Family Background, Academic Ability, and College Decisions in the 20th Century U.S.

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Motivation

Big picture goal:

Understand changes in U.S. college enrollment over time.

Focus of this paper:

Changes in the **composition** of college students since 1920s.

- **rich** versus **poor** students
- high versus low **ability** students

The role of **financial** conditions

- student loans
- college costs
- college wage premium

Empirical Contribution

Compile 40+ historical data sources on college enrollment 1919 - 1980

Main finding:

- The role of student **ability** has **increased**.
- The role of family **background** has **decreased**.

Quantitative Modeling Contribution

Model college decisions of heterogeneous students.

Identify changes in financial conditions that drive changes in enrollment patterns.

Main finding:

- Unimportant: college costs and borrowing limits.
- Important: college wage premium.

Evidence

Objective

The goal: Characterize how college entry varies with

- student ability
- family background

over the period 1919-1980.

Data Sources

Post 1960 data

- access to micro data
- Project Talent, NLSY
- ability measured by standardized test scores
- family background measured by income

Pre 1960 data

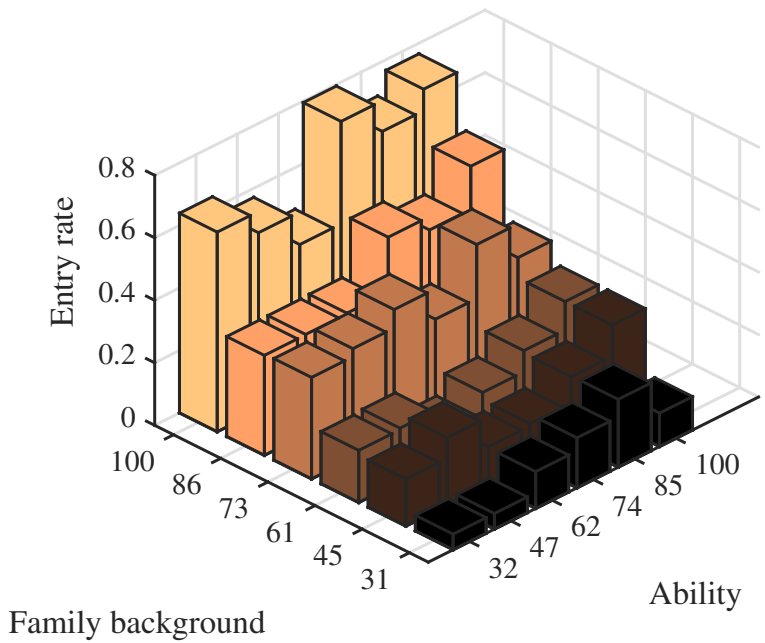
- no micro data
- published cross-tabulations of college entry rates
- ability: test scores or class rank
- family background: income or socioeconomic status

Example: Updegraff (1936)

Sample: 15% of Pennsylvania's 1933 graduating class.

Family background: socioeconomic status (6 bins)

Ability: test scores (6 bins)



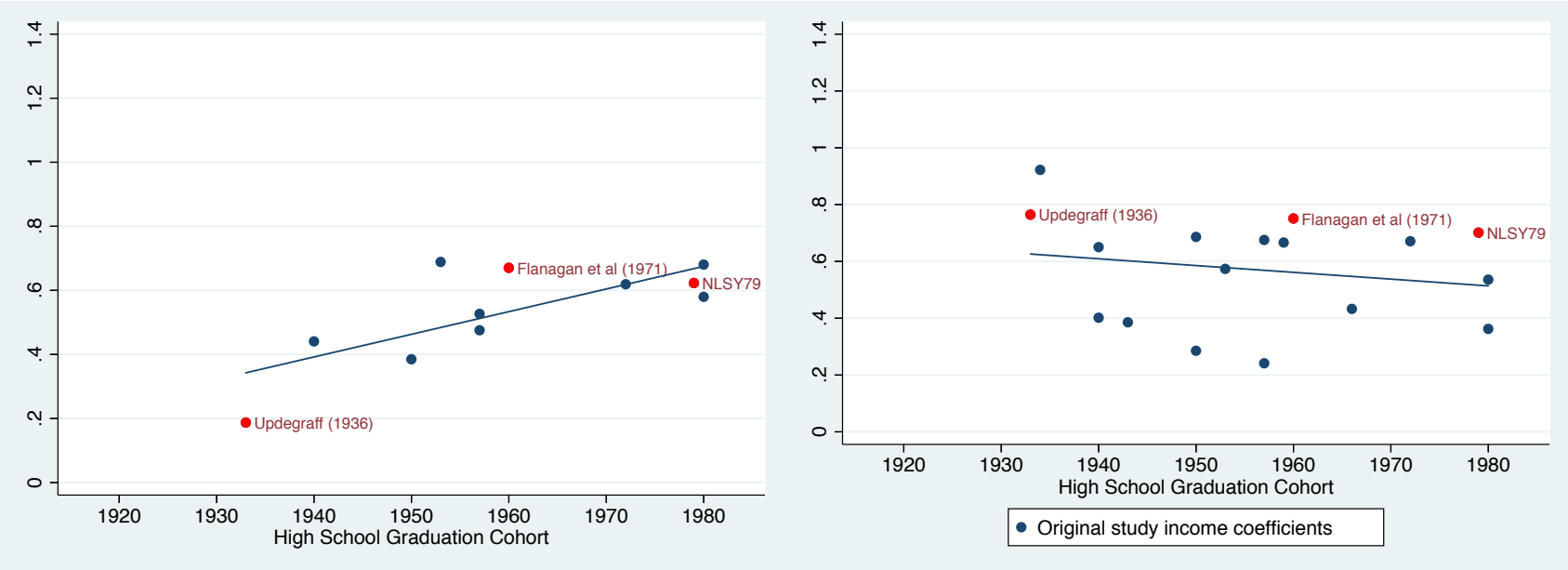
Summarizing Historical Studies

Regress college entry rates on

- ability percentile $\rightarrow \beta_{IQ}$
- family background percentile $\rightarrow \beta_F$

Percentiles are bin midpoints.

Importance of Background vs. Ability



Ability Family background

Coefficients from **bivariate** regressions (entry rates on ability **and** family background)

Importance of Background vs. Ability

Ability

Family background

Coefficients from **univariate** regressions (entry rates on ability **or** family background)

Comparability

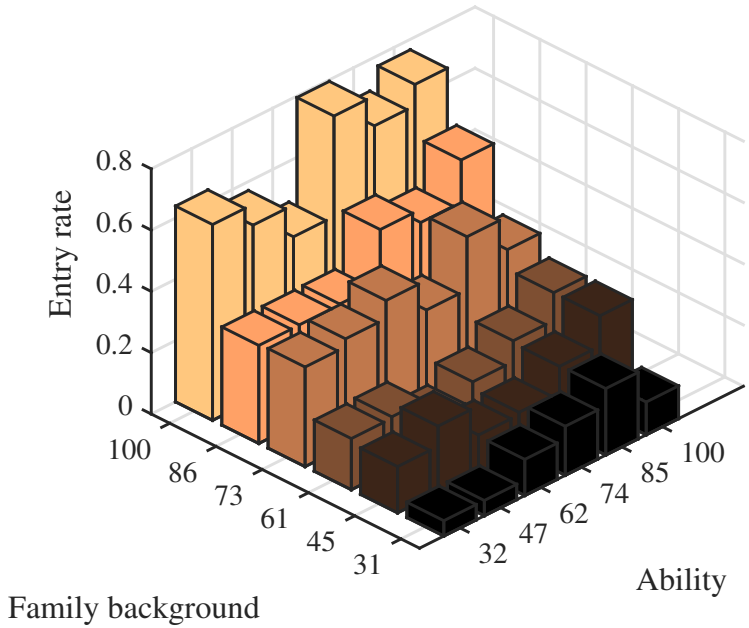
Histories studies differ in

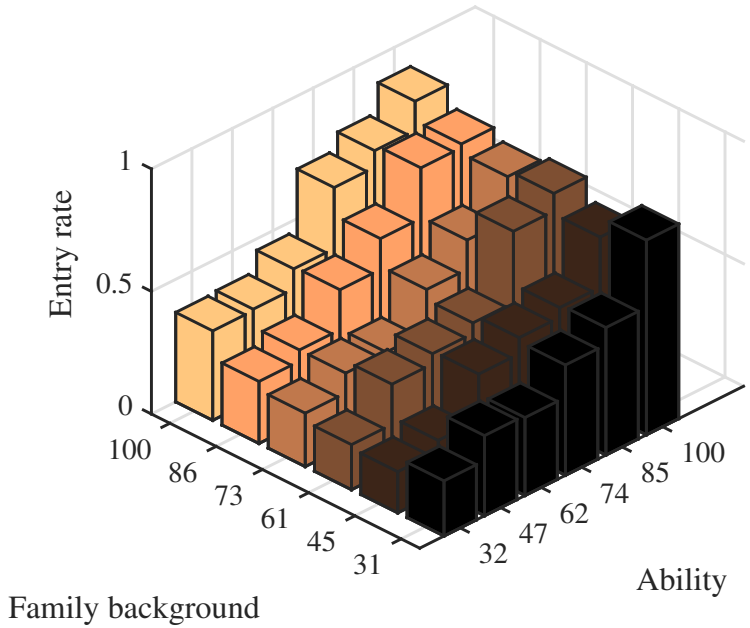
- sizes of percentile bins
- measures of ability and family background

Does lack of comparability affect the results?

