# 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 1930-1980.

# Data Sources

**Post 1960 data**

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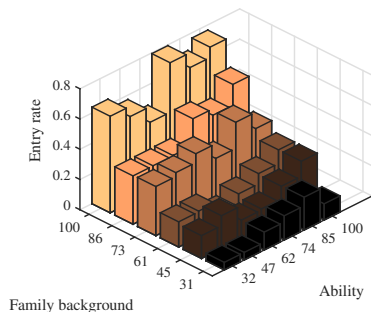- family background measured by income

**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)
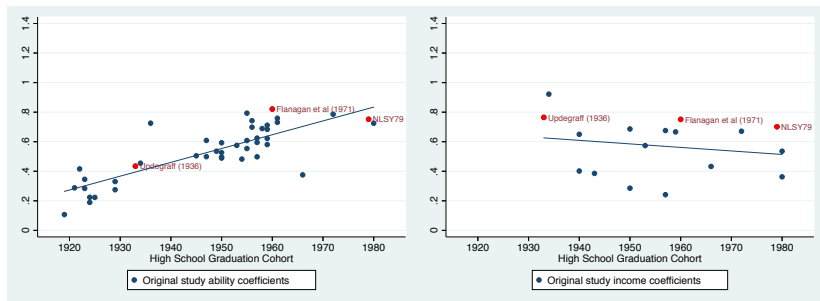
Ability: test scores (6 bins)

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

# Importance of Background vs. Ability



Ability                                          Family background

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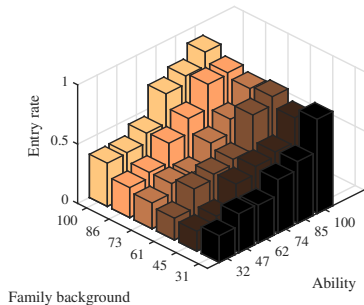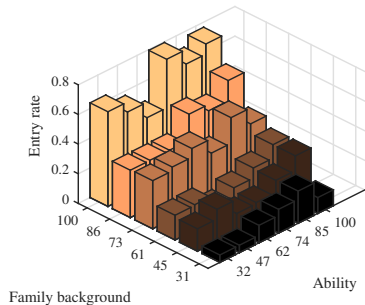family background)

# 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 problem, we replicate each study in NLSY79 data.

# Example: Updegraff (1936)



Entry rates: Updegraff (1936) and NLSY replication.

# NLSY Replication Results



Variation in study design does not systematically affect $\beta_{IQ}$ or $\beta_F$.

# 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 $\tau$
- ability signal $m$
- preference for college (details below)

Ability $x$ is not observed until the start of work.

# College Entry Decision

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

$\eta_c, \eta_w$: 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

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

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:

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

# Years 3-4 In College

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

subject to

- ▶ budget constraint
- ▶ borrowing constraint

# Calibration

Step 1:

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

Step 2:

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

- ▶ 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

$IQ = x +$ 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 | 0.57 |
| College premium | 0.36 | 0.35 | 0.56 |
| Borrowing limit | 0 | 0 | 22,596 |
| College cost | 2,139 | 2,256 | 2,731 |
| $\beta_{IQ}$ | 0.22 | 0.70 | 0.71 |
| $\beta_F$ | 0.68 | 0.48 | 0.06 |

▶ Details   ▶ Details

# Time-Series Calibration

Time-varying parameters:

