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

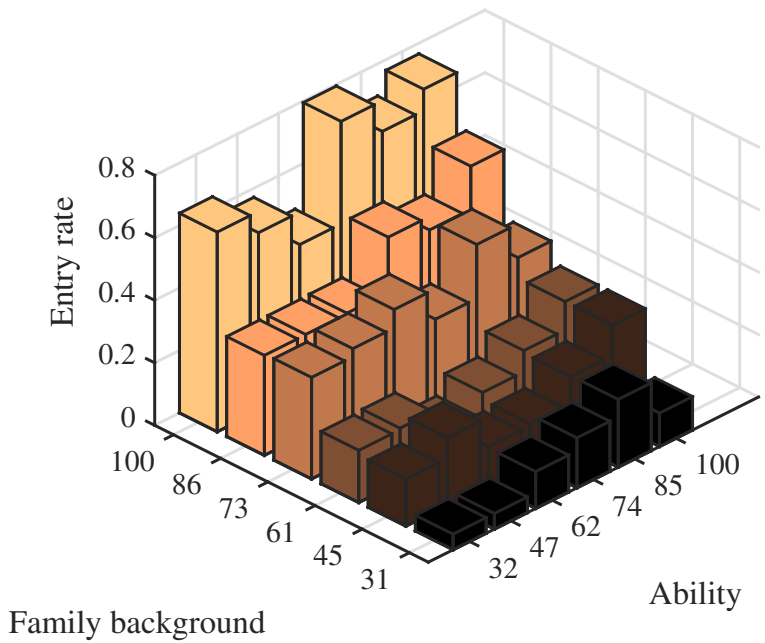
- no micro data
- published cross-tabulations of college entry rates
- ability: test scores or class rank
- family background: income or socioeconomic status

Example: Updegraff (1936)

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

Family background: socioeconomic status (6 bins)

Ability: test scores (6 bins)