To address this question, we replicate each study in NLSY79 data.

Example: Updegraff (1936)





Entry rates: Updegraff (1936) and NLSY replication.

Across studies: no evidence that changes in study design affect time trends in β_{IQ} or β_F. ▸ Details

Key Empirical Finding

Large change in who attends college

- Academic **ability** has become **more** important
- Family **background** has become **less** important

Next step:

Develop a **model** to uncover why these changes occurred.

Model

Model Overview

We follow one cohort from high school graduation to retirement.

Timing:

1. Choose between **college** entry or **work** as high school graduate.
   family income is used for parental consumption or transfer to child
2. Years 1-2 in college:
   choose consumption, saving, leisure, work hours
   subject to a borrowing constraint
3. At the end of year 2:
   a subset of students **drops out**
4. Years 3-4 in college:
   similar to years 1-2
5. Work as college **graduate** starting in year 5

Endowments

Each family is endowed with a type $j \in \{1, ..., J\}$

All agents of type j share the same values for

- parental income y_p
- college cost τ
- ability signal m
- preference for college (details below)

Ability x is not observed until the start of work.

College Entry Decision

$$\max\{\underbrace{V_{HS}(j) - \gamma\eta_w}_{\text{work as HSG}}, \underbrace{V_{entry}(j) - \gamma\eta_c}_{\text{enter college}}\} \tag{1}$$

η_c, η_w: type I extreme value shocks (for computational reasons)

Working as HSG

Value of working as HSG:

$$V_{HS}(j) = \max_{z_w \geq 0} u_p(y_p - z_w) + \mathbb{E}_a\{V_w(z_w, HS, x)|j\} + \bar{\eta} \qquad (2)$$

y_p: parental income

z: transfer to the child

$\bar{\eta}$: common preference for working as HSG

- permits the model to match overall college entry rate for each cohort

Work Phase

$$V_w(k,x,s) = \max_{c_a} \sum_{a=1}^{A-A_s} \beta^{t-1} u_w(c_a) \tag{3}$$

subject to a lifetime budget constraint

$$\sum_{a=1}^{A-A_s} R^{1-a} c_a = Y(s,x) + Rk \tag{4}$$

Value of College Entry

$$V_{entry}(j) = \max_{z_c \geq 0} u_p(y_p - z_c) + V_1(z_c, j) \tag{5}$$

Years 1-2 In College

$$V_1(k,j) = \max_{k',c,l} (1+\beta)\, u\left(c+\bar{c}_j, 1+\bar{l}_j - l\right) + \beta^2 V_m\left(k',j\right) \qquad (6)$$

subject to

- budget constraint: $k' = Rk + 2\left(w_{coll} l - \tau_j - c\right)$
- borrowing constraint: $k' \geq k_{min,3}$

$\bar{c}_j, \bar{l}_j$: increasing in m

- prevents high ability students from consuming too much in college

End of Year 2 in College

With probability $1-\pi(x)$: drop out and start working.

Otherwise: remain in college for 2 more years.

Continuation value:

$$V_m(k,j) = \mathbb{E}_x\left[(1-\pi[x])\, V_w(k,x,CD) + \pi[x]\, V_3(k,j)\right] \qquad (7)$$

Years 3-4 In College

$$V_3(k,j) = \max_{k',c,l} (1+\beta)\, u(c+\bar{c}_j, 1+\bar{l}_j - l) + \beta^2 \mathbb{E}_x V_w\left(k', x, CG\right)$$

subject to

- budget constraint
- borrowing constraint

Calibration

Step 1:

- Calibrate all parameters to **NLSY79** data
- High school graduates around 1979

Step 2:

Calibrate a subset of **time-varying** parameters for high school graduates around

- **1960**: Project Talent data
- **1933**: Updegraff (1936) data

Calibration Targets (NLSY79)

Median lifetime **earnings** by schooling (CPS)

College **entry** and graduation rates, by $[y_p, IQ]$ quartile

College **financing** (by y_p and IQ quartile):

1. College costs
2. Parental transfers (High School & Beyond)
3. Parental income
4. Hours worked and earnings in college
5. Student loans

$IQ = x + \text{noise}$

Calibrated Parameters

- Endowment distributions (college costs, parental income, abilities and signals)
- Preferences (consumption, leisure, parental altruism)
- Lifetime earnings
- Graduation rates: $\pi(x)$

▸ Details

Fit: ▸ College entry ▸ College graduation ▸ Earnings ▸ Debt and transfers

Time Series Calibration

We compare 3 cohorts:

Cohort	Updegraff (1936)	Project Talent	NLSY79
	1933	1960	1979
College entry rate	0.39	0.53	0.58
College premium	0.36	0.35	0.56
Borrowing limit	0	0	22,596
College cost	2,154	2,038	2,731
β_{IQ}	0.22	0.70	0.58
β_F	0.68	0.48	0.42

▸ Details ▸ Details

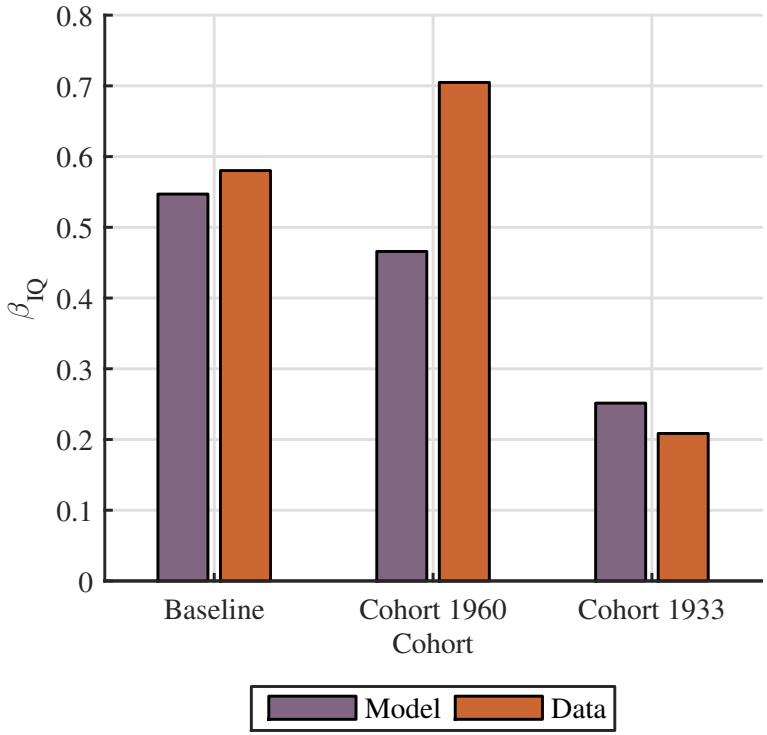
Time-Series Calibration

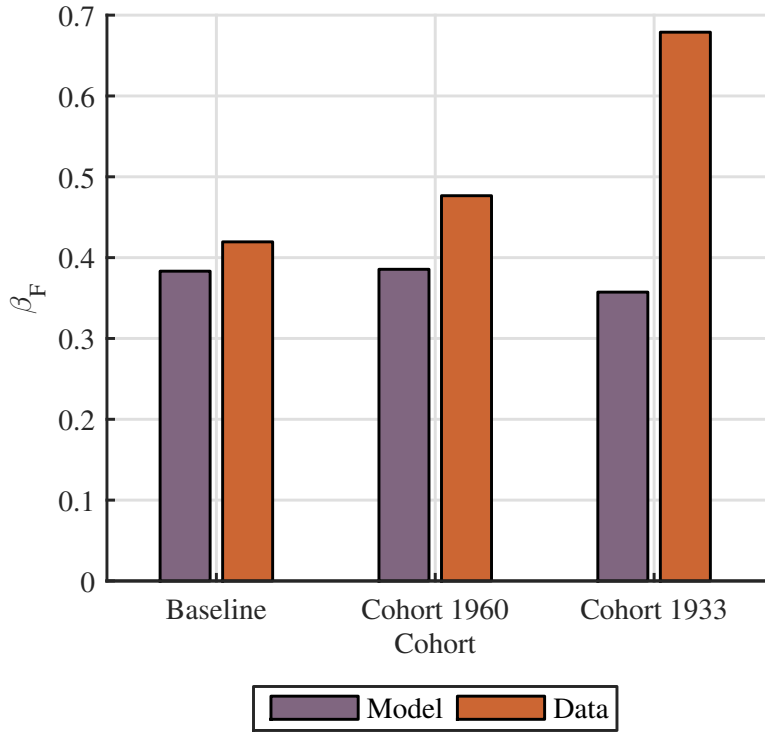
Time-varying parameters:

- borrowing limit: k_{min}
- mean college cost: μ_τ
- lifetime earnings gap by schooling: $\bar{Y}(s)$
- taste for college: $\bar{\eta}$
- parental altruism (to match share of college costs paid by "family contributions")