- borrowing limit: $k_{min}$
- mean college cost: $\mu_\tau$
- 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
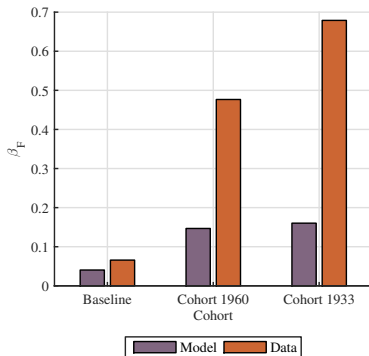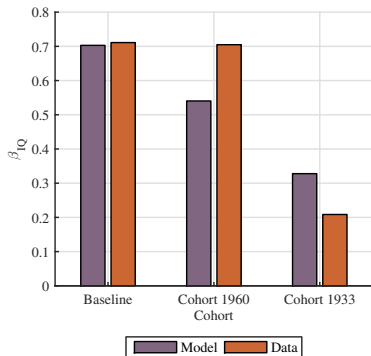


Financial conditions account for

- 3/4 of the change in $\beta_{IQ}$
- 1/6 of the change in $\beta_F$

# 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
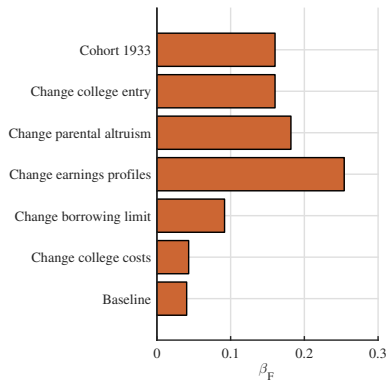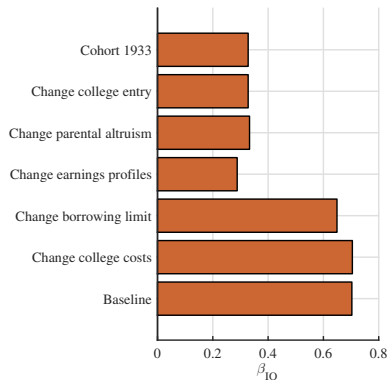


Most of the changes in college entry patterns are due to the rising college premium.

▸ 1960 cohort

# College Financing Over Time
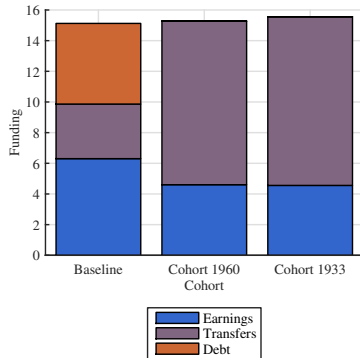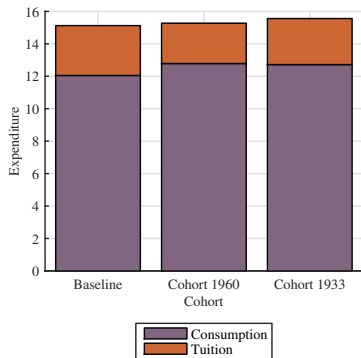


How do students pay for college without loans?

They get larger transfers.

# Conclusion

x

Detail Slides

# Calibrated Parameters

| Parameter | Description | Value |
|---|---:|---:|
| Endowments | | |
| $\mu_\tau, \sigma_\tau$ | Marginal distribution of $\tau$ | $3.5, 3.5$ |
| $\sigma_{IQ}$ | IQ noise | $0.36$ |
| Preferences | | |
| $\omega_l$ | Weight on leisure | $0.30$ |
| $\omega_w$ | Weight on u(c) at work | $8.84$ |
| $\varphi_p$ | Curvature of parental utility | $0.48$ |
| $\mu_p$ | Weight on parental utility | $0.41$ |
| $\sigma_p$ | Std of weight on parental utility | $0.19$ |
| $\bar{\eta}$ | Preference for HS | $-0.11$ |
| $\bar{c}_{max}$ | Max free consumption | $0.6$ |
| $\bar{l}_{max}$ | Max free leisure | $0.18$ |
| Other | | |
| $\bar{Y}_s$ | Log skill prices | $6.41, 6.46, 6.79$ |
| $w_c$ | College wage | $32.6$ |