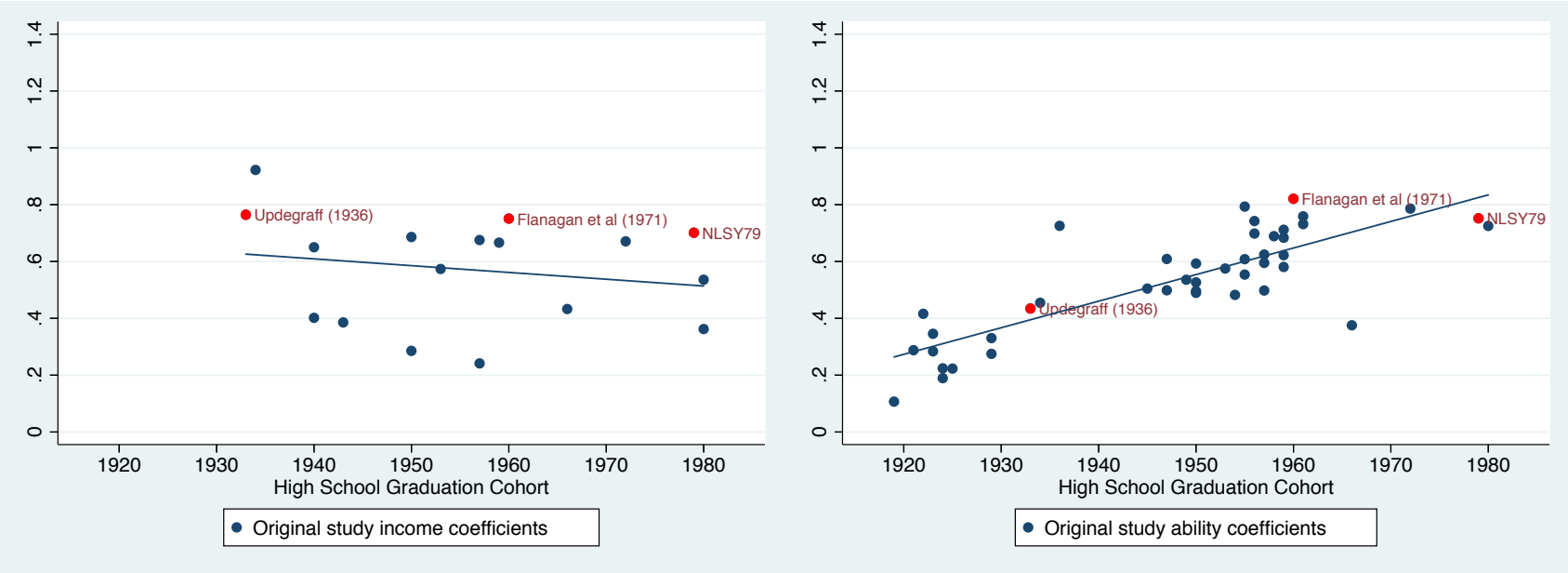
Summarizing Historical Studies

Regress college entry rates on

- ability percentile $\rightarrow \beta_A$
- family background percentile $\rightarrow \beta_F$

Percentiles are bin midpoints.

