

The Inframarginal Returns to College

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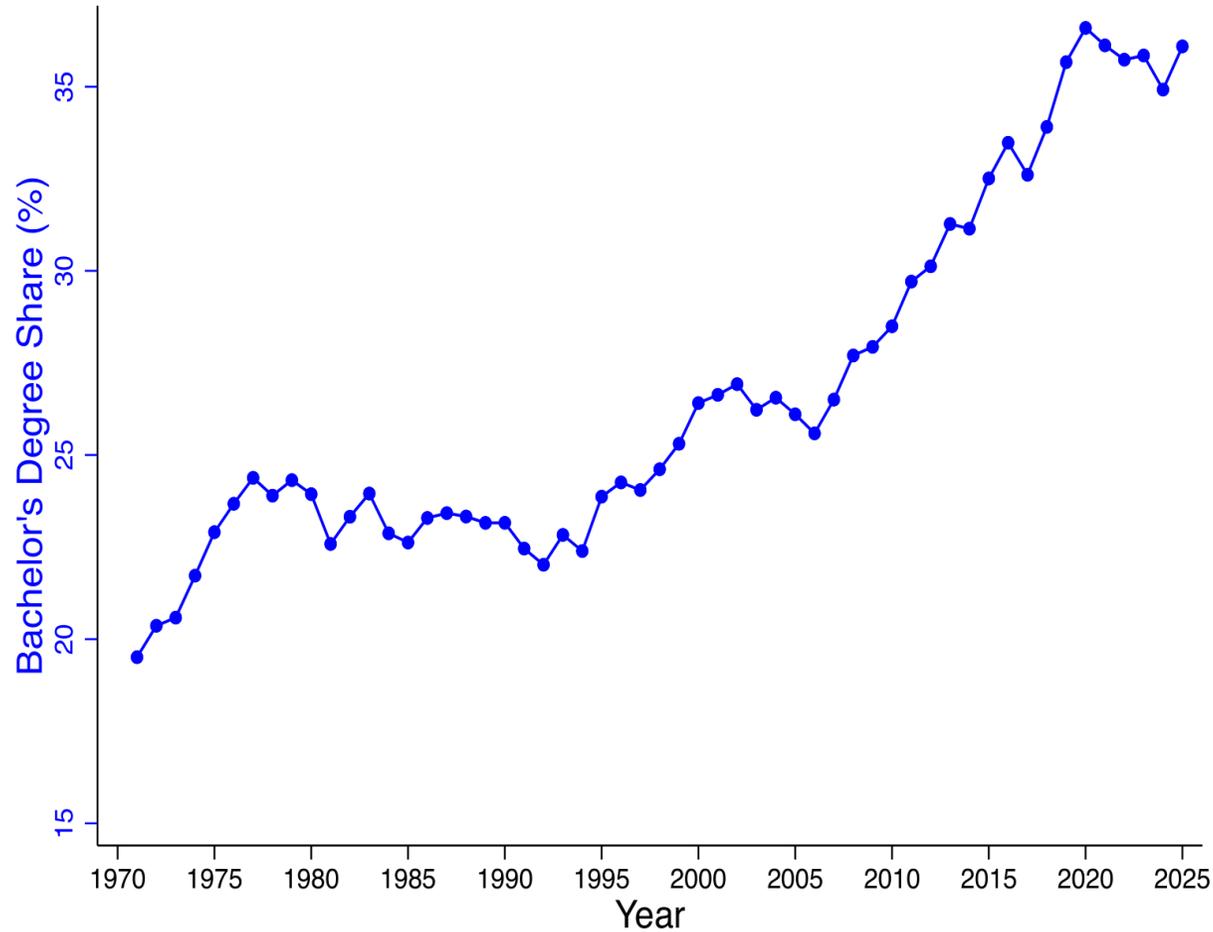
Prelude

- Large academic literature finding positive returns to a college degree on the margin.
 - Zimmerman (JoLE 2014) “*The Returns to College Admission for Academically Marginal Students*”
 - Uses cutoff at admissions thresholds for a large public university in Florida and finds marginally admitted students earn 22% more 8-14 years after high school completion.
 - Mountjoy (QJE 2025) “*Marginal Returns to Public Universities*”:
 - Uses cutoff at admissions thresholds to compute the return (in dollars) to being admitted to two- and four-year public universities in Texas. Finds marginally admitted student has 9% higher lifetime income.
- Expanding access to college (either four year or two year) is a key policy objective of many politicians.
- However, for most policy and understanding aggregate shifts, what is important is not the return to college “*on the margin*” . What is important for large changes in policy is how the *infra-marginal* respond.