# College Entry Rates
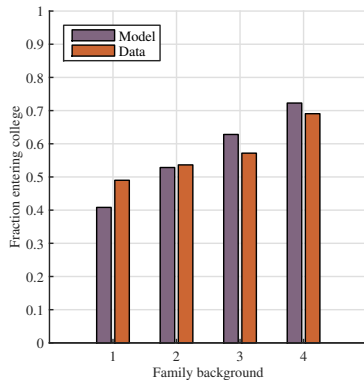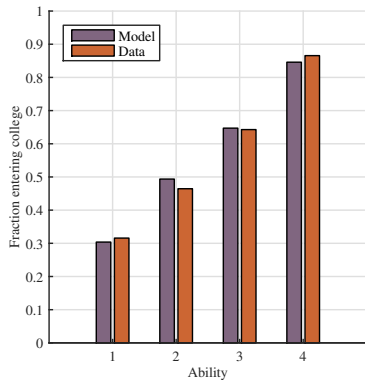
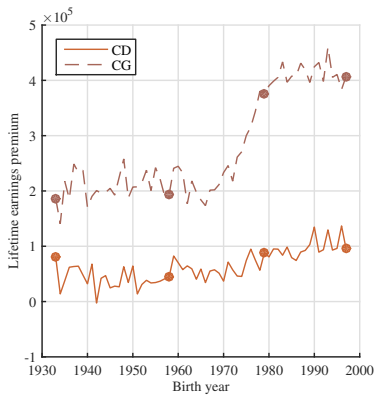# College Graduation Rates
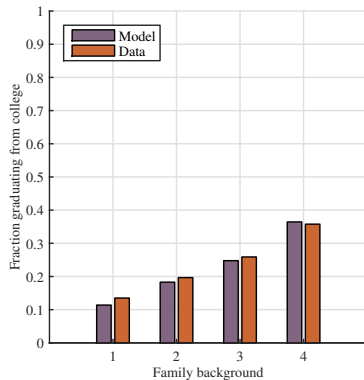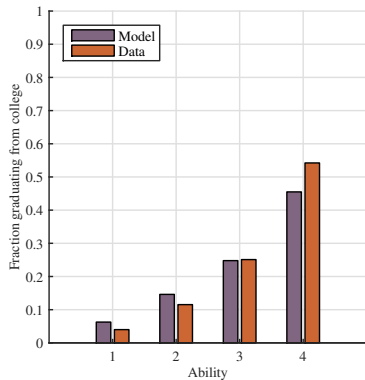
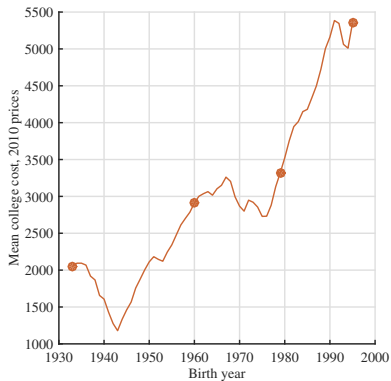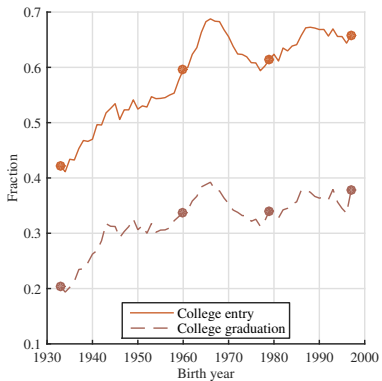# Debt and Transfers
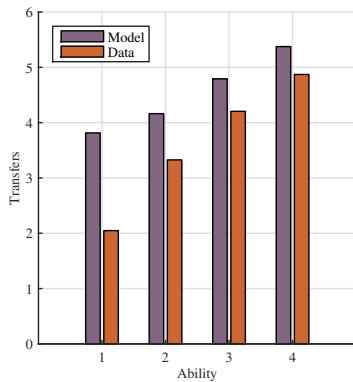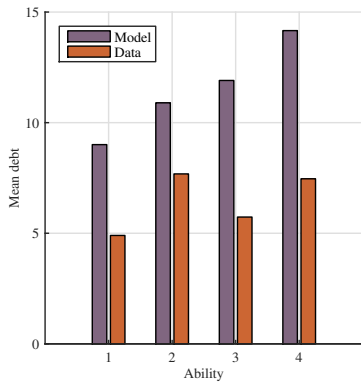
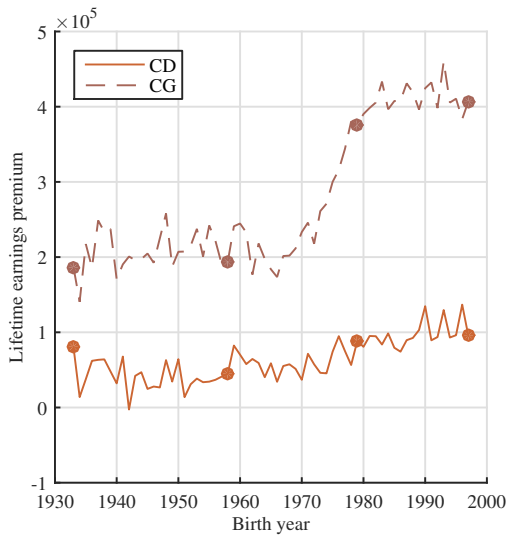# Hours and Earnings in College
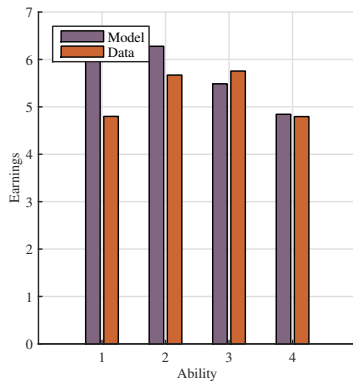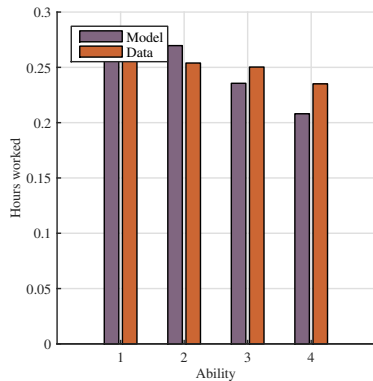
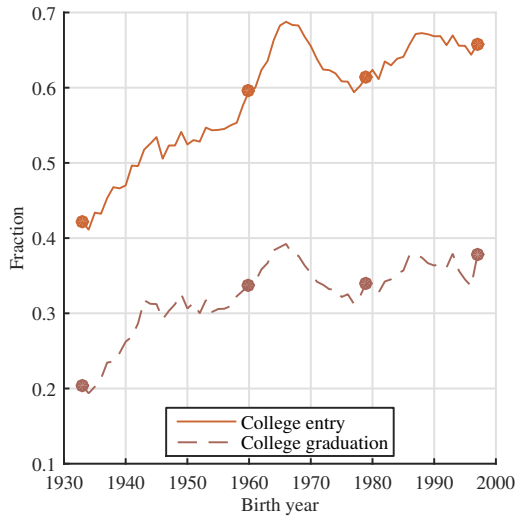# Accounting for Changing College Entry
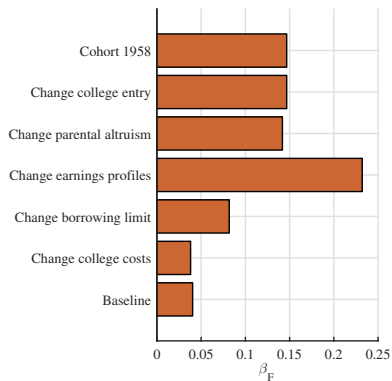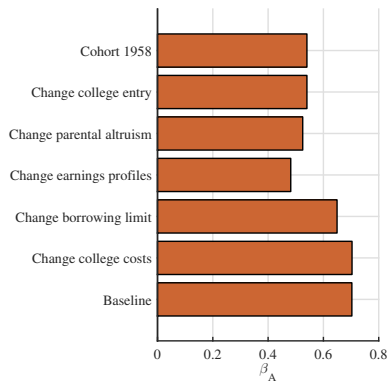
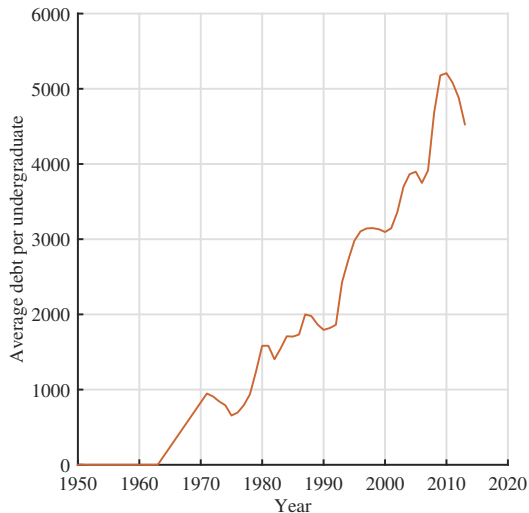# Time Series Data
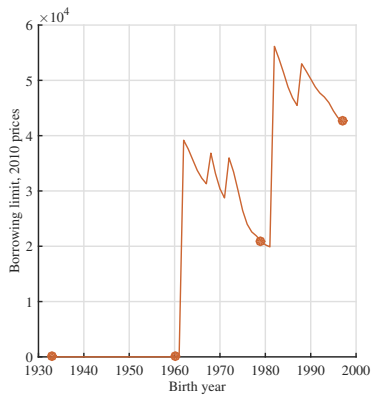
# Time Series Data