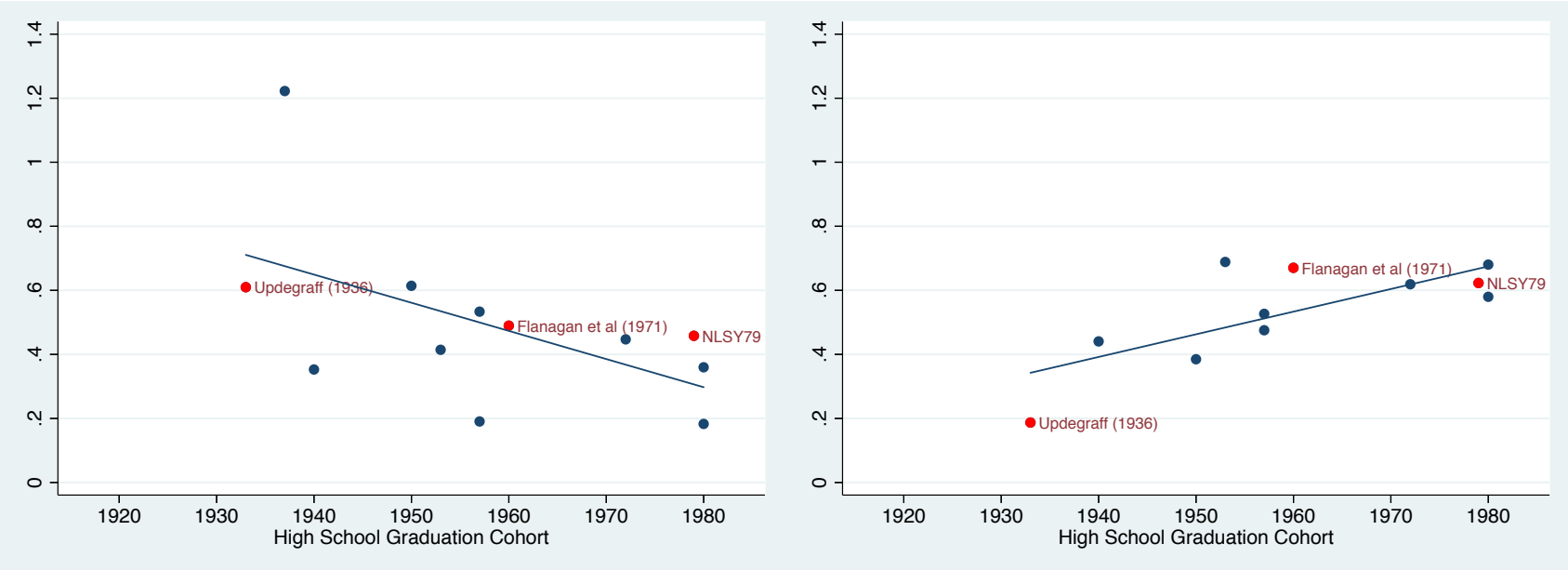
Importance of Background vs. Ability



Family background Ability

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

Importance of Background vs. Ability



Family background Ability

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

Comparability

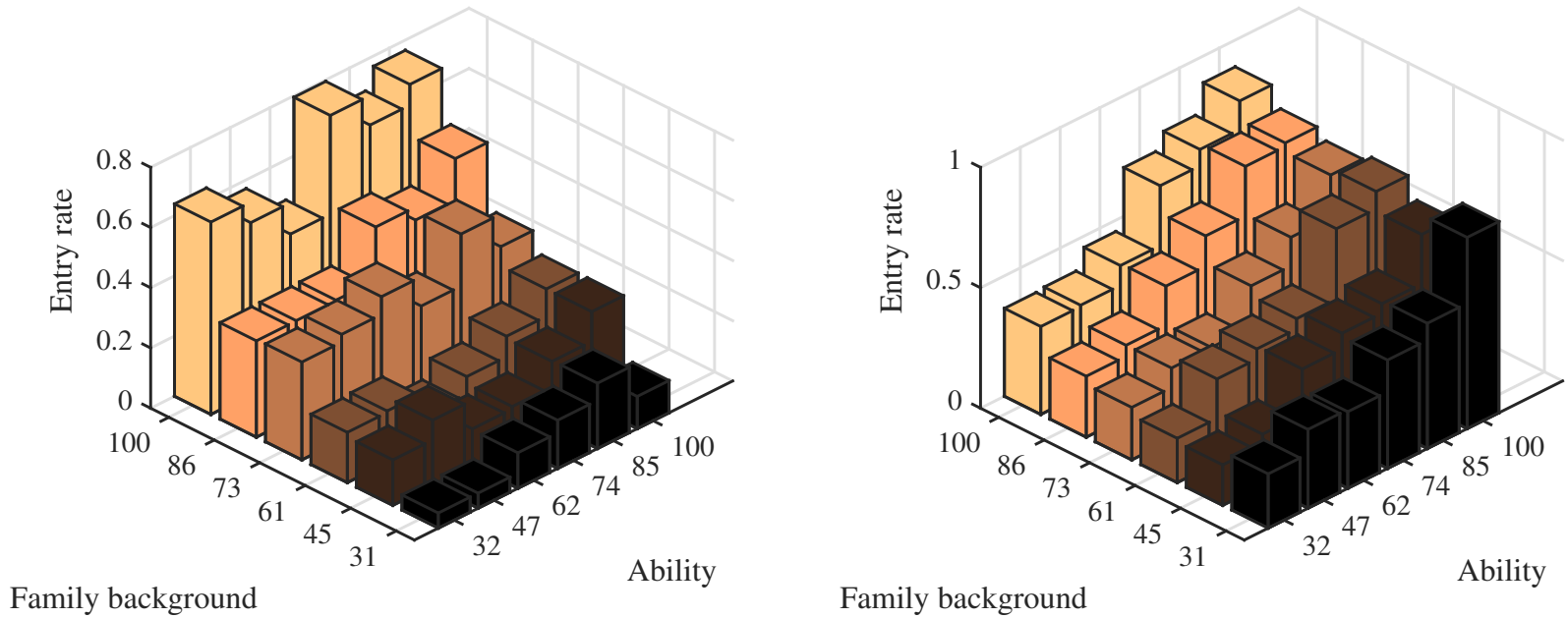
Histories studies differ in

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

Does lack of comparability affect the results?

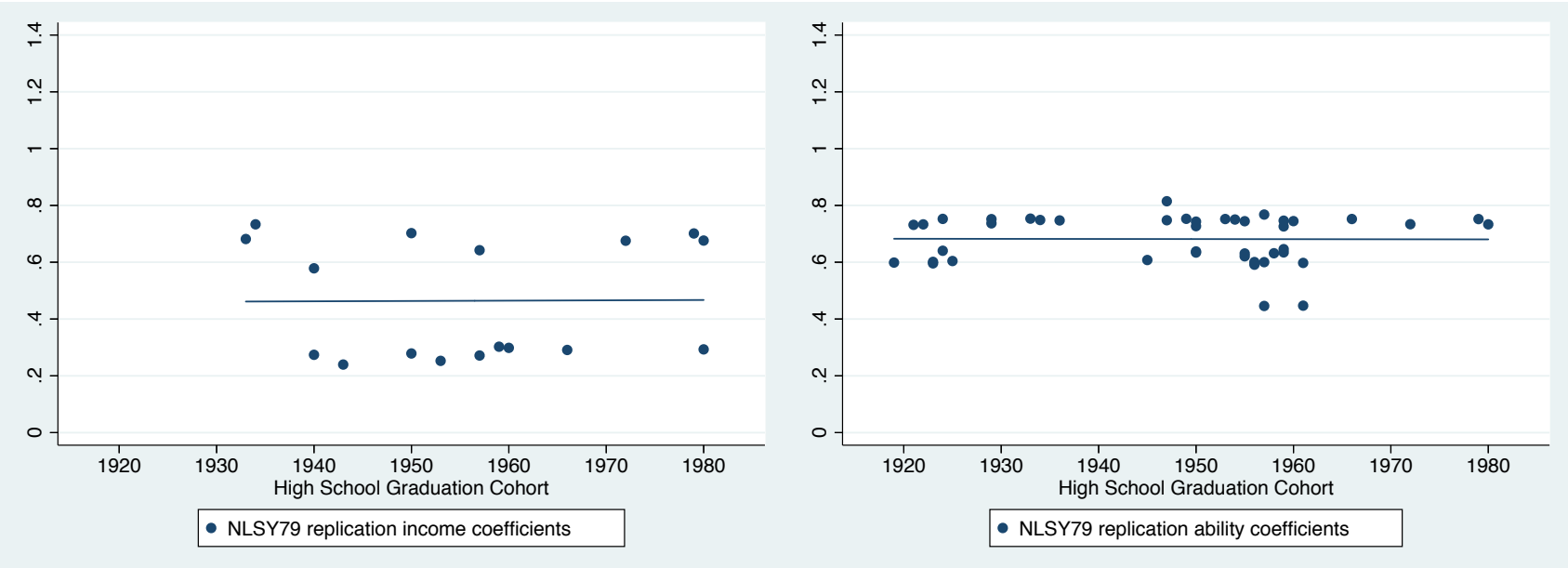
To address this problem, we replicate each study in NLSY79 data.

Example: Updegraff (1936)



Entry rates: Updegraff (1936) and NLSY replication.

NLSY Replication Results



Variation in study design does not systematically affect β_A or β_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 (HSG).
   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:
   learn whether student graduates
4. Years 3-4 in college:
   similar to years 1-2
5. Work as CG 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 p
- ability signal m
- preference for college (details below)

Ability x is not observed until the start of work.

College Entry Decision

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

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

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

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

College Entry Decision

Value of working as HSG:

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

Divide parental income y_p between

- transfer to the child z
- parental consumption $y_p - z$

Value of college entry:

$$V_{entry}(j) = \max_{z_c \geq 0} T_c u_p(y_p - z_c) + V_1(T_c z_c, j) \quad (3)$$

Years 1-2 In College

$$V_1(k,j) = \max_{k',c,l} (1+\beta)\, u\left(c+\bar{c}_j, 1+\bar{l}_j - l\right) + \beta^2 V_m\left(k', j\right) \qquad (4)$$

subject to

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

Continuation value:

$$V_m(k,j) = \mathbb{E}_x\left[\left(1-\pi[x]\right) V_w(k,x,CD) + \pi[x]\, V_3(k,j)\right] \qquad (5)$$

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

- prevents high ability students from consuming too much in college

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

Work Phase

State vector:

- assets (or debts) k
- ability x
- schooling $s \in \{HSG, CD, CG\}$

Household problem:

$$V_w(k,x,s) = \max_{c_a} \sum_{a=1}^{A-A_s} \beta^{t-1} u_w(c_a) \tag{6}$$

subject to a lifetime budget constraint

$$\sum_{a=1}^{A-A_s} R^{1-a} c_a = Y(s,x) + Rk \tag{7}$$

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

Colege **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

Calibrated Parameters

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

▸ Details

Fit

▸ College entry ▸ College graduation

Time-Varying Parameters

Parameter	Target
Mean college cost	Mean college cost
Borrowing limit	Federal student loan limits
Parental altruism	Share of college costs paid by "family c
$\bar{Y}(s)$	Median lifetime earnings by scho
Preference for work as HSG, $\bar{\eta}$	College enrollment

also target: entry rates by iq, yp +++

Results

College Entry Over Time

We characterize changes in college entry patterns by regressing entry rates on IQ and y_p quartiles.