This Paper

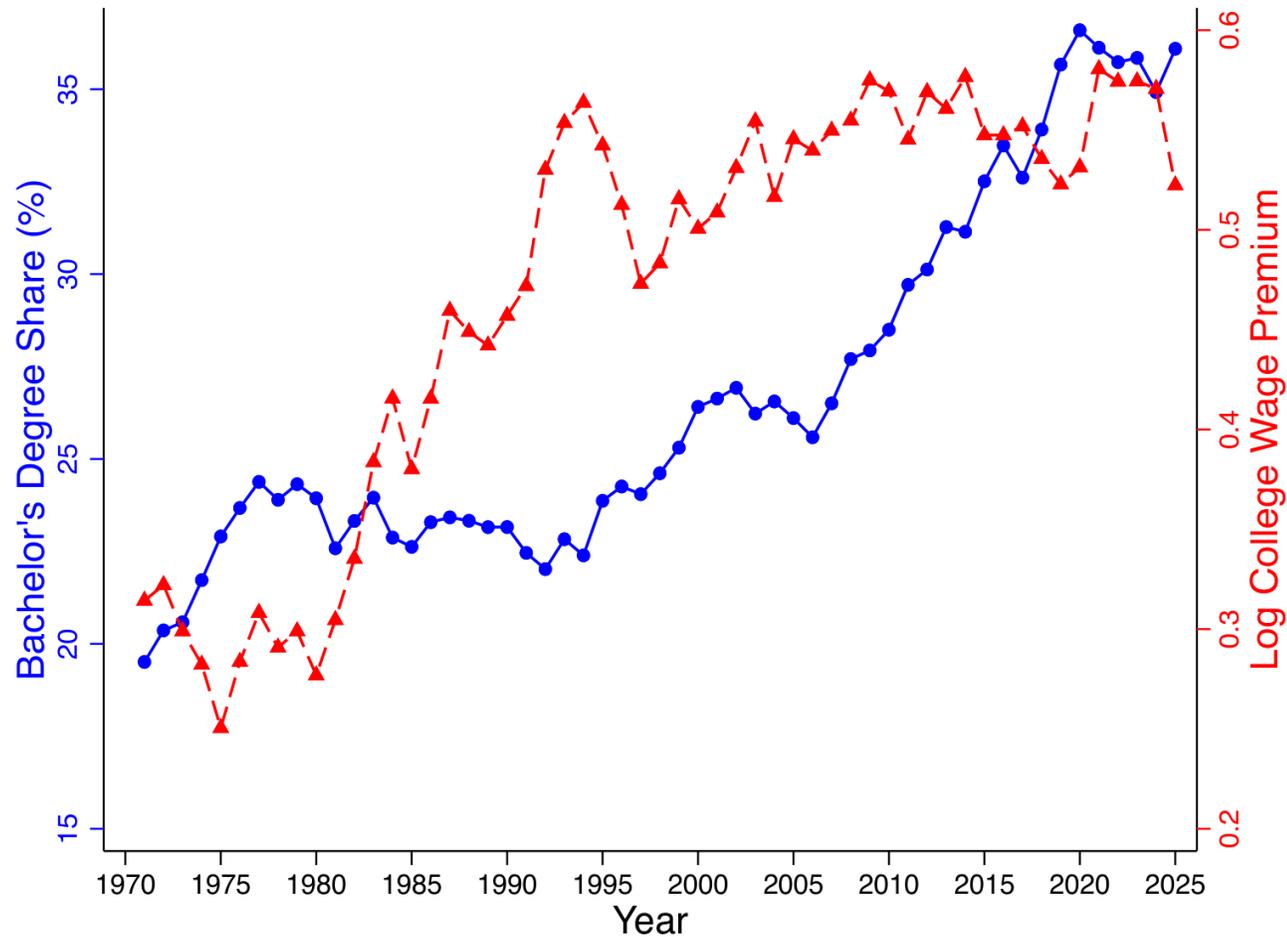
- **Assess the returns to college (2 year and 4 year) for individuals away from the margin so as to understand the impact of large policy changes. Paper has five parts.**
 1. *Develop an equilibrium model of the decision to attend college (inspired by Willis-Rosen 1979).*
 - Occupational and educational choice model with rich occupational and individual heterogeneity.
 - College attendance is costly along many dimensions (money, effort, etc.). Liquidity constraints can bind.
 - Occupations differ in their productivity and the extent they reward four year and two year education.
 2. *Use a variety of micro data sources to pin down key parameters and elasticities within the model.*
 3. *Show the model is consistent with a variety of untargeted moments (including recent estimates of the marginal returns to education).*
 4. *Use the model to compute the welfare gains of various policies designed to expand access to college education.*
 5. *Use the model to explain the evolution of college attainment from 1980-2020.*

Trends in College Attainment Over Time: Men 25-34 (CPS)



- Little change in bachelor share in the 1980-2000 period
- Large change in bachelor share in 2000-2020 period

Trends in College Attainment Over Time: Men 25-34 (CPS)