Results

College Entry Over Time





Financial conditions account for

- 3/4 of the change in β_{IQ}
- 1/6 of the change in β_F

Accounting for Changing College Entry

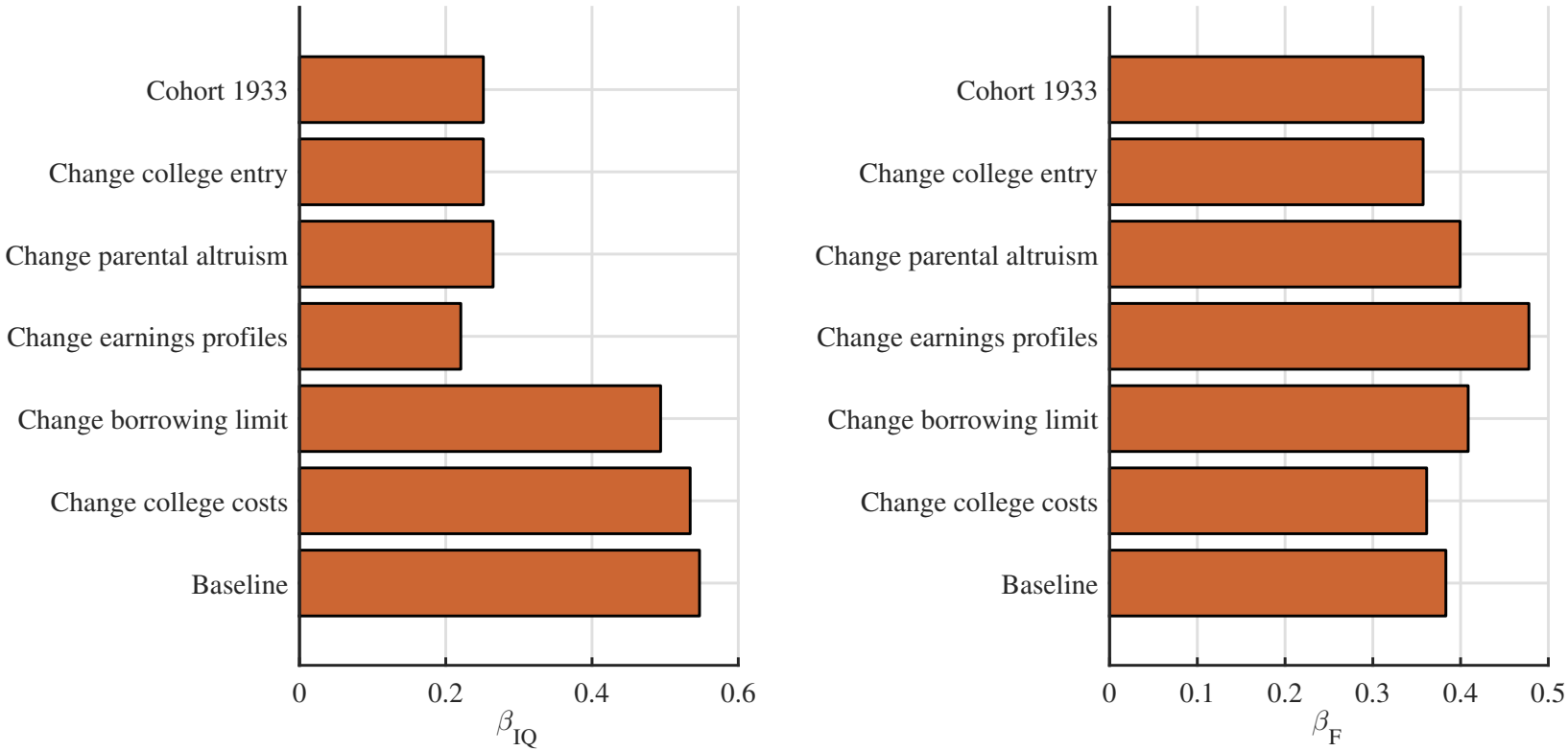
Which exogenous driving forces account for the changes in college entry patterns?

One answer:

1. Start with the baseline (NLSY79) model.
2. One-by-one, change a forcing variable to match the value for an earlier cohort.

For ease of interpretation: The overall college entry rate is held fixed by adjusting the preference parameter $\bar{\eta}$.

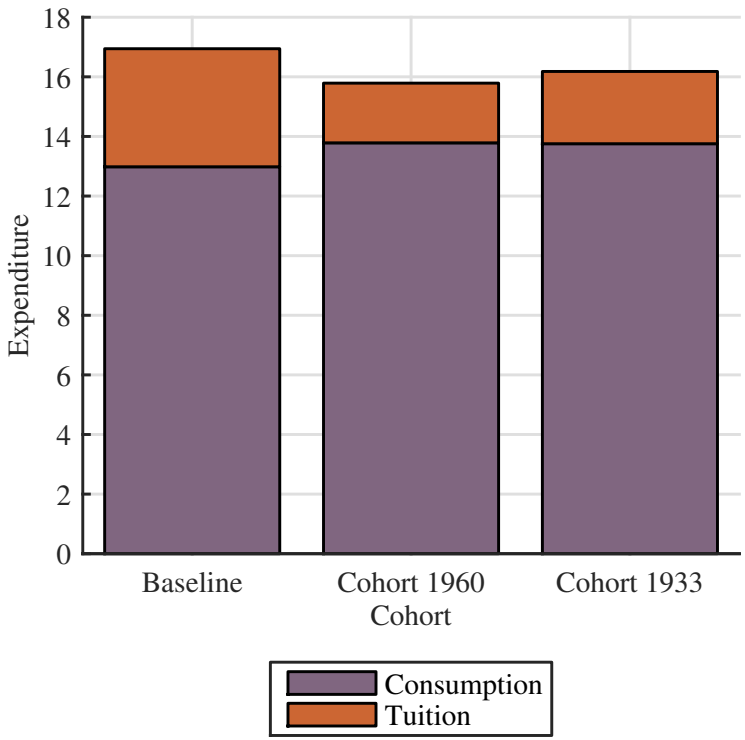
Accounting for Changing College Entry

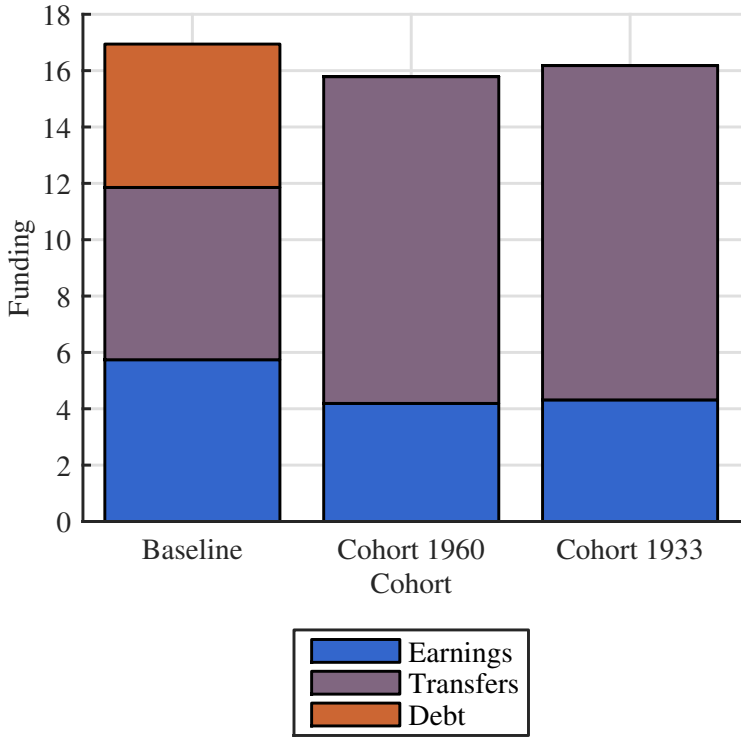


Most of the changes in college entry patterns are due to the rising college premium.

▸ 1960 cohort

College Financing Over Time





How do students pay for college without loans?

They get larger transfers.