$\rightarrow \beta_A, \beta_F$

	β_{IQ}	β_{yp}
Baseline		
Model	0.70	0.04
Data	0.71	0.07
Cohort 1940		
Model	0.54	0.15
Data	0.70	0.48
Cohort 1915		
Model	0.33	0.16
Data	0.21	0.68

Result: financial conditions account for x% of the variation in ability sorting, y% of the variation in income sorting

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

Table: regression coefficients for each change (1915 and 1940 cohort)

	Cohort 1961		Cohort 1961	
	β_{IQ}	β_{yp}	β_{IQ}	β_{yp}
Change college costs	0.70	0.04	0.70	0.04
Change borrowing limit	0.65	0.09	0.65	0.08
Change earnings profiles	0.29	0.25	-0.00	-0.00
Change parental altruism	0.33	0.18	-0.00	-0.00
Change college entry	0.33	0.16	0.54	0.15

Upshot:

- most of the change in IQ sorting is due to college premium
- same for yp sorting, but there borrowing limits play a role

Conclusion

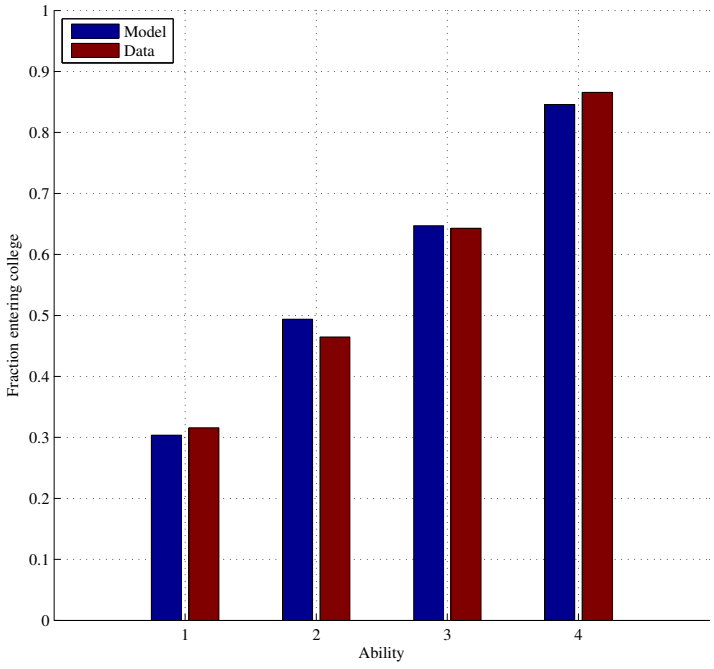
x

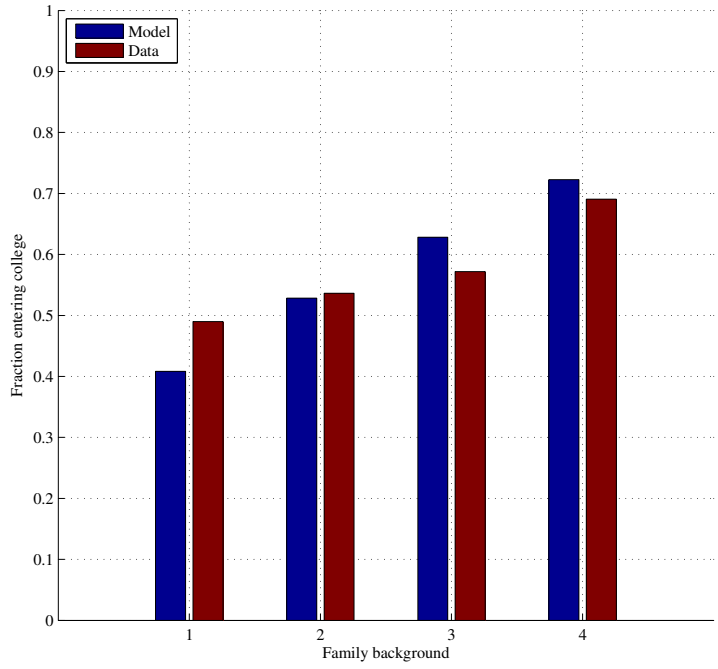
Detail Slides

Calibrated Parameters

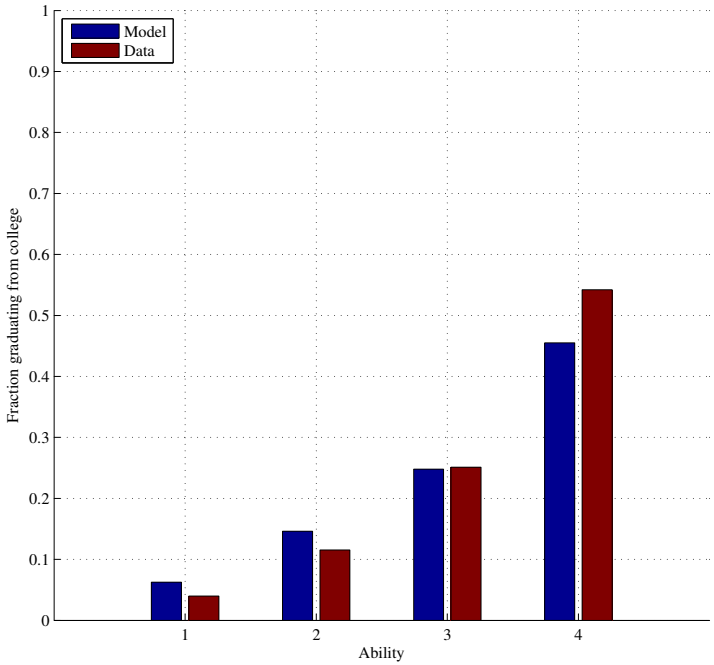
Parameter	Description	
Endowments		
$\alpha_{p,y}, \alpha_{p,m}, \alpha_{y,m}, \alpha_{\omega,m}$	Endowment correlations	$-0.06, 0.34, 0.4$
$\alpha_{a,m}$	Correlation, a, m	
μ_p, σ_p	Marginal distribution of p	3
σ_{IQ}	IQ noise	
Preferences		
ω_l	Weight on leisure	
ω_w	Weight on u(c) at work	
φ_p	Curvature of parental utility	
$\mu_{\omega,p}$	Weight on parental utility	
$\sigma_{\omega,p}$	Std of weight on parental utility	
$\bar{\eta}$	Preference for HS	
$MaxcColl$	Max free consumption	
$MaxlColl$	Max free leisure	
Other		
$\hat{es}$	Log skill prices	-0.05, -0.01

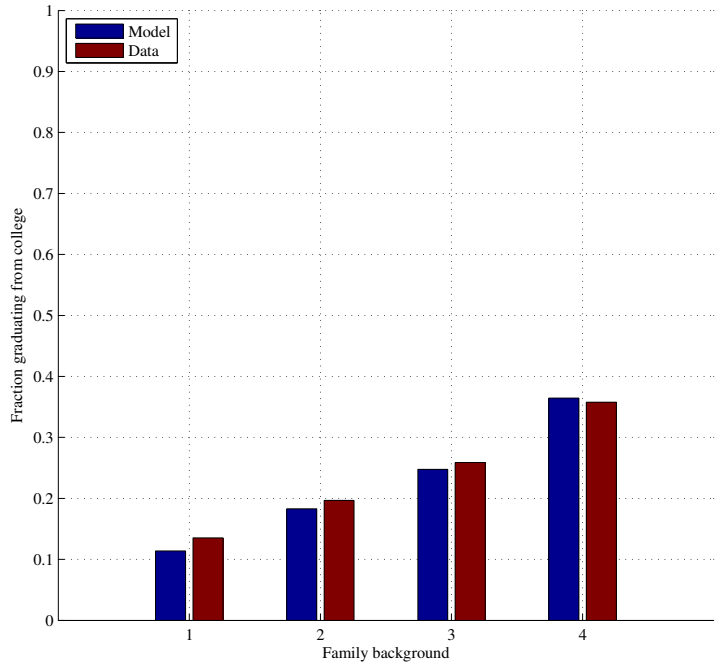
College Entry Rates





College Graduation Rates





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