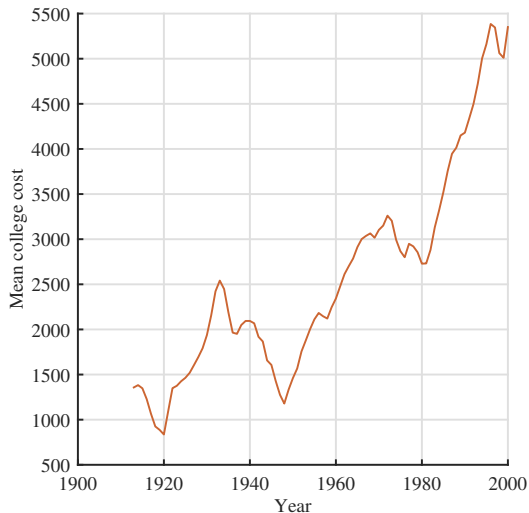# College Premium

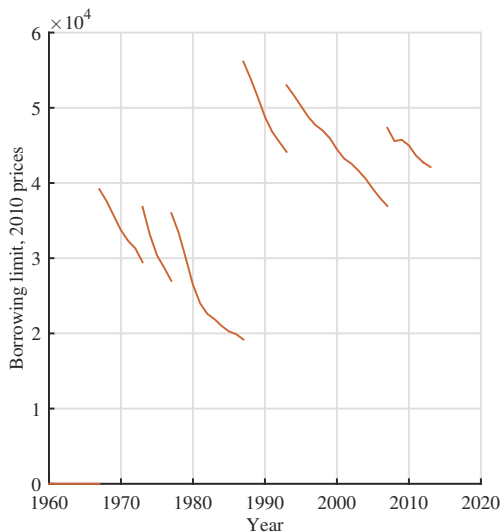# Cohort Schooling

# 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