Conclusion

x

Detail Slides

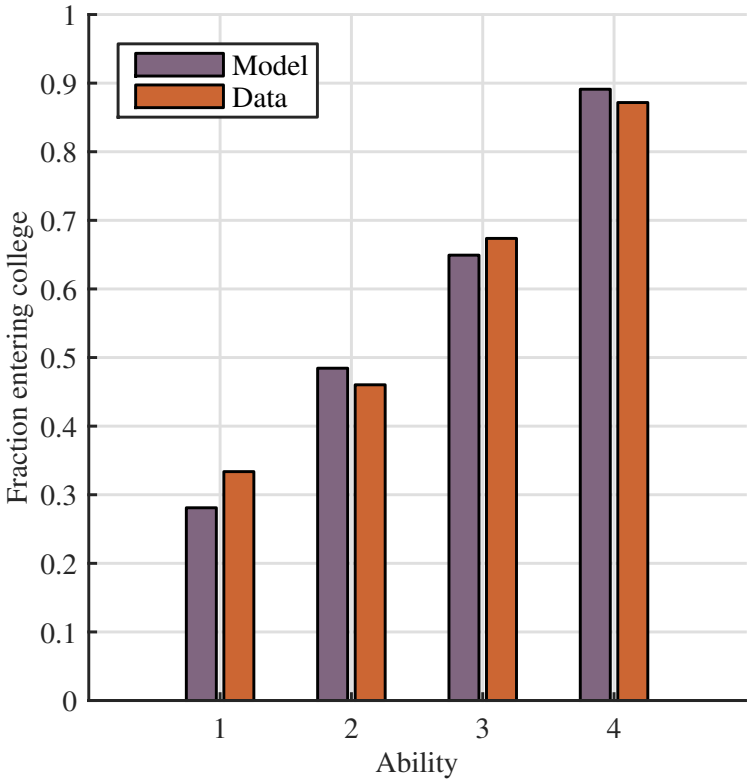
NLSY Replication Results

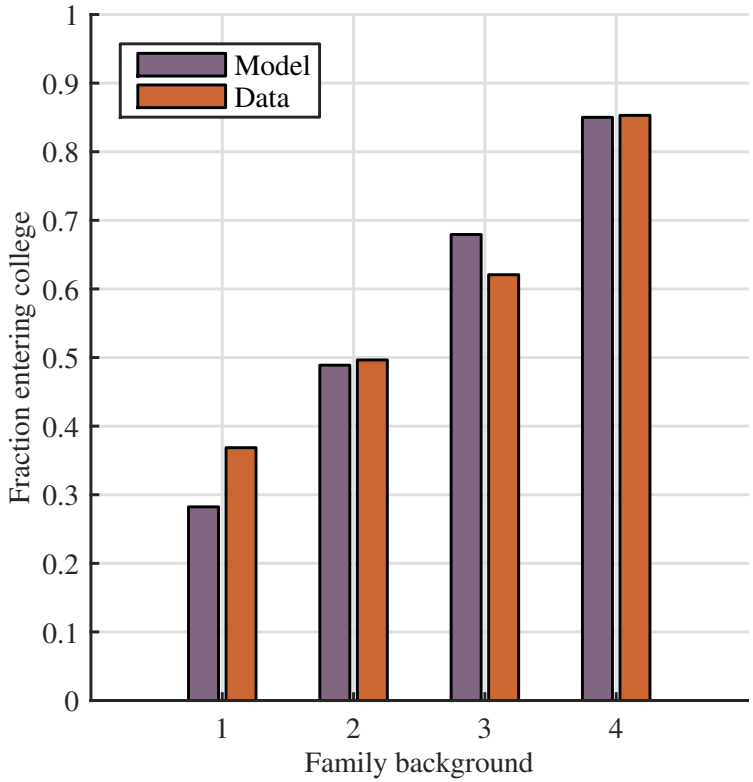
Variation in study design does not systematically affect β_{IQ} or β_F.

Calibrated Parameters

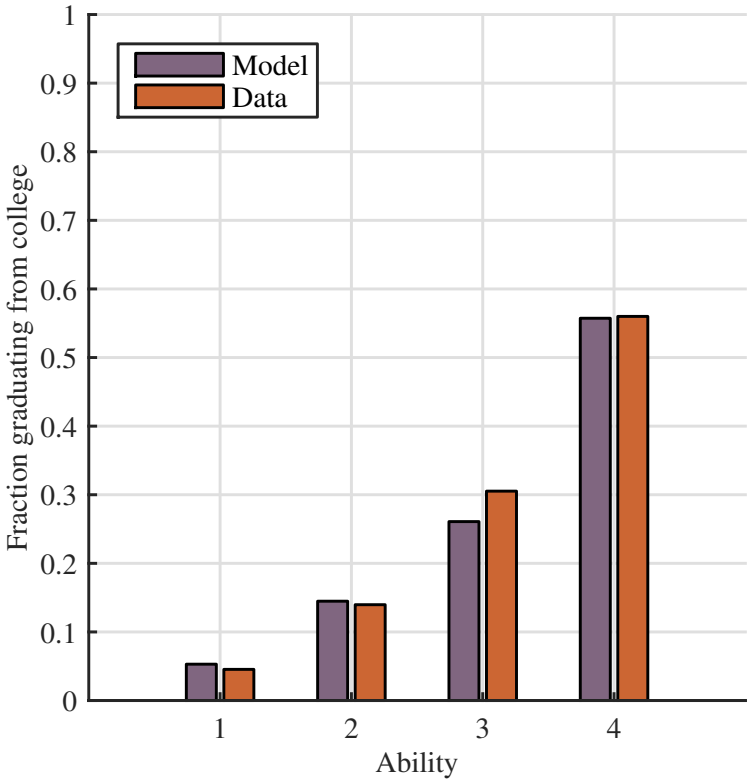
Parameter	Description	Value
Endowments		
μ_τ, σ_τ	Marginal distribution of τ	$3.9, 3.0$
σ_{IQ}	IQ noise	0.32
Preferences		
ω_l	Weight on leisure	0.23
ω_w	Weight on u(c) at work	8.60
φ_p	Curvature of parental utility	0.54
μ_p	Weight on parental utility	0.44
σ_p	Std of weight on parental utility	0.14
$\bar{\eta}$	Preference for HS	-0.10
$\bar{c}_{max}$	Max free consumption	0.9
$\bar{l}_{max}$	Max free leisure	0.10
Other		
$\bar{Y}_s$	Log skill prices	6.48, 6.52, 6.72
w_c	College wage	24.4