- Little change in bachelor share in the 1980-2000 period – *yet huge increase in skill premium.*
- Large change in bachelor share in 2000-2020 period – *little change in the skill premium during this period.*

Some Key Findings

- Policies that dramatically reduce the costs of college education will have little effect on college completion or individual welfare. Given costs, these broad based policies have a negative rate of return. [Note: Our analysis (so far) is taking existing policies as given.]
- The benefits of expanding policies accrue to high income individuals who are already going to college.
- Model can replicate the modest marginal income effect of policies that expand policies for marginal individuals (consistent with the literature).
- Importantly, model highlights that income response to college (either on the margin or for infra-marginal individuals) are not overly informative about the welfare effects of college. *College is also costly in both terms of time and effort.*
- Key quantitative findings: (i) *Many individuals have small income gains from college given their absolute and comparative advantage* and (ii) *Tuition costs represent only a small portion of the total costs of going to college faced by individuals*, These results explain why a broad based expansion of college tuition subsidies will have small effects on college going policies.

Model

Model Overview

- *Individuals indexed by i* ; rich individual heterogeneity
- *Occupations indexed by o* (there is a total of O occupations); rich occupational heterogeneity
- Individuals choose:
 - Whether or not to go to college (E) and how much college to get ($E=\{1,2,3\}$)
 - $E = 1$ is no-college*
 - $E = 2$ is some college (no bachelors degree)*
 - $E = 3$ is a bachelors degree or more*
 - Which occupation o to work in conditional on college decision.
 - How much effort to invest in human capital accumulation (S), effort is costly in utility terms.
- Model is static: Variation across time (t) should be considered different steady states of the model.

Model Overview: Heterogeneity Across Individuals

- *What Individuals “Draw”* (i.e., what defines an individual)
 - **Absolute Advantage:** α_i (drawn from a distribution with a variance of σ_α)
 - **Comparative Advantage:** ϕ_{io} (O draws – drawn from distributions with a shape parameter σ_ϕ)
 - **Cost of College:** ε_{iE} (drawn from distribution with a shape parameter $\sigma_{\varepsilon E}$)
- Extension: Will allow for absolute and comparative advantages correlation ($\text{corr}(\alpha_i, \phi_{io})$ for all o)

■ **Summary: Individual i is defined by the vector of draws:** $(\alpha_i, \phi_{i1}, \phi_{i2}, \dots, \phi_{iO}, \varepsilon_{i2}, \varepsilon_{i3})$

- We have **4 parameters** that determine the key elasticities in our model ($\sigma_\alpha, \sigma_\phi, \sigma_{\varepsilon 2}, \sigma_{\varepsilon 3}$): *The shapes of these four distributions will determine both the marginal and inframarginal responses to model driving forces.*

Model Overview: Occupational Heterogeneity and Individual Choices

- Define “*worker accumulated human capital*”: $S_{i(E,o,t)}$ and “*worker skill*”: $\alpha_i (1 + S_{i(E,o,t)})$
 - *S will be time investments made by individual in human capital accumulation. Will depend on their education choice (E), occupation choice (o) and time period. Define S formally on upcoming slides.*
 - **Occupations (o) differ in:**
 - Their overall occupational productivity (or demand) which affects all workers (β_{ot}).
 - The occupational return to worker skill for the three types education groups ($\gamma_{1ot}, \gamma_{2ot}, \gamma_{3ot}$).
 - The cost associated with going to different colleges for that occupation ($\kappa_{2ot}, \kappa_{3ot}$)
- **Occupation o is defined by the vector:** $(\beta_{ot}, \gamma_{1ot}, \gamma_{2ot}, \gamma_{3ot}, \kappa_{2ot}, \kappa_{3ot})$

Individual Utility

- Individuals maximize utility:

$$\max_{o,S,E \in \{1,2,3\}} U_{iot}^E = \frac{W_{i(E,o,t)} (1 - S_{i(E,o,t)})^{\psi_E}}{\left(K_{Eot} \mathcal{E}_{iE} \right)^{I_{E=2,3}}}$$

- $W_{i(E,o,t)}$ is the wage individual i will earn if they choose to get education E and work in occupation o in period t (define in next slides). Higher wages means higher utility.

Individual Utility

- **Individuals maximize utility:**

$$\max_{o,S,E \in \{1,2,3\}} U_{iot}^E = \frac{W_{i(E,o,t)} (1 - S_{i(E,o,t)})^{\psi_E}}{\left(K_{Eot} \mathcal{E}_{iE} \right)^{I_{E=2,3}}}$$

- $S_{i(E,o,t)}$ is the time effort that individual i puts into accumulating human capital prior to working (i.e., during their “school stage”). Depends on their choice of schooling (E), occupation (o) and time period (t).
- Think of $1-S$ as “leisure” in a schooