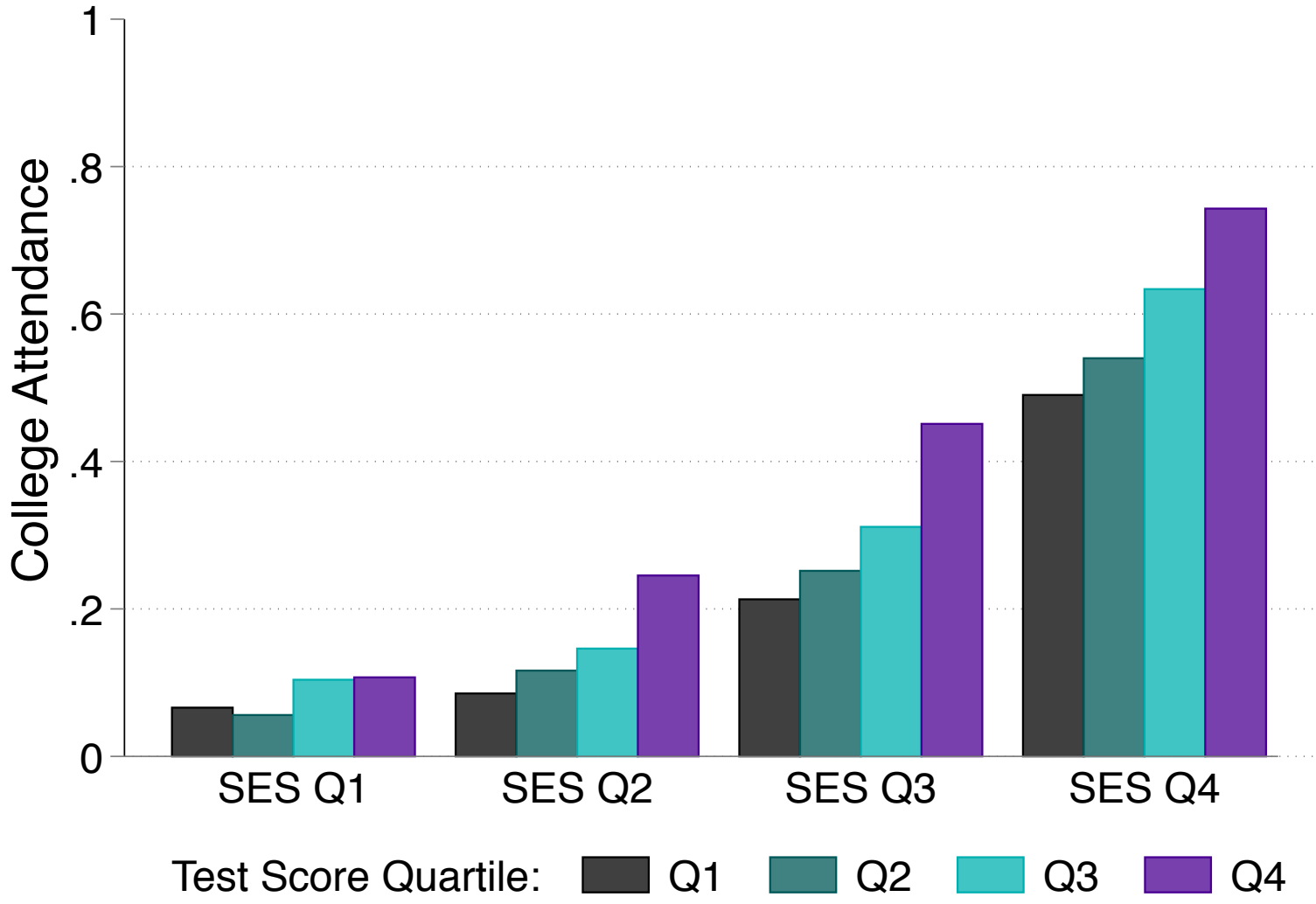
- Student ability measured by:
  - standardized test scores
  - class rank
- Family background measured by:
  - parental income
  - index of socioeconomic status

Data Sources

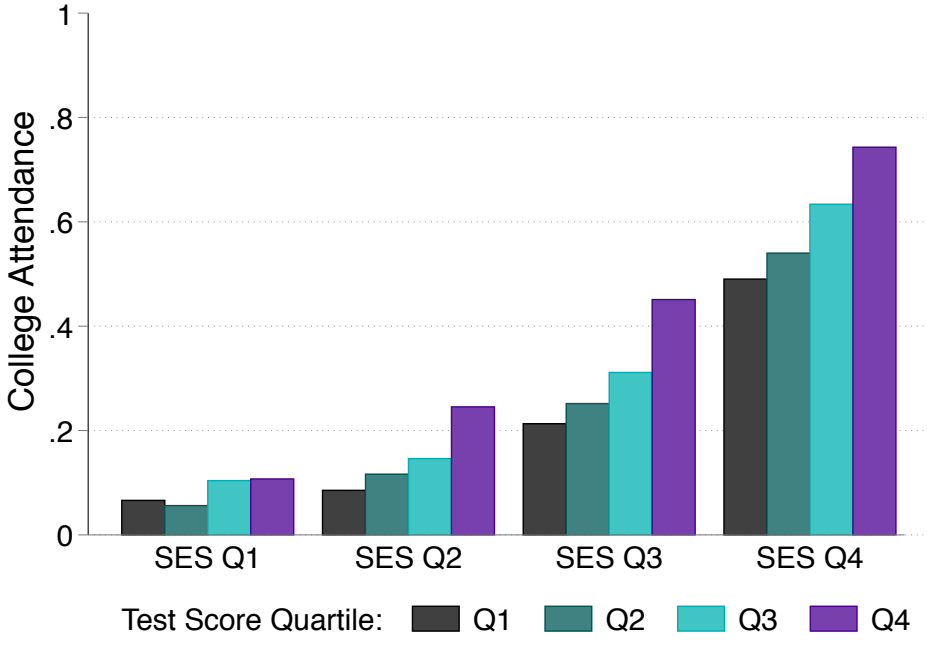
Sources span 1919 to 1997 graduating cohorts. Two broad eras:

1. Modern era (1960–date)
   - Nationally representative surveys with microdata
   - Project Talent, NLSY79, NLSY97
2. Pre-modern era (1919–1960)
   - Limited surveys, no microdata, rely on published summaries
   - Three dozen studies by researchers in many fields.

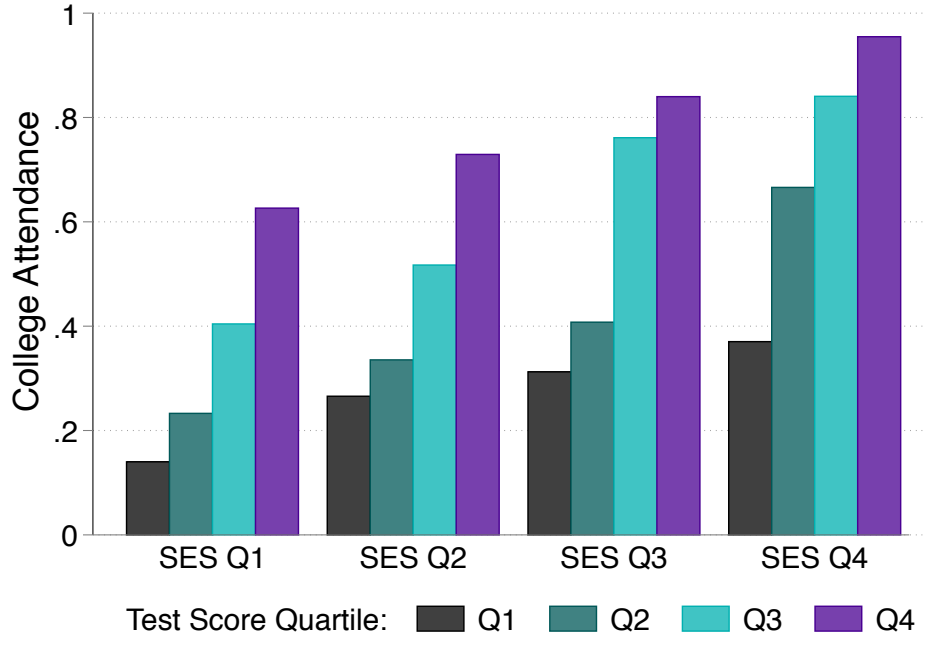
Historical Study Results: Updegraff (1933)



Historical Study Results 1933 vs. 1960

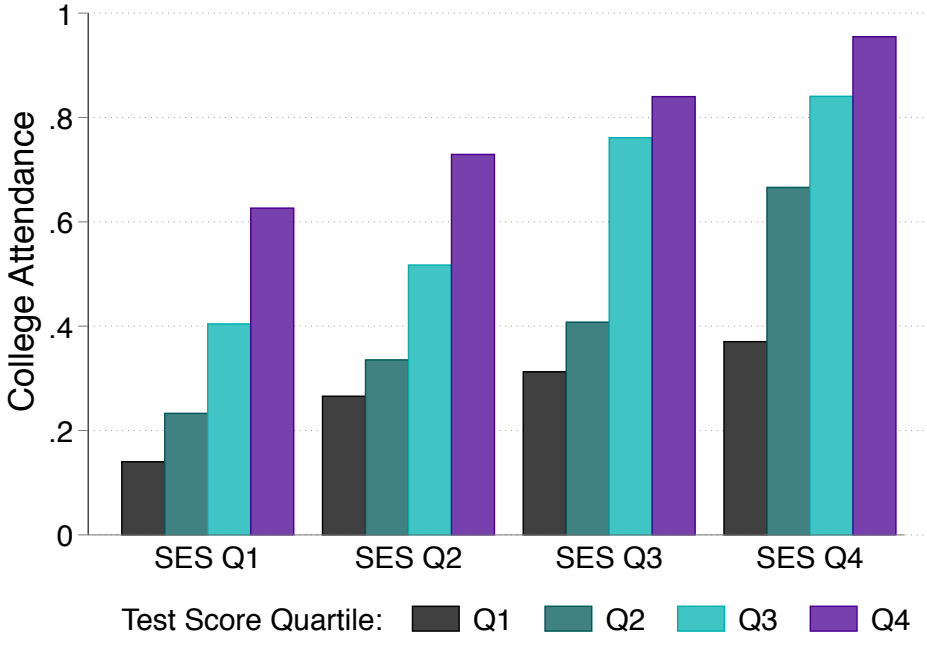


1933 (Updegraff)

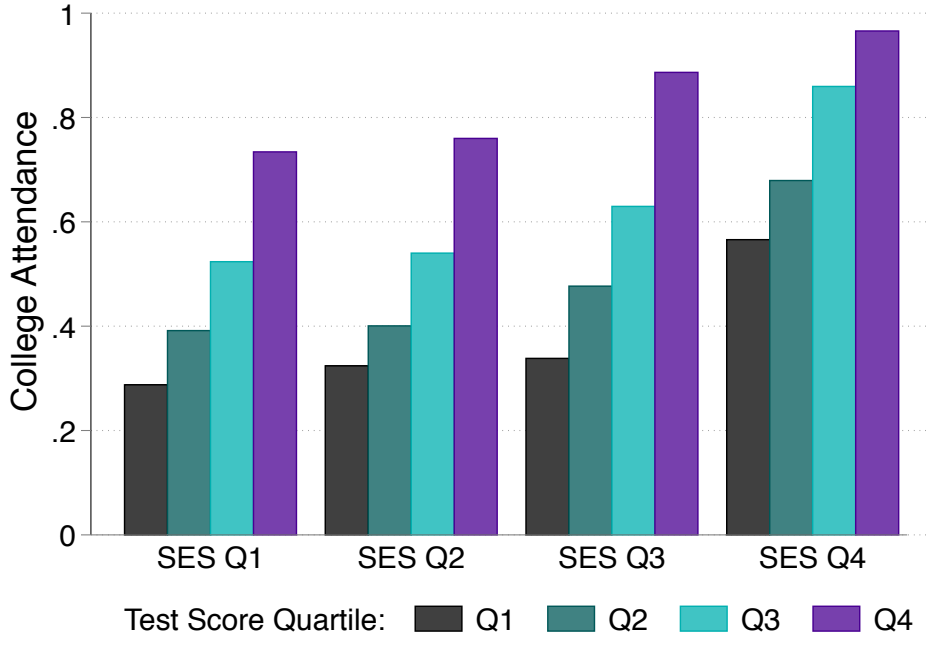


1960 (Project Talent)

Historical vs. Modern Study Results



1960 (Project Talent)



1979 (NLSY79)

Comparability

Two steps to address comparability issues

1. Compile as many studies as possible
    - Show that Updegraff is representative of pre-WWII era
2. "Replicate" studies in NLSY79
    - Find little role for most elements of study design

Supplementary Evidence: Historical Studies

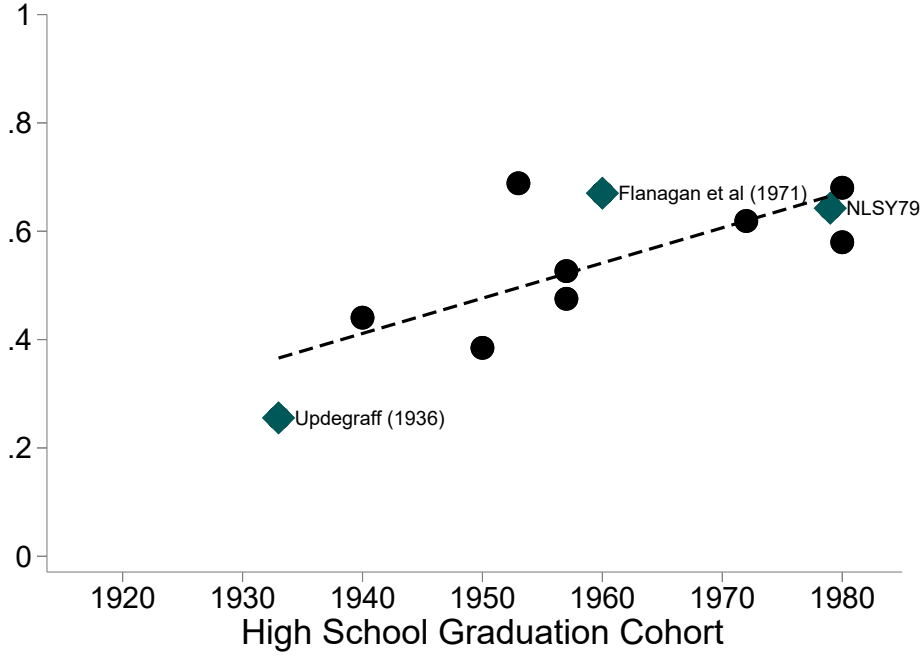
Compare results for roughly twenty historical studies

- Data: $C(s)$; $C(p)$; or $C(s, p)$

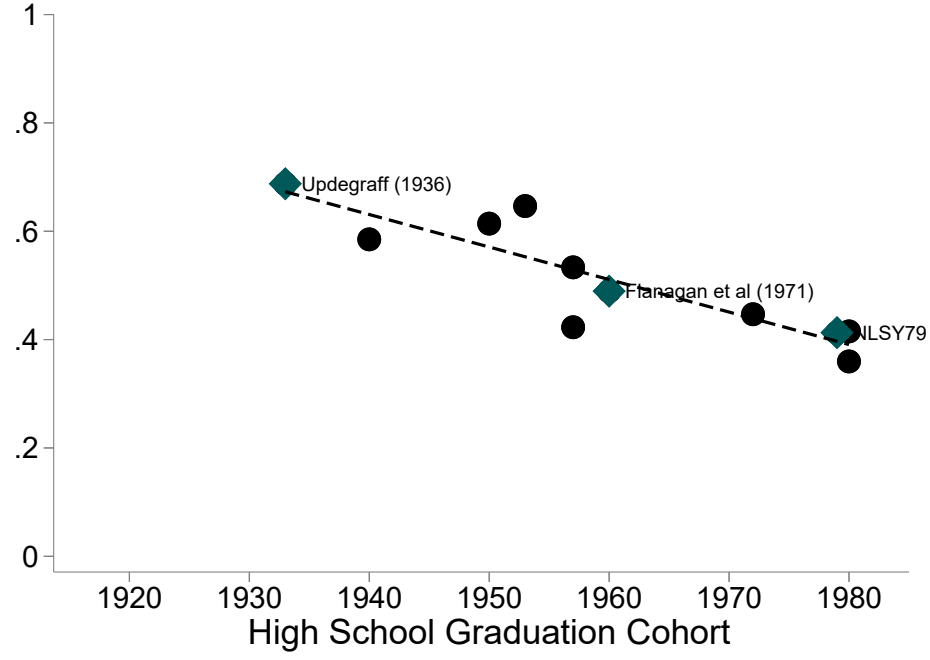
Regress C on s, p, or both

- s and p are midpoints of percentile ranges
- Report β_s, β_p
- Study time series

Coefficients from Bivariate Studies

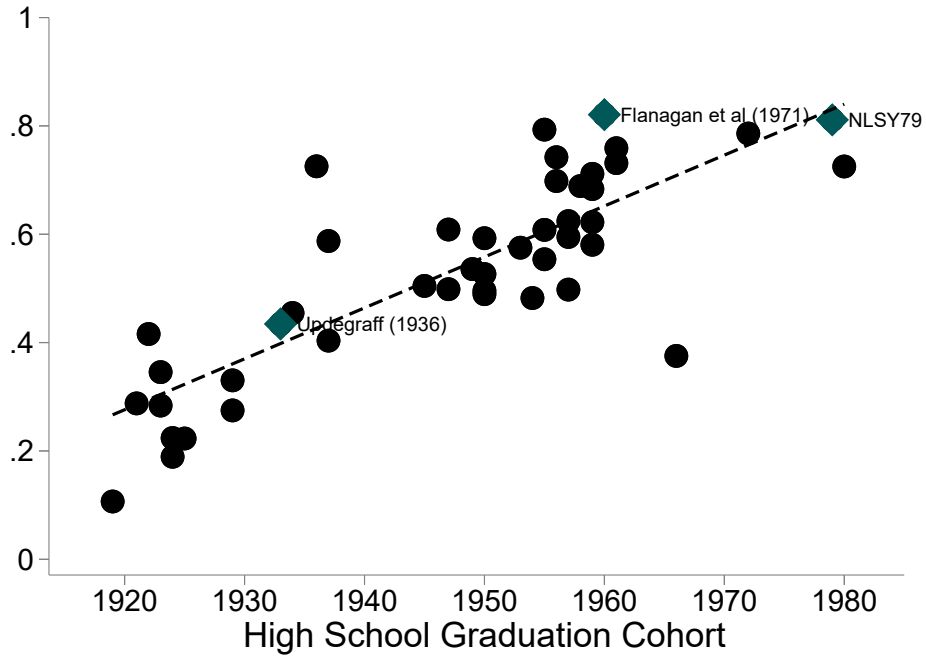


Academic Ability (β_s)