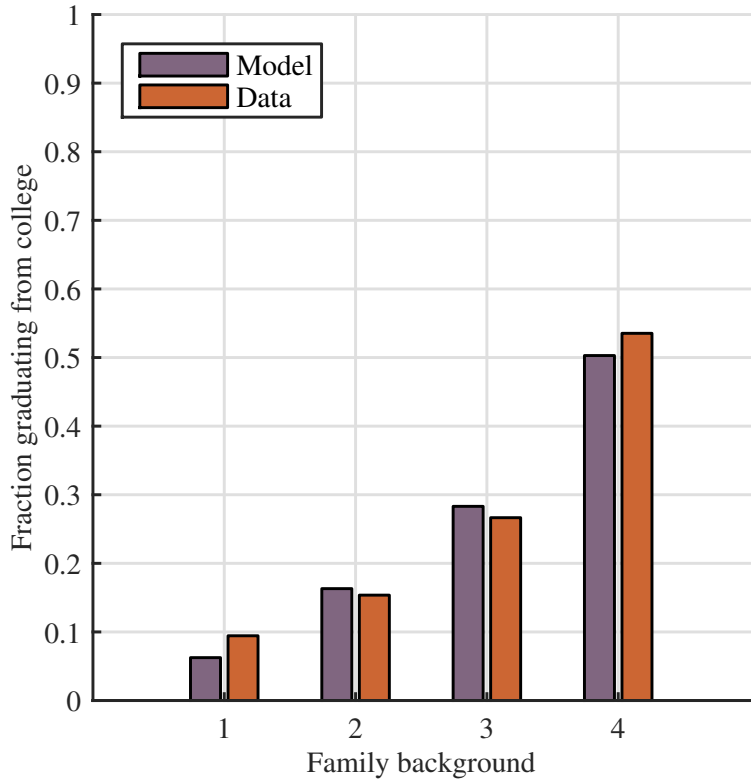
College Entry Rates



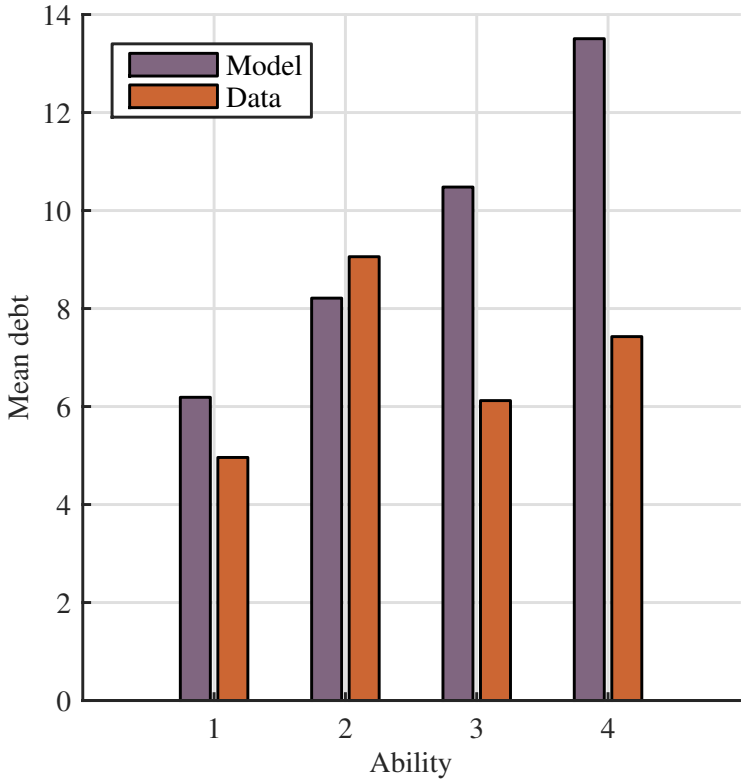


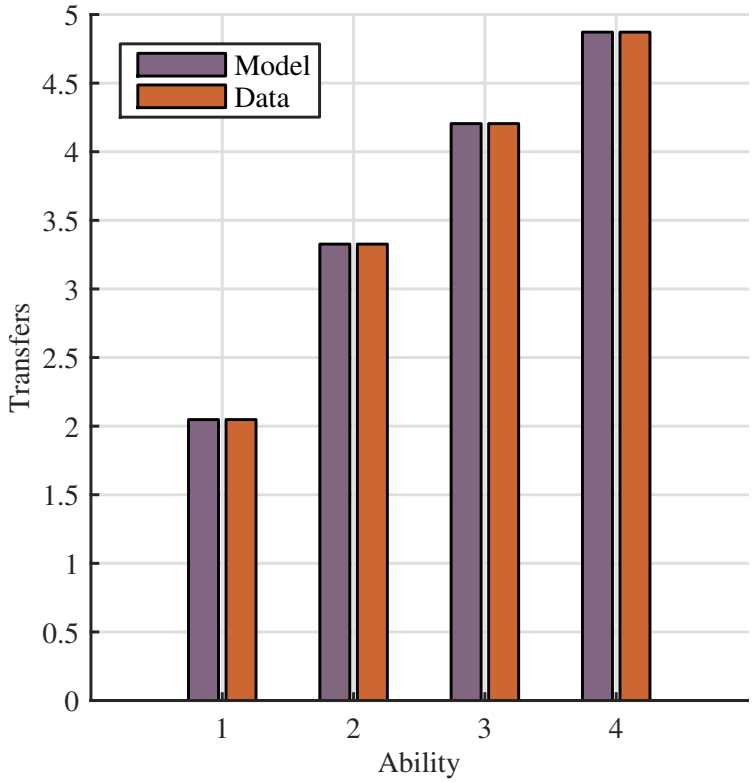
College Graduation Rates



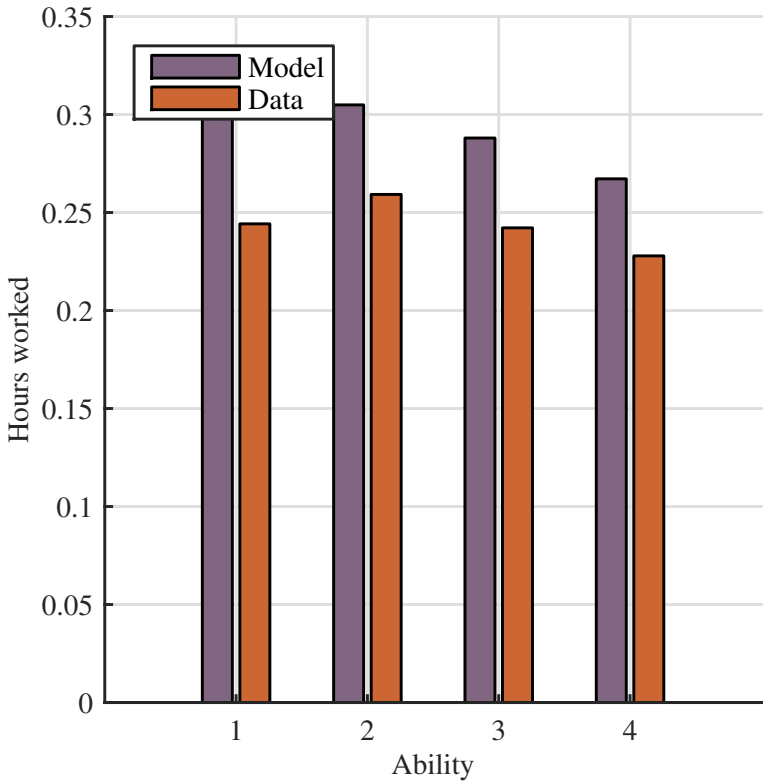


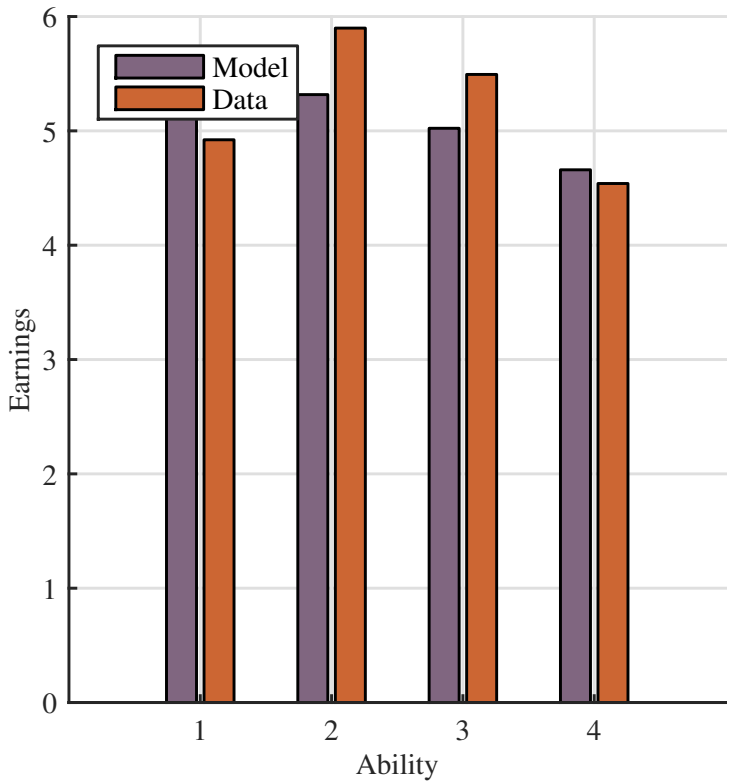
Debt and Transfers



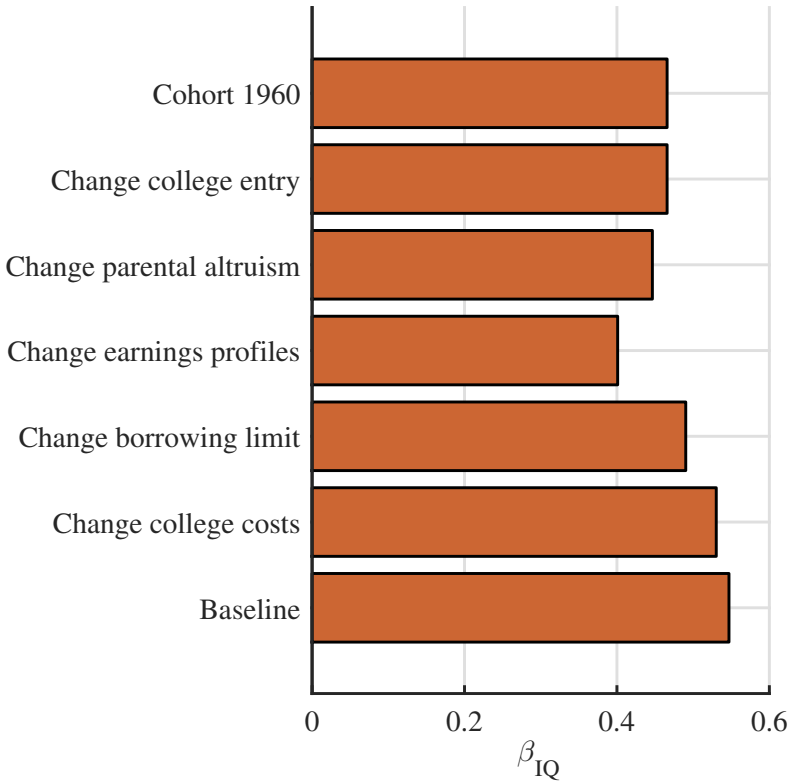


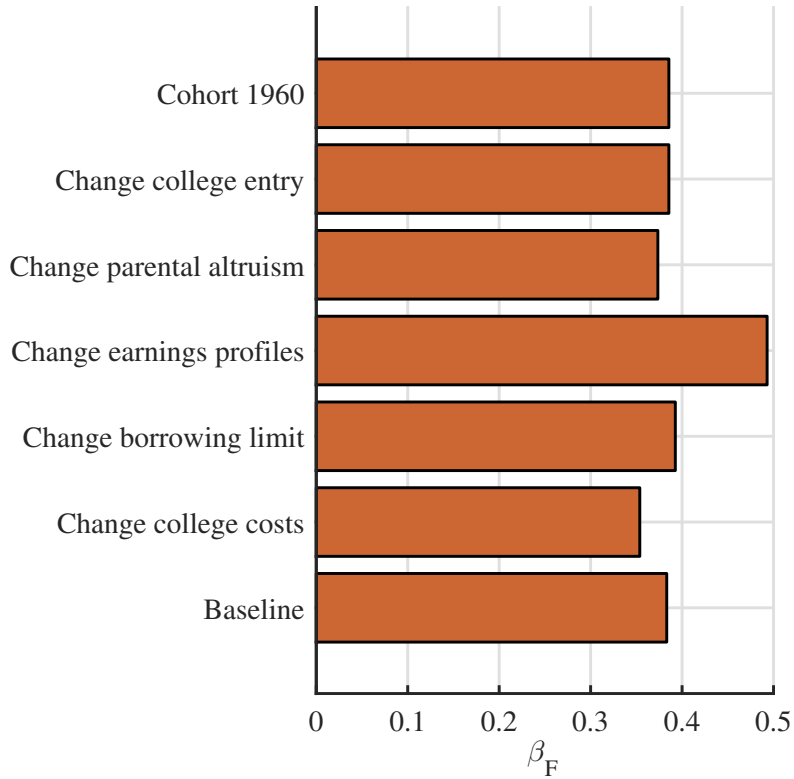
Hours and Earnings in College



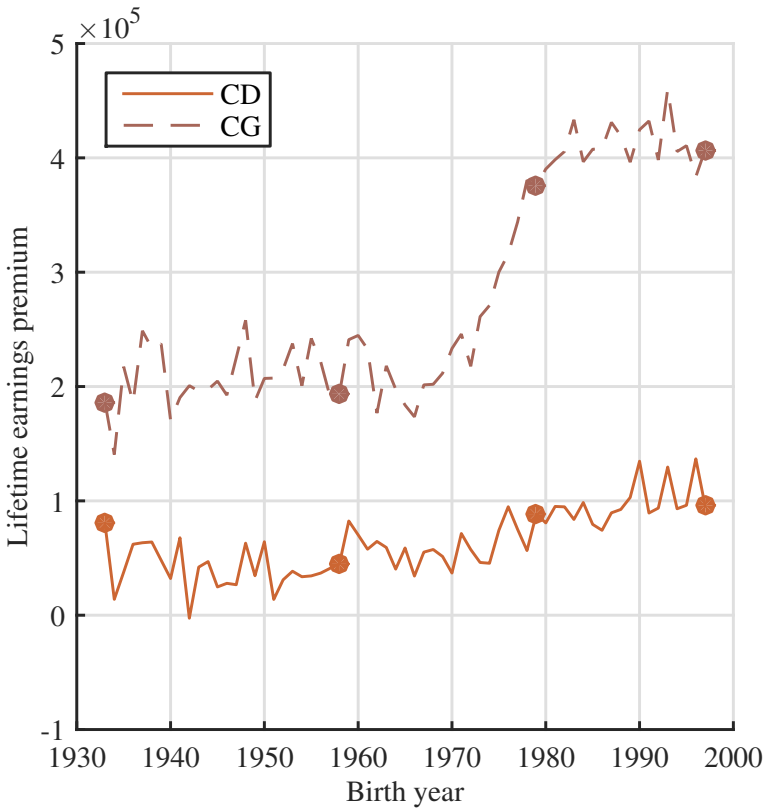


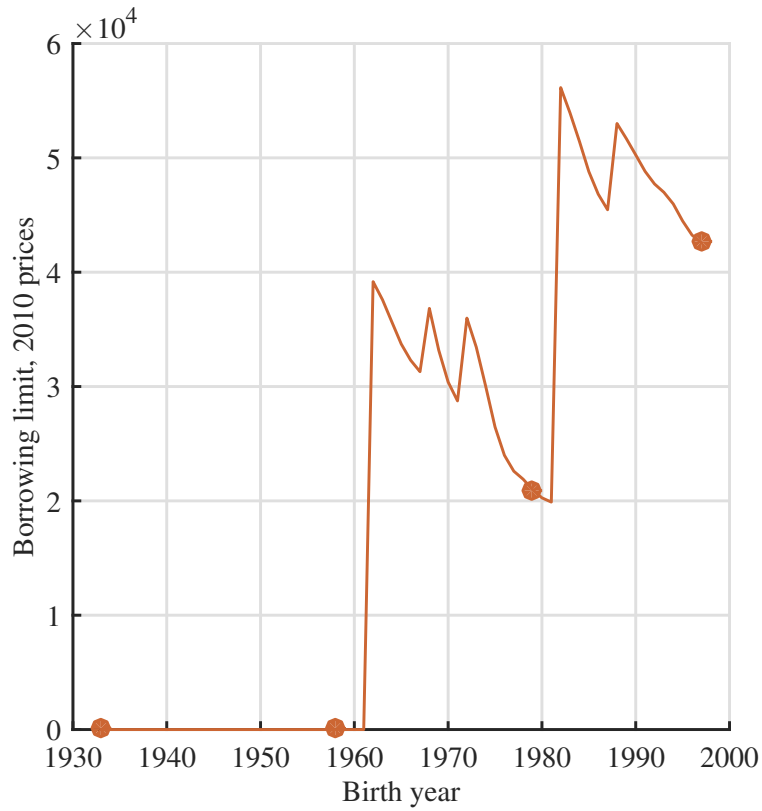
Accounting for Changing College Entry





Time Series Data





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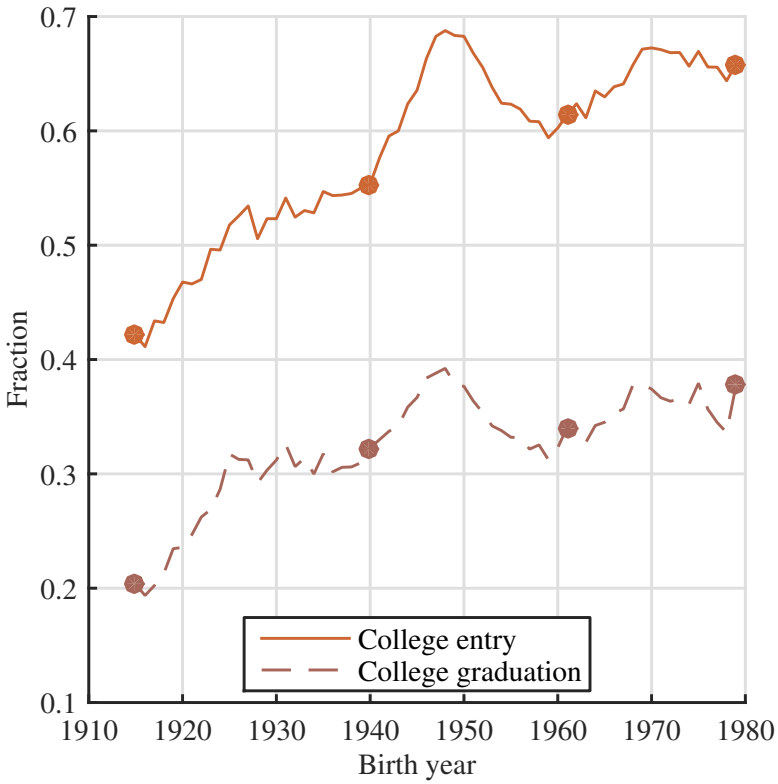
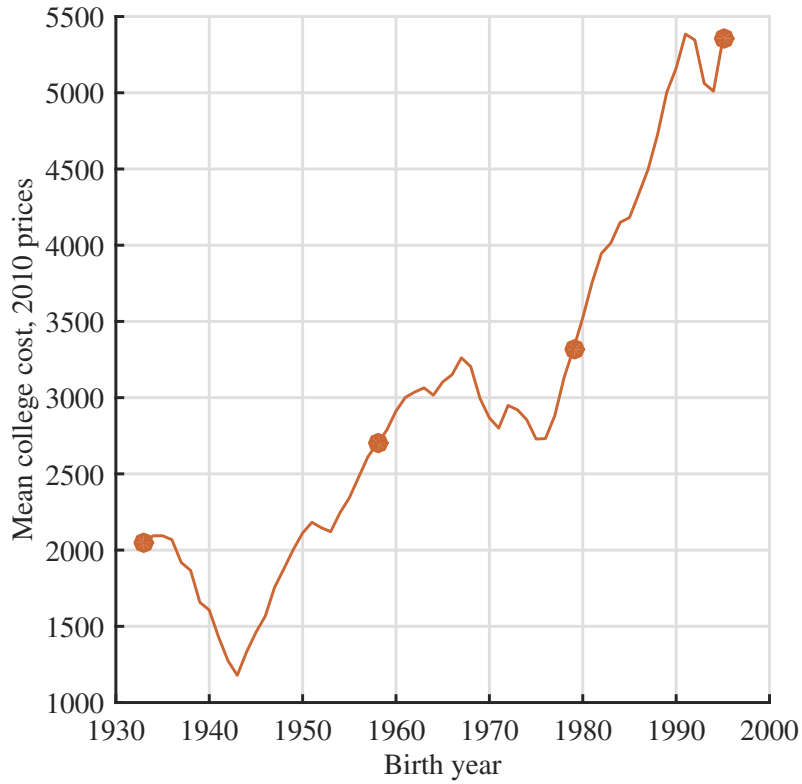
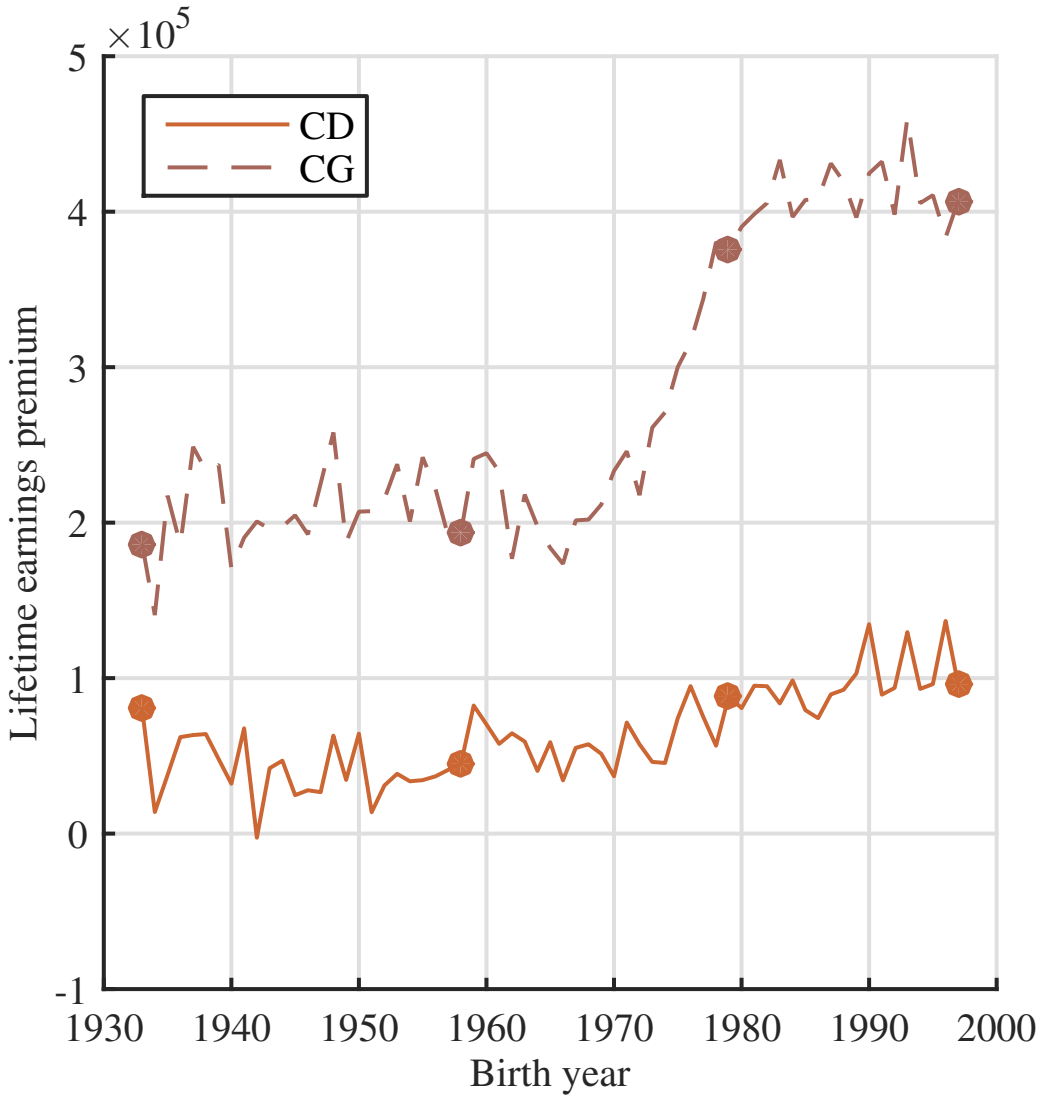
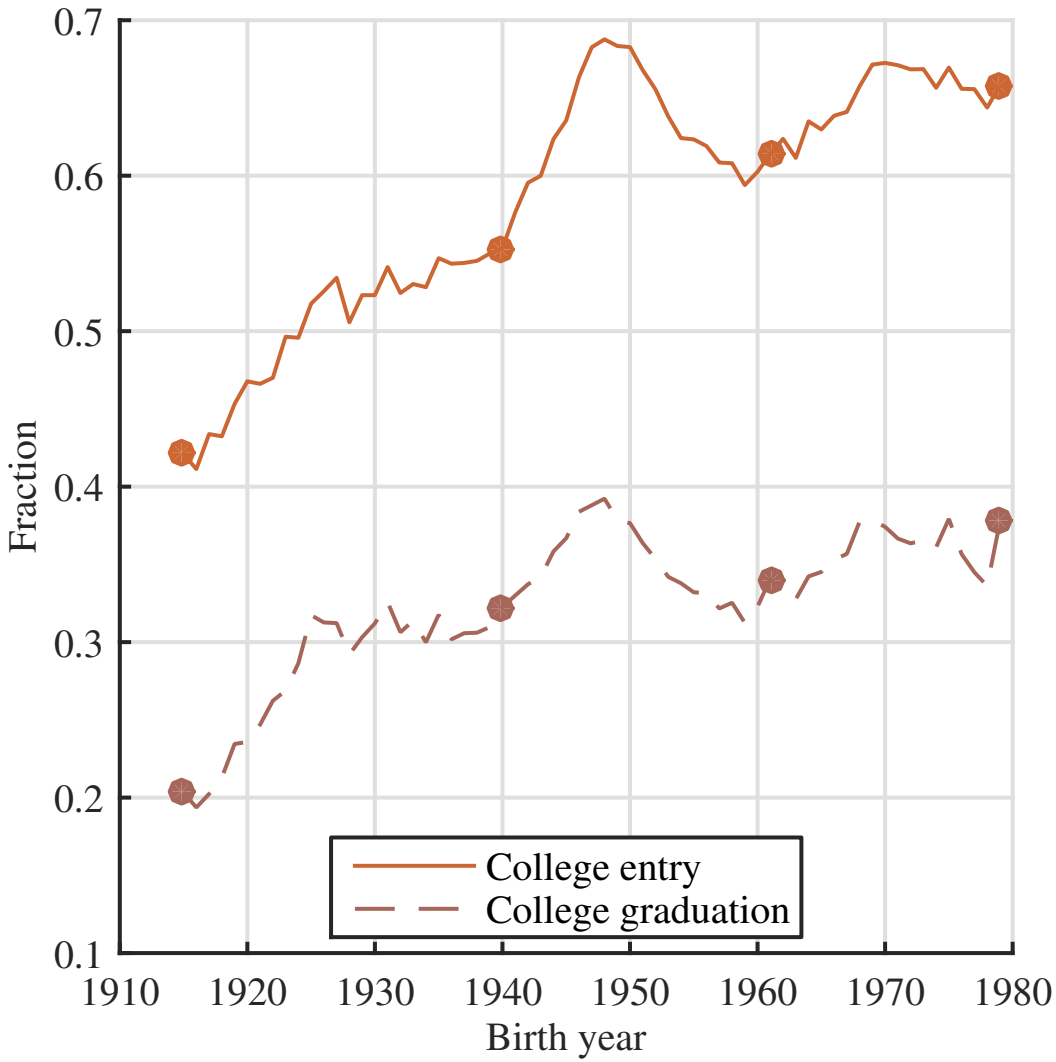




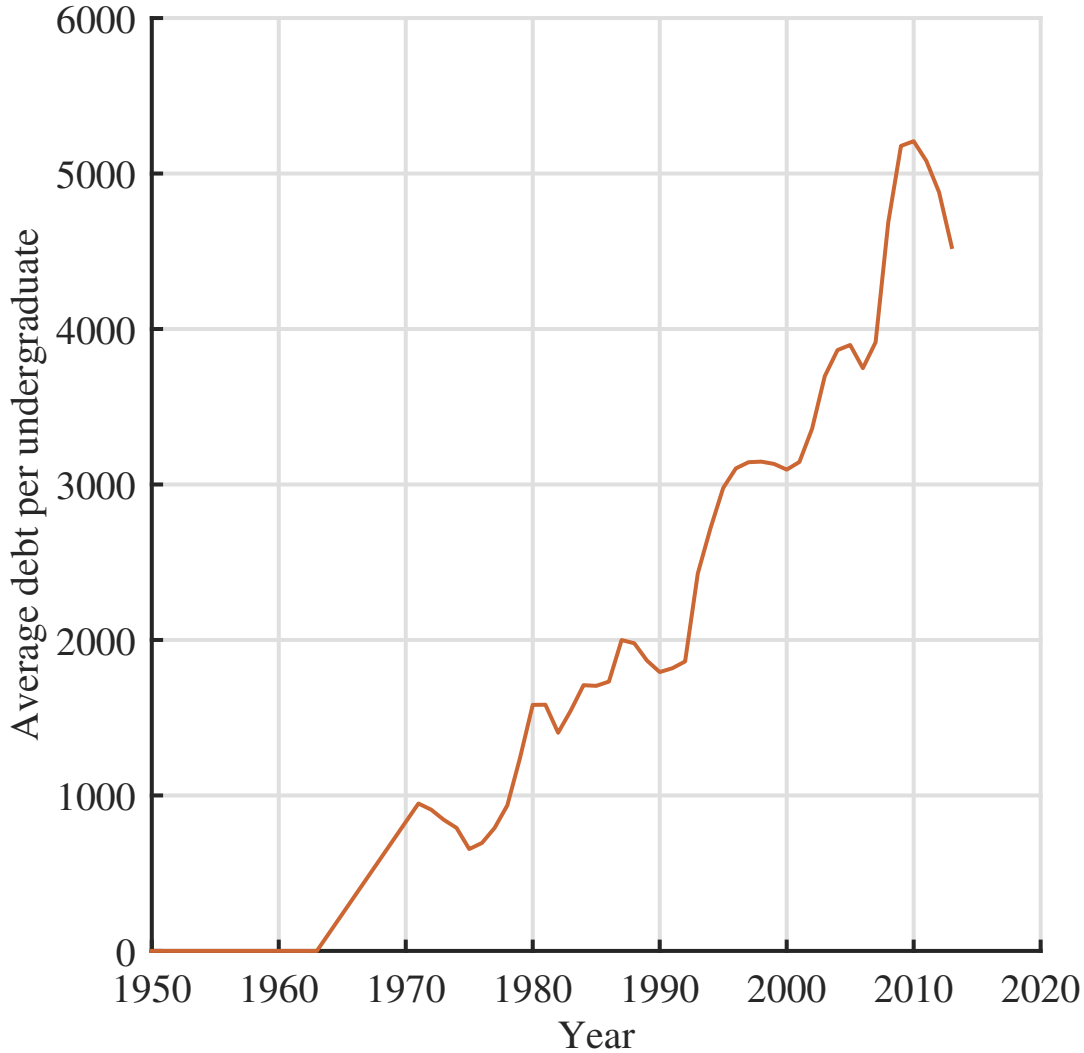
College Premium



Cohort Schooling

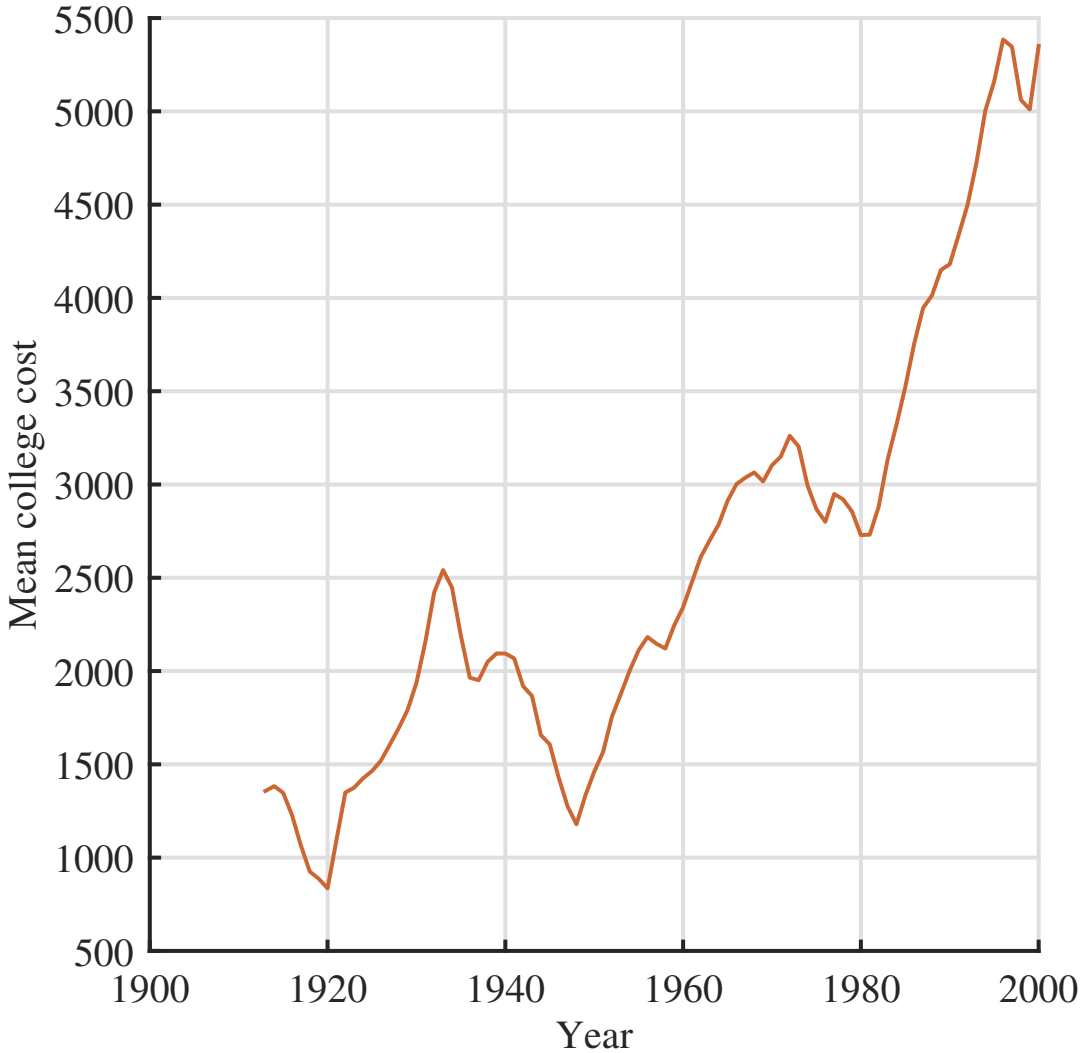


Mean Student Debt



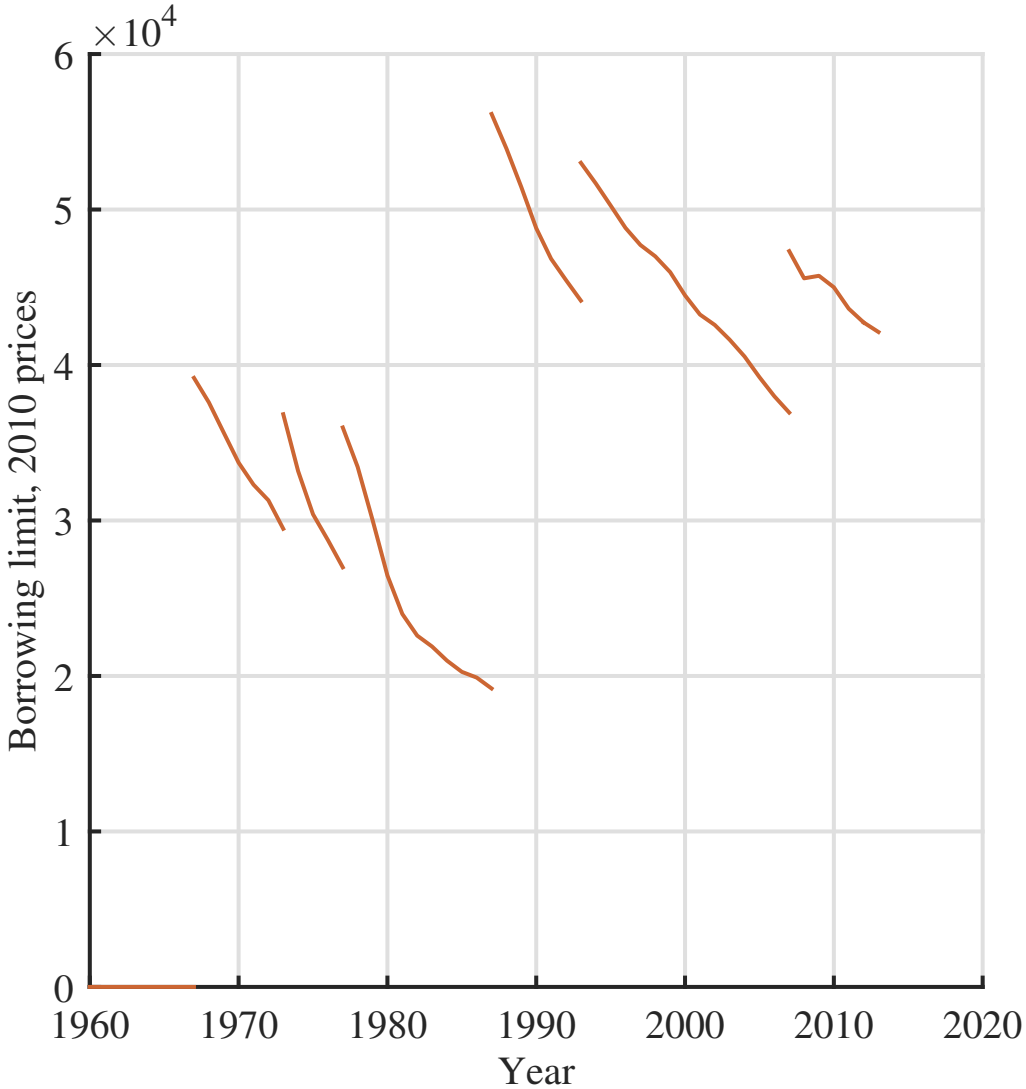
Mean debt per undergraduate, 2010 prices.

College Costs



Mean out of pocket college cost, 2010 prices.

Borrowing Limits



Lifetime maximum undergraduate federal loan limits.

References I