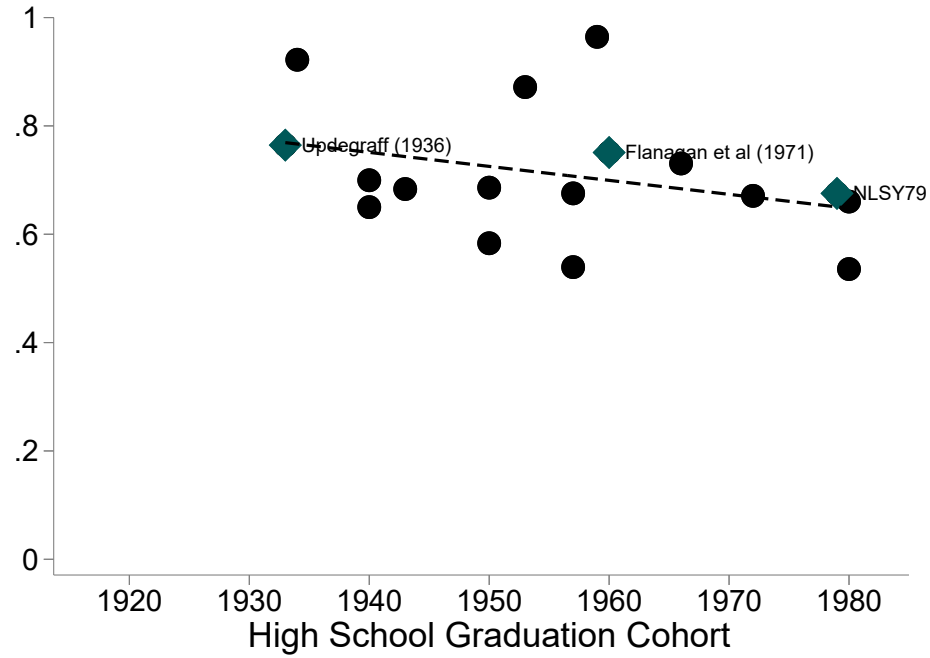


Family Background (β_p)

Coefficients from Univariate Studies

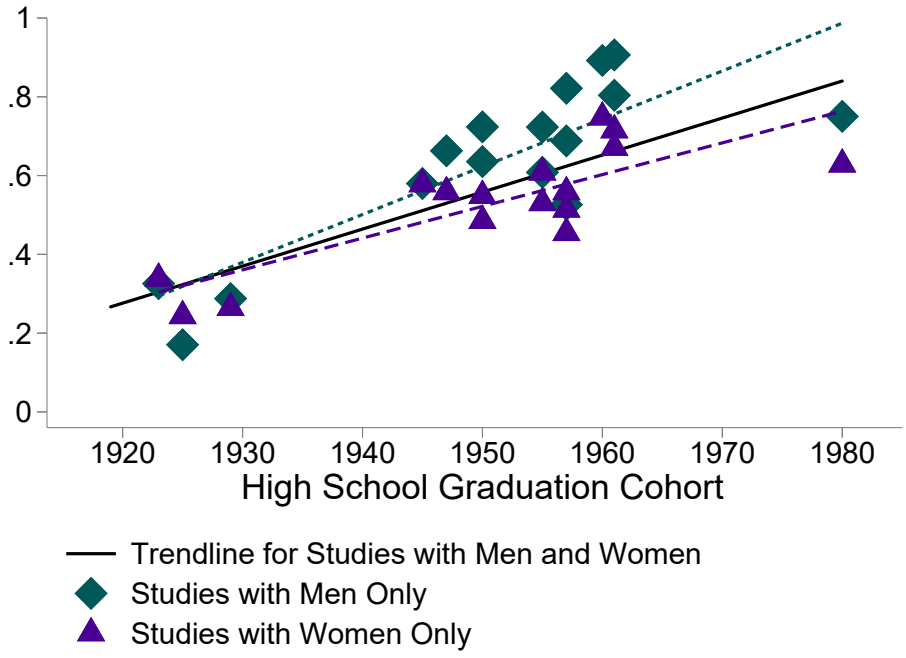


Academic Ability (β_s)

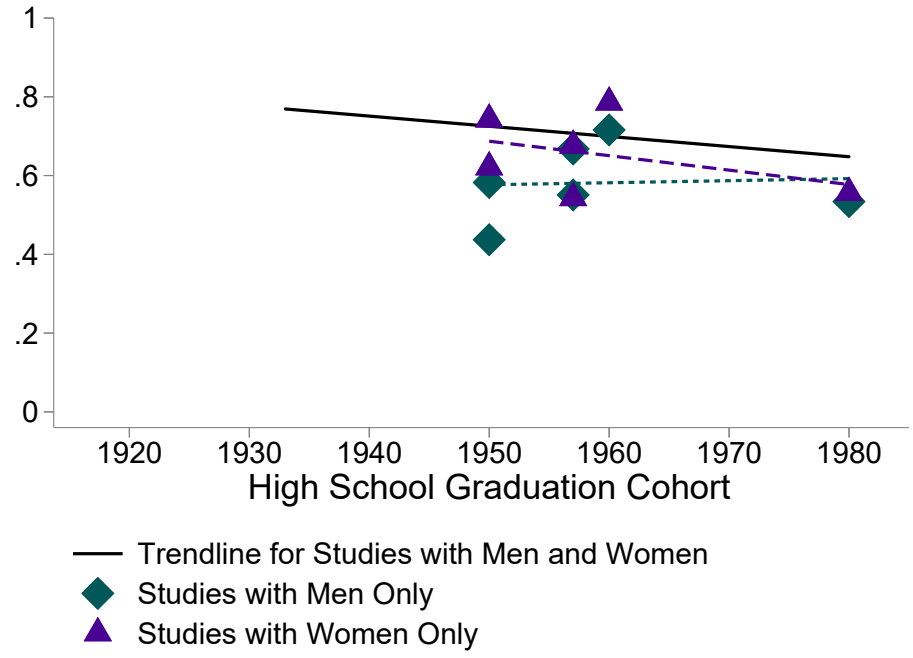


Family Background (β_p)

Historical Patterns by Gender



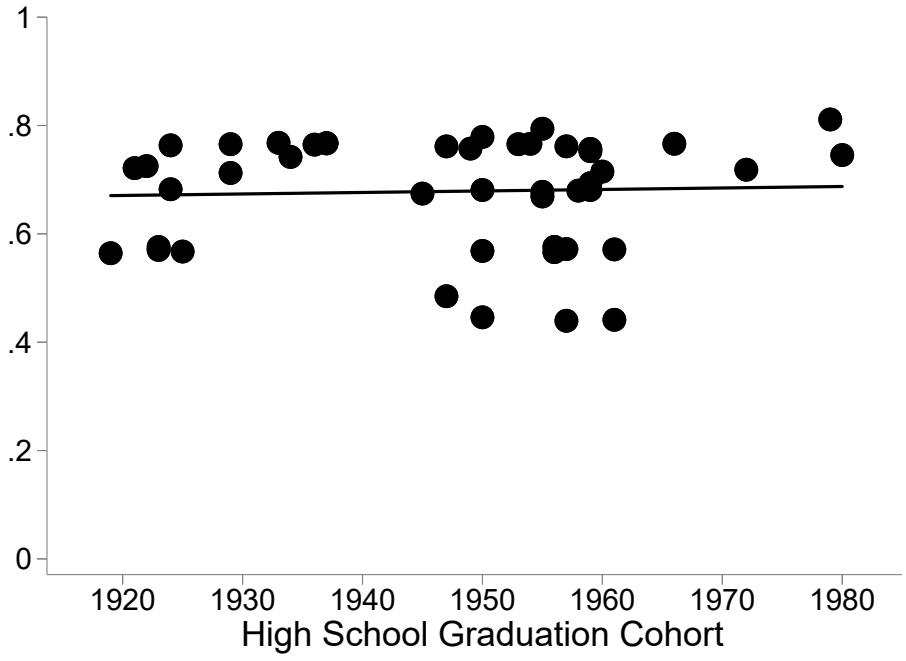
Academic Ability (β_s)



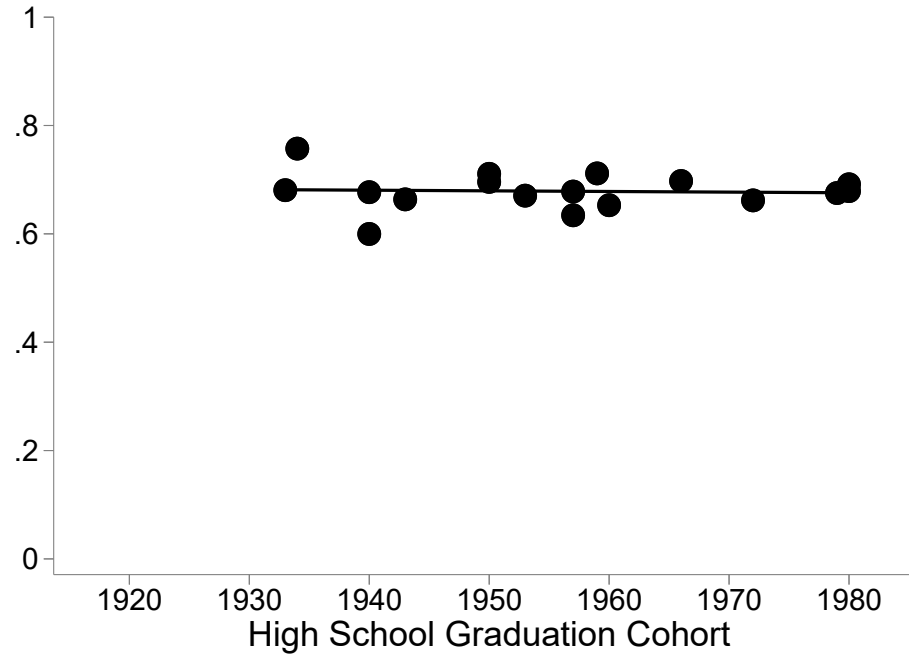
Family Background (β_p)

Reversal affected women as well

Falsification Test: Replicate Studies in NLSY79



Academic Ability (β_s)



Family Background (β_p)

▸ Replication of Bivariate Studies

Outline

Conventional Explanations

GI Bill

- Reversal affected men and women
- Reversal lasted after the large burst of financing

College financing changes little during this era

- Students and parents financed 85–90 percent of total cost
- Private loans were rare
- Federal student loans came later ▸ Pre-1958 Funding ▸ Post-1958 Funding

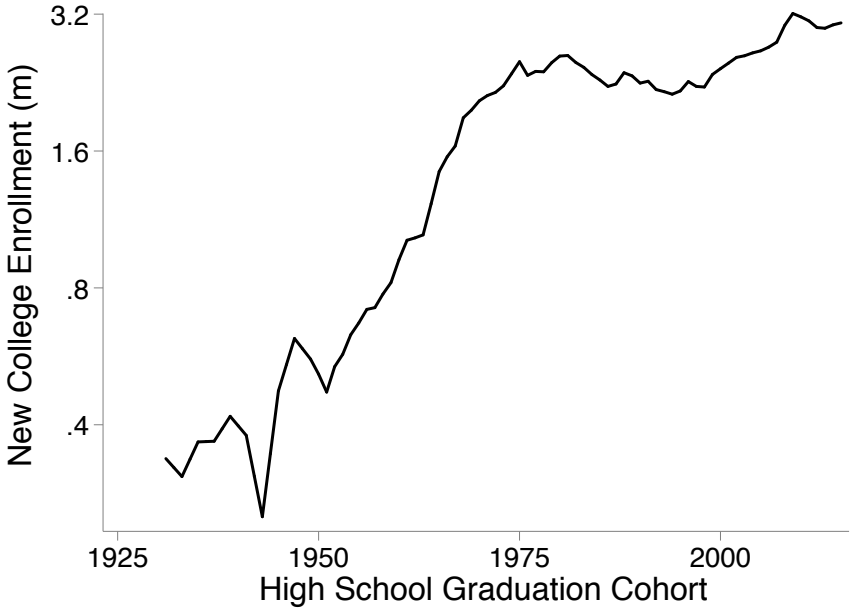
New explanation needed

Model Ingredients

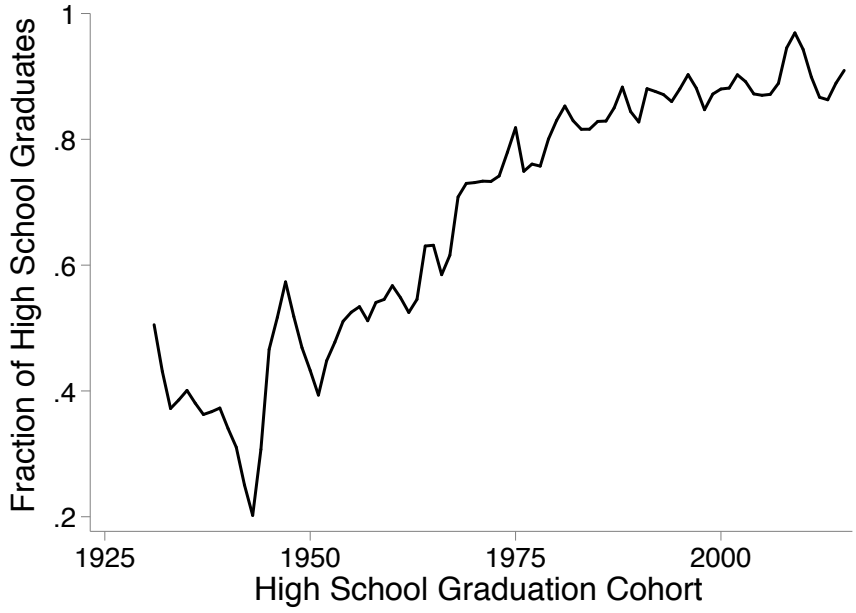
Exogenous driving forces

- Increase in college attendance (rising value of college)
- Adoption of standardized college admissions exams

The Increase in Educational Attainment



First-Time Enrollment

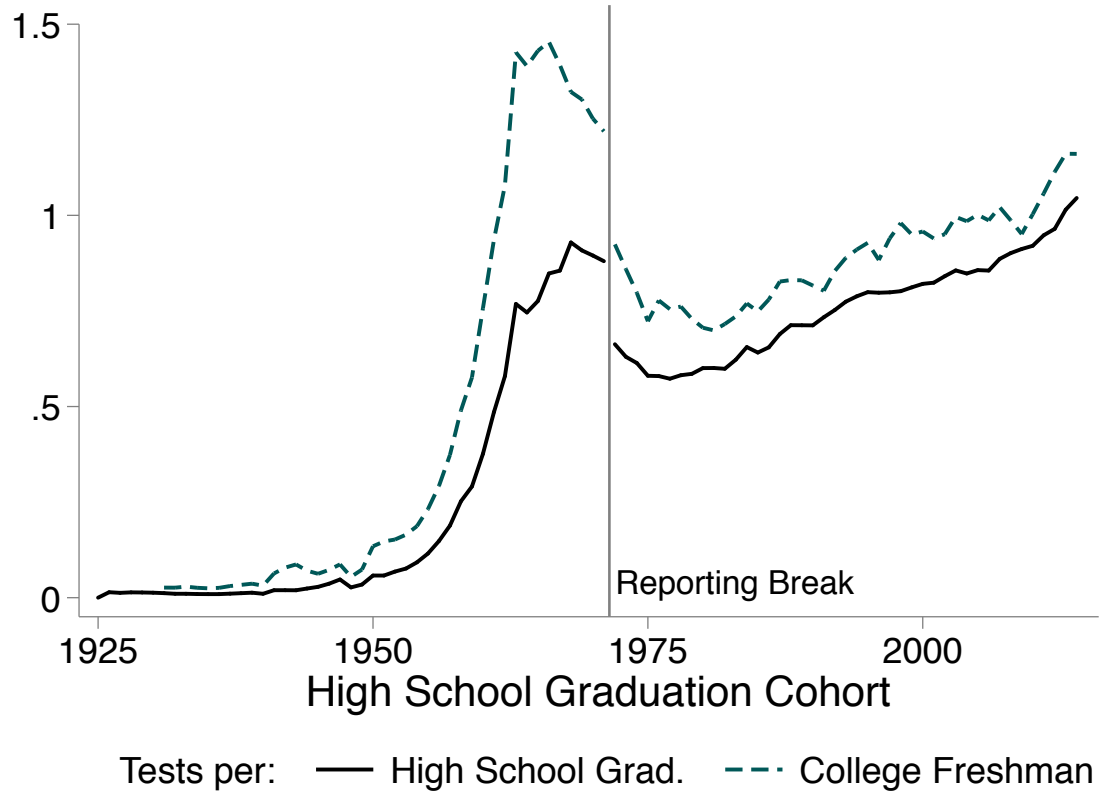


Enrollment Rate

Drivers: curriculum, college wage premium, cost, G.I. Bill

▸ Census Data ▸ Cost of College

College Entrance Examinations



Driver: cost, standardization, College Board

▸ Cost of Exams

Model Ingredients

Exogenous driving forces

- Increase in college attendance (rising value of college)
- Adoption of standardized college admissions exams

Mechanism: national integration of college (Hoxby, 2009)

- Oversubscribed colleges institute selective admissions
- Growing quality differences between colleges
- Students apply outside local college

Reversal generated by changing college quality menu for students

Outline

Model Overview

Framework: islands model of college choice

- I distinct local areas (islands)

Two agents: 1 college and measure 1 of HS grads per island

- Colleges choose admissions criteria to maximize objective
- Students choose whether to work, attend local college, or search

Colleges

College i has endowment $\bar{q}_i$ spaced uniformly on $[\underline{q}, \overline{q}]$

Quality depends on endowment and mean ability of students:

$$q_i = \bar{q}_i + \bar{a}_i$$

College objective is lexicographic:

- Accept students until $e_i = E$
- Then raise quality via selective admissions cutoff $\underline{a}_i$.

Student Endowments

New high school graduates endowed with (a, p, g, s, i) drawn from F

- Ability a is unobserved
- Family background p
- Signals g and s of ability

Base decisions on expected ability: $\mathbb{E}(a \mid \mathbb{I}_t)$

- $\mathbb{I}_t = (p, g)$ for 1933 cohort
- $\mathbb{I}_t = (p, g, s)$ for 1960 cohort

Attending Local College

Students can attend local college if $\mathbb{E}(a \mid \mathbb{I}_t) \geq \underline{a}_l$. If so:

- Consume p while in college
- Generate human capital $h(a, q) = [\phi q^\gamma + (1 - \phi)a^\gamma]^{\alpha/\gamma}$
- Work at wage rate w_t^c after graduation

Implies the value function:

$$V(p, \mathbb{I}_t, l) = \log(p) + \hat{\alpha}\mathbb{E}_a \left[\log\left(\left[\phi q_l^\gamma + (1 - \phi)a^\gamma\right]^{1/\gamma}\right) \mid \mathbb{I}_t\right] + V_t^C$$

Attending Non-Local College

Students can pay cost κ to apply nationally

- κ lowers consumption in college
- Allows students to attend best college they can be admitted to.

Implies the value function:

$$W(p, \mathbb{I}_t) = \mathbb{E}\left\{ \max_{i:\mathbb{E}(a|\mathbb{I}_t) \geq \underline{a}_i} V(p - \kappa, \mathbb{I}_t, i) + \bar{\zeta}\zeta_i \right\}$$

Career Choice

Students can also work as high school graduates

- V_t^{HS}

Career choice:

$$\max\left\{V_t^{HS} + \bar{\eta}\eta_{HS}, V(p, \mathbb{I}_t, l) + \bar{\eta}\eta_V, W(p, \mathbb{I}_t) + \bar{\eta}\eta_W\right\}$$

Admissions Algorithm

Generically, this model has multiple equilibria

- Peer effects

Focus on results of a particular algorithm

- Guess college quality q_i
- Rank students by $\mathbb{E}(a \mid \mathbb{I}_t)$
- Assign students to most preferred available option, in order
- Check resulting quality against initial guess

Calibration Strategy: Fit Reversal

Parameters (17)

- College endowments and capacity (3 parameters)
- Student endowments (6 parameters)
- Human capital production (6 parameters)
- Preference shocks (2 parameters)
- Only two parameters vary over time (V_t^c and $\mathbb{I}_t$).

Moments (64)

- Distribution by (s, p) (30)
- College sorting by (s, p) by cohort (32)
- Fraction of students applying to multiple colleges by cohort (2)

Calibrated Parameters

Parameter	Description	Value
Colleges		
$\underline{q}$	Lower bound on college endowments	0.61
$\overline{q}$	Upper bound on college endowments	2.26
E	College capacity	0.55
Endowments		
μ_p	Mean log parental transfer	-0.08
μ_a	Mean ability	0.90
σ_p	Standard deviation of log transfer	0.10
ρ	Correlation of parental transfers and ability	0.43
σ_g	Noise in grades	0.74
σ_s	Noise in test scores	1.50
Human capital production		
γ	Substitution between ability and quality	-0.26
ϕ	Weight on quality	0.74
$\hat{\alpha}$	Curvature of human capital production	0.71
κ	Application cost	0.41
V_t^C	Relative value of college	(-0.37, 0.66)
Preferences		
$\bar{\eta}$	Scale of taste shocks among broad education choices	0.08
$\bar{\zeta}$	Scale of taste shocks among colleges	0.08

Outline

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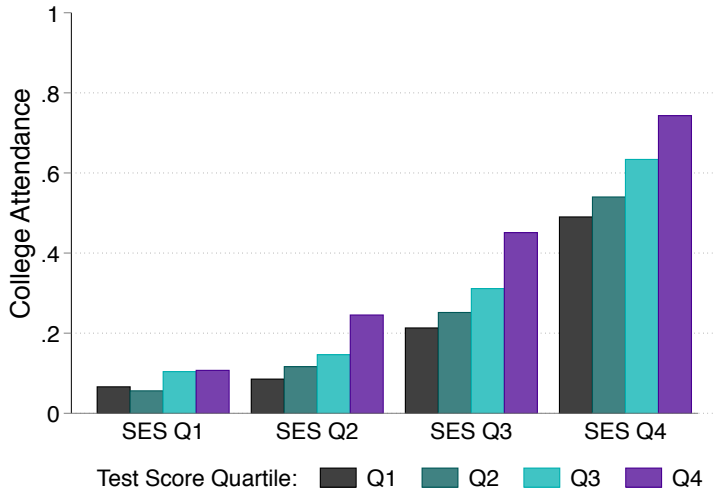
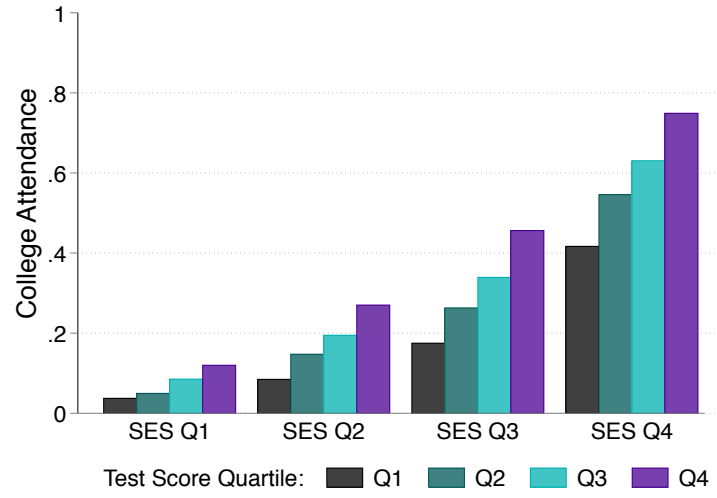
Model Fit (1)

	1933 Cohort		1960 Cohort	
	Data	Model	Data	Model
College attendance	0.29	0.29	0.53	0.52
Local college attendance	0.85	0.85	0.51	0.51
β_s	0.23	0.29	0.71	0.78
β_p	0.69	0.67	0.48	0.60

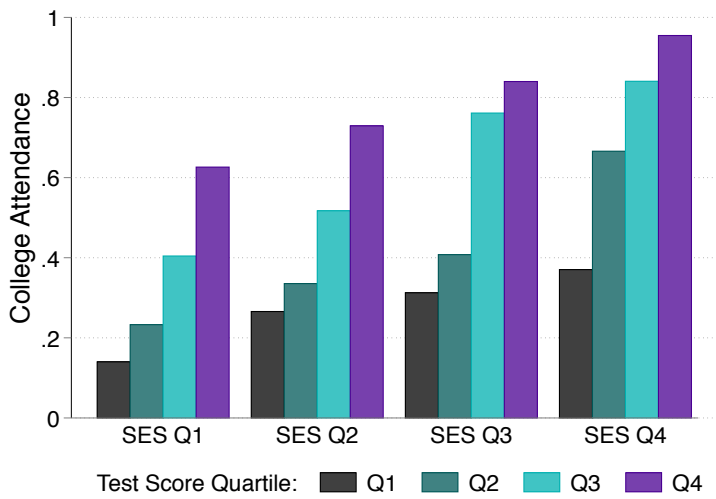
Model Fit (2)



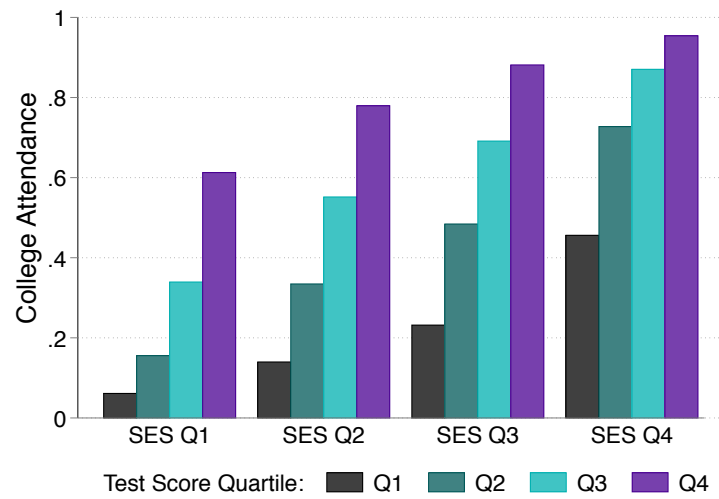
1933 Data



1933 Model



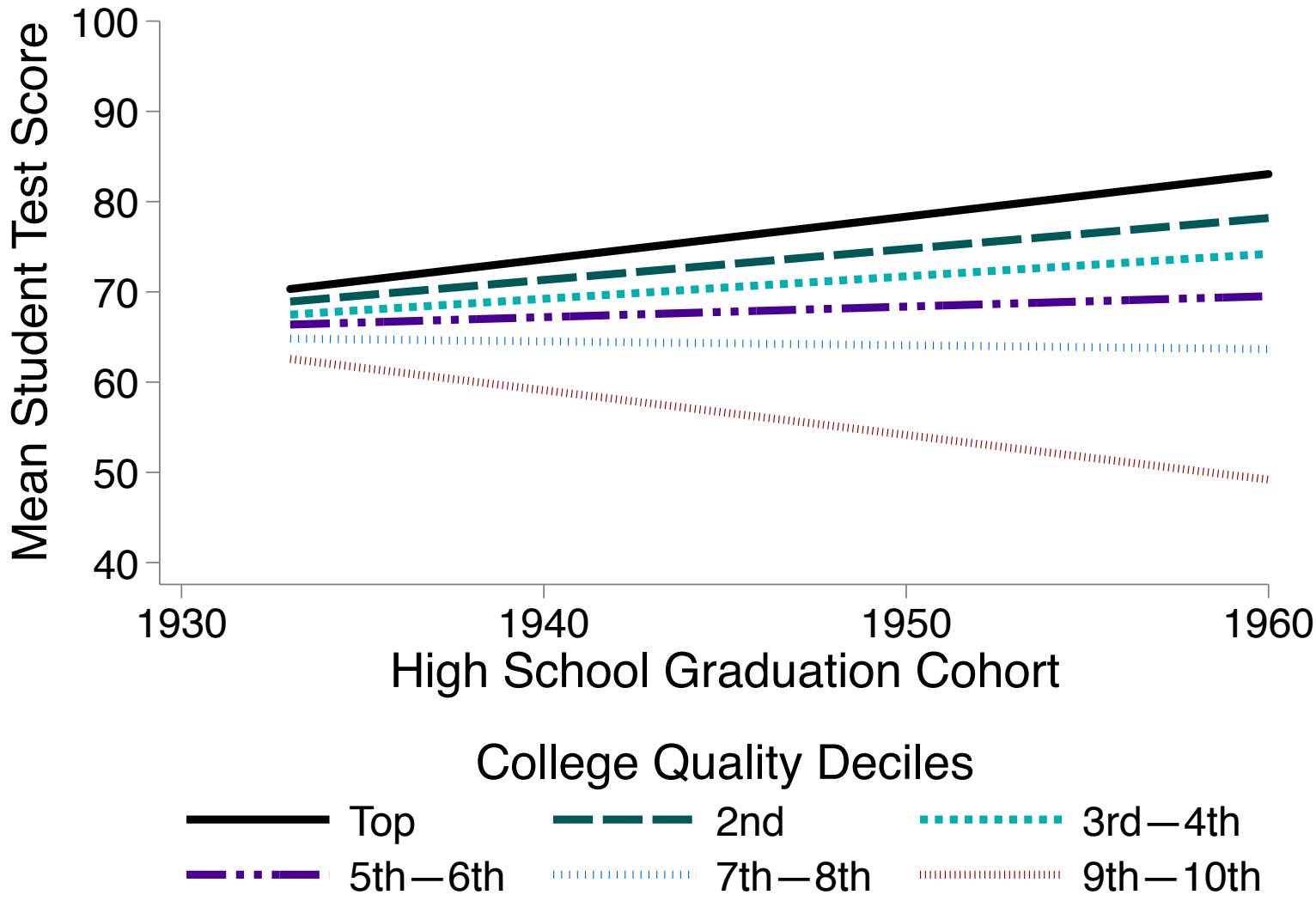
1960 Data



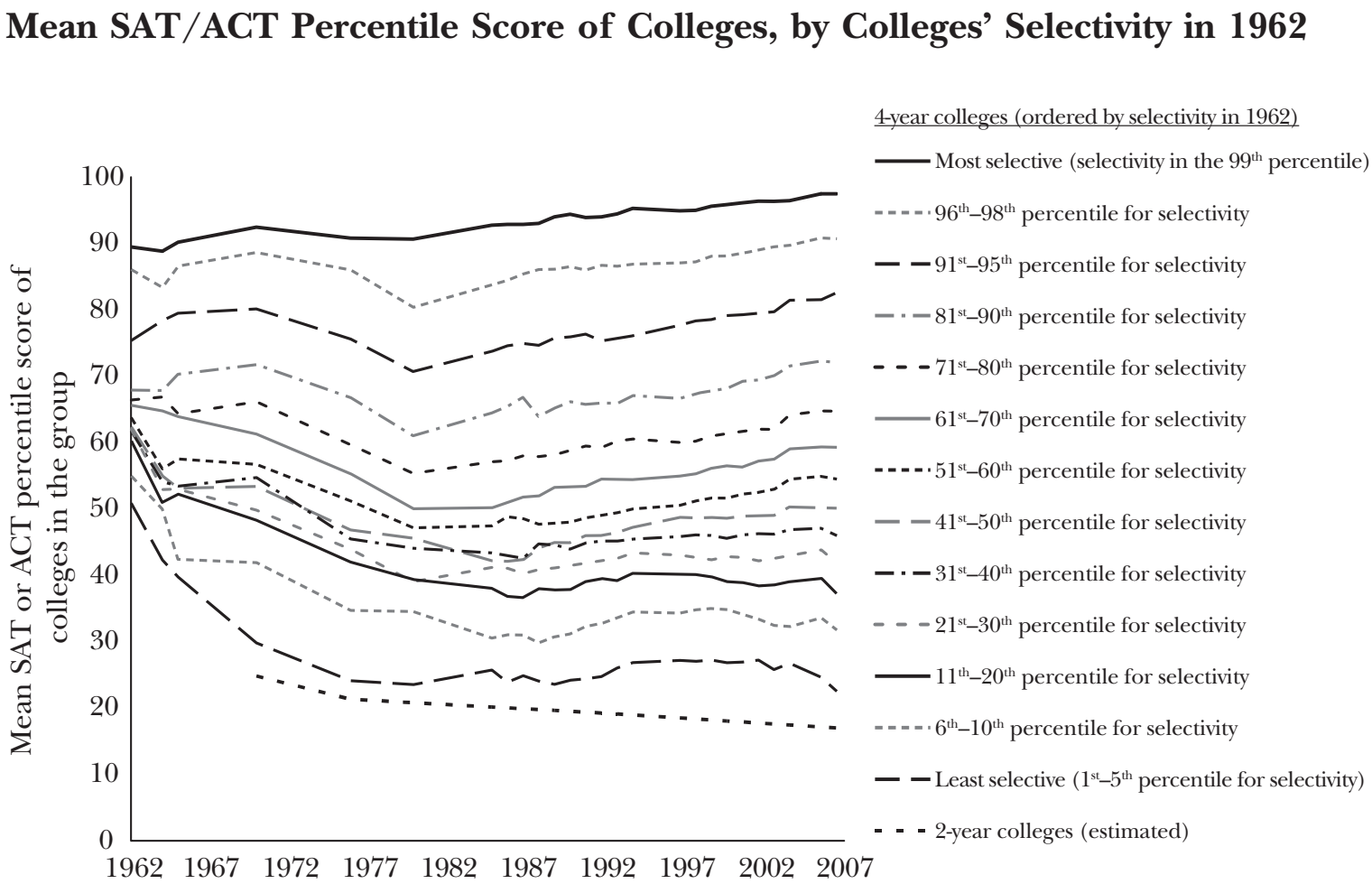
1960 Model

Mechanism: Selective Admissions $\Longrightarrow$ Quality Dispersion

Colleges with selective admissions: 6 $\rightarrow$ 90%



Data: Dispersion of College Quality (Hoxby, 2009)

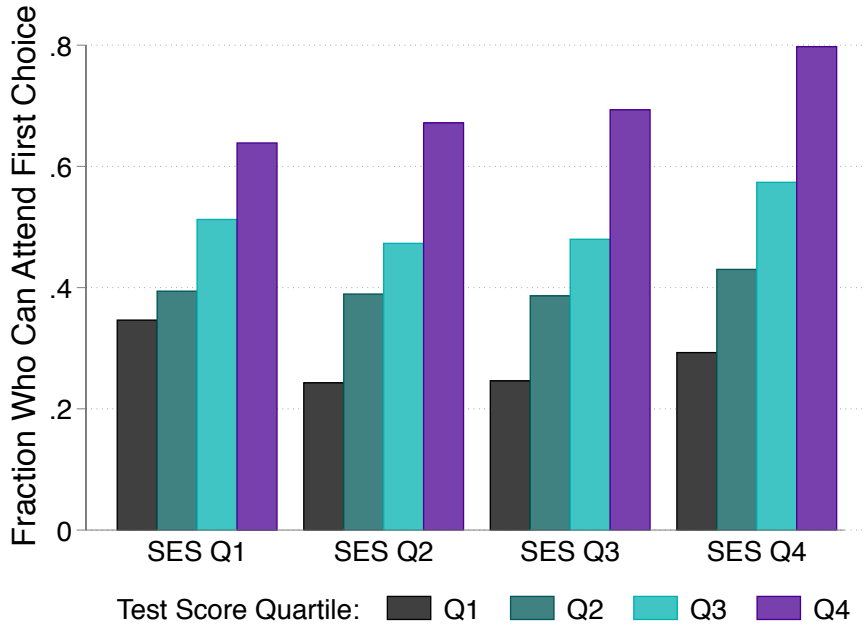


Spotty evidence from 1950s: spread was 20pp

Model Mechanism: Selective Admissions

Quality heterogeneity incentivizes non-local college attendance

- High-ability students apply to improving colleges
- Low-ability students rationed out of some local colleges



Access to First Choice (1960)

Disentangling the Driving Forces

Main mechanism: rising attendance, limited capacity

- Test scores help generate β_s

	1933	1960			
		Baseline	No Tests	Constant V_t^C	3× Capacity
College attendance	0.29	0.52	0.52	0.29	0.80
Local college attendance	0.85	0.51	0.51	0.81	0.67
β_s	0.29	0.78	0.46	0.47	0.48
β_p	0.67	0.60	0.68	0.61	0.46
Access to first choice	0.99	0.56	0.55	0.98	0.78
Fraction selective	0.08	0.86	0.86	0.12	0.12

Time-Varying High School Graduation

Account for variation in who graduates high school b/w 1933, 1960

- Little impact on outcomes in the model

	Data	Model	
		Baseline	Time-Varying Graduation
College attendance	0.24	0.22	0.22
Local college attendance	-0.34	-0.34	-0.33
β_s	0.48	0.49	0.48
β_p	-0.21	-0.07	-0.04
Access to first choice	-	-0.44	-0.44
Fraction selective	-	0.78	0.78

Conclusion

Empirical Component:

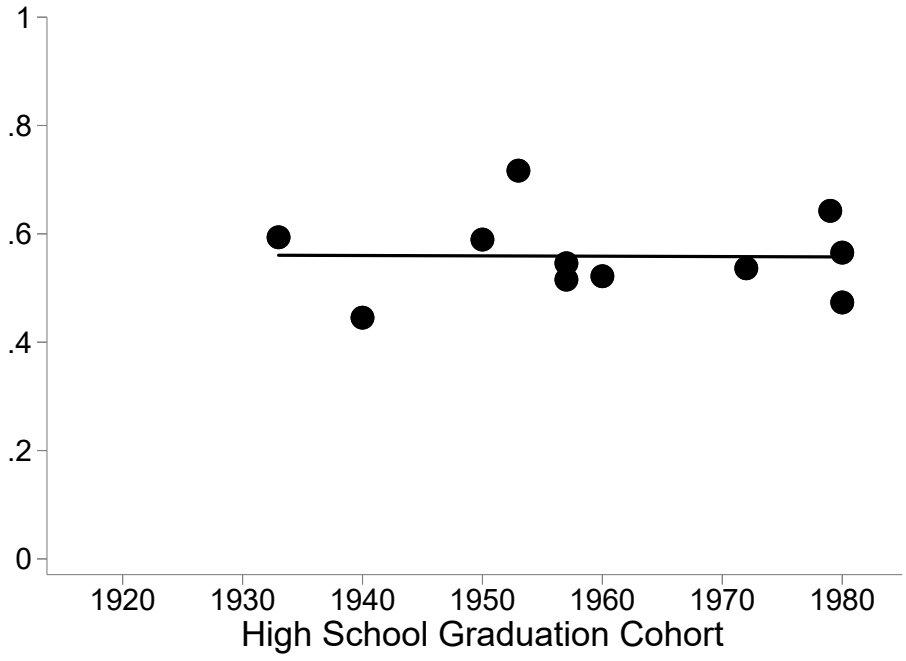
- Compile 42 data sources on college-going behavior
- Document changes over time, 1919–1979
    - 1950s: reversal in relative importance of family and ability

Model:

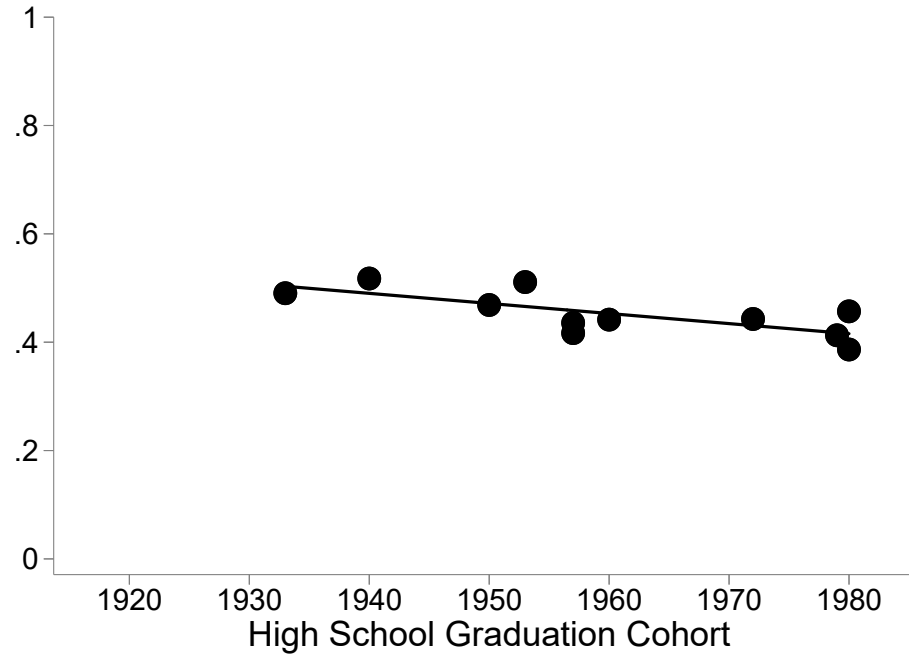
- Exogenous increase in attendance, adoption of test scores
- Endogenous national integration of higher ed (Hoxby, 2009)
- Reversal generated by changing college quality menu for students

EXTRA SLIDES

NLSY79 Replication of Bivariate Studies



Academic Ability (β_s)



Family Background (β_p)

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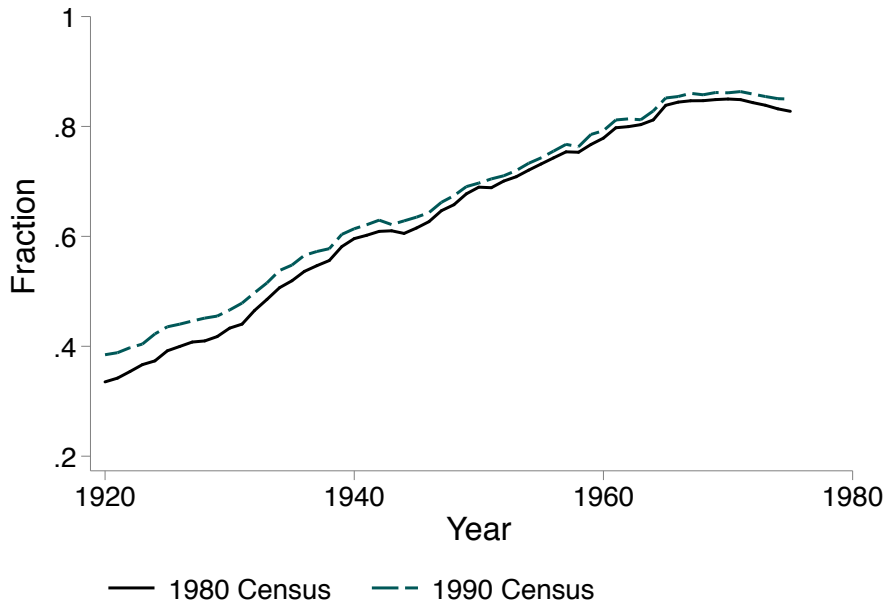
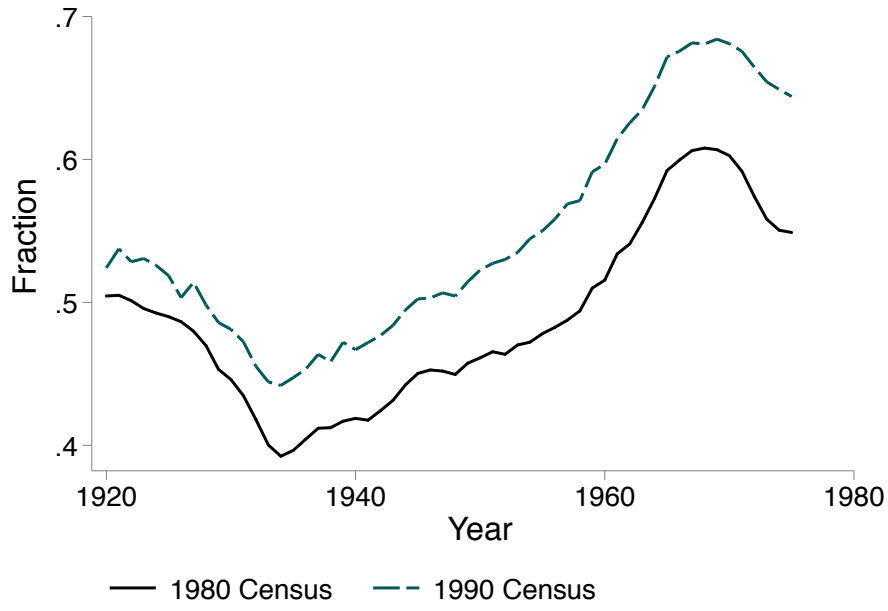
College Attendance: Census Data



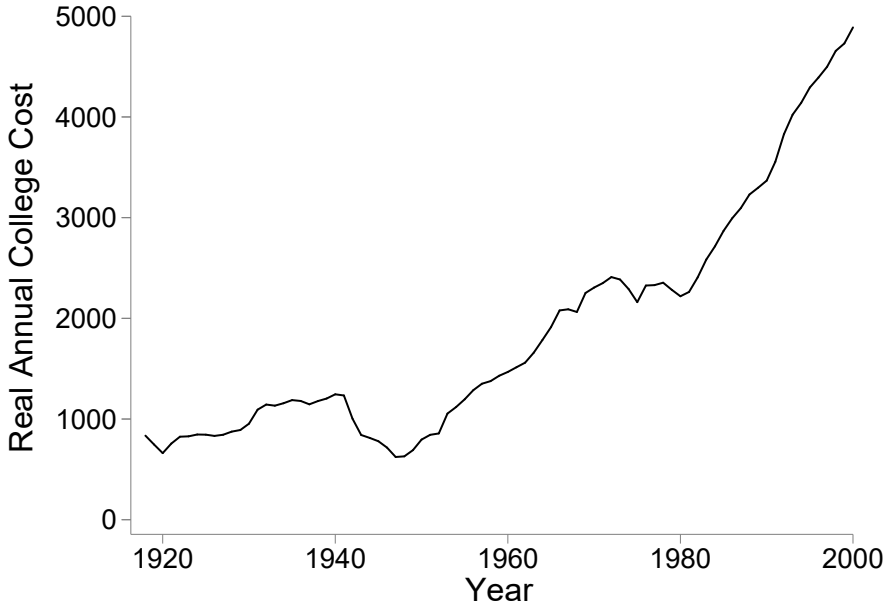
High School Graduation



College Attendance

Back

College Cost Time Series



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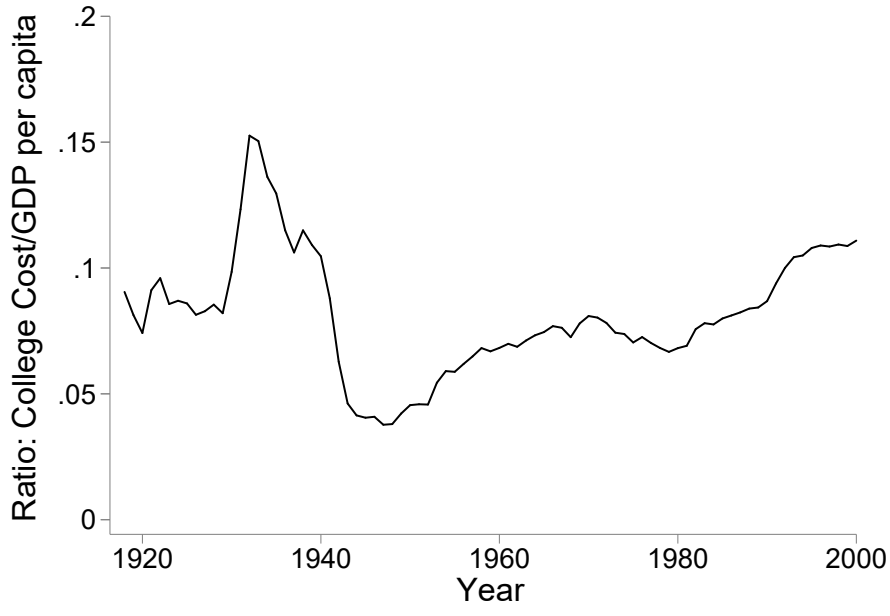
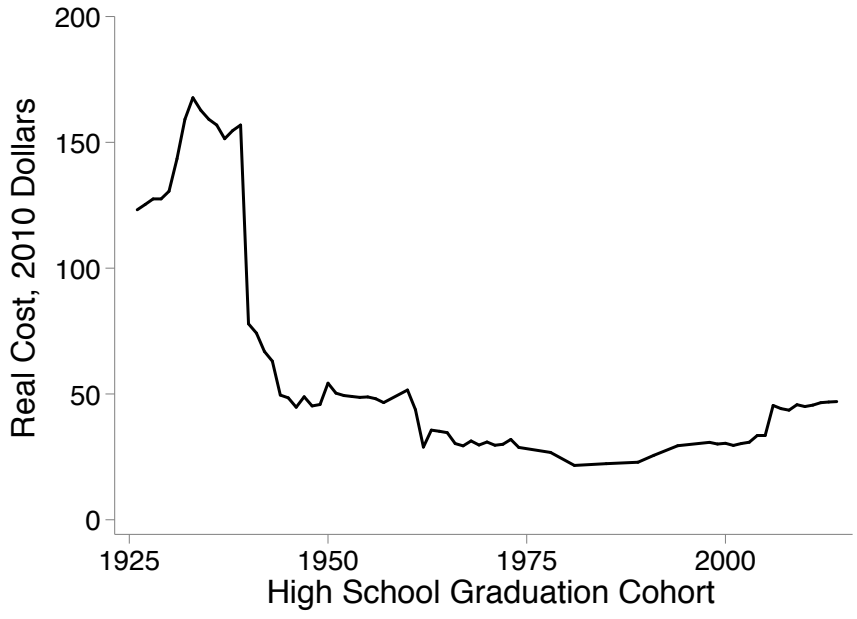


Relative to GDP per capita

Back

College Admissions Exam Cost Time Series



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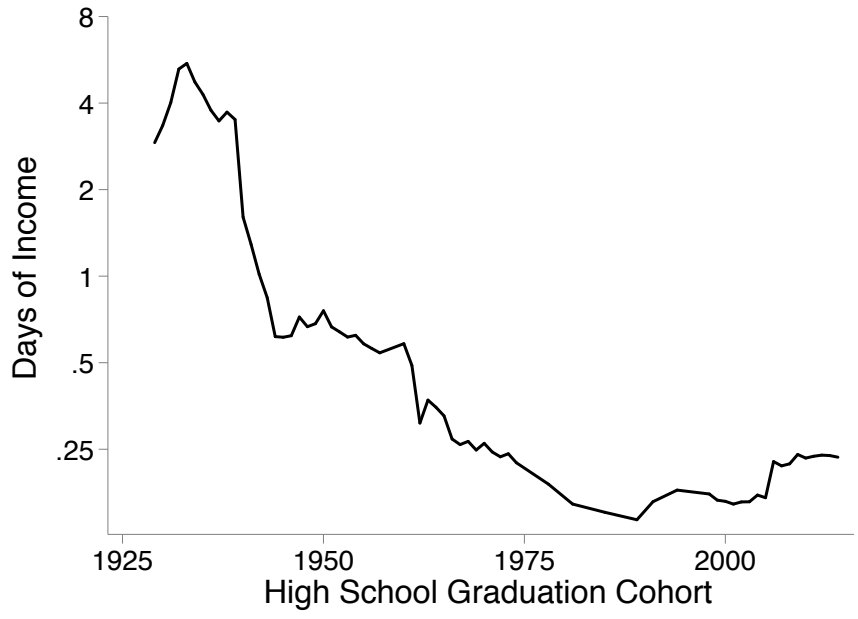

Relative to GDP per capita

▸ Back

Federal Role in College Financing Pre-1958

Federal spending relative to college educational and general income

	Year				
	1919–20	1929–30	1939–40	1947–48	1957–58
Federal share	7.4	4.3	6.7	34.1	18.9
Veteran	0.0	0.0	0.0	23.6	0.1
Non-veteran	7.4	4.3	6.7	10.5	18.8

Back

Federal Role in College Financing Post-1958

Federal aid spending, real 2010 dollars

	Year			
	1959–1960	1969–1970	1979–1980	1999–2000
Aid per pupil	703	2,361	2,672	4,545
Share general	0.28	0.48	0.68	0.95
Share loans	0.15	0.39	0.40	0.70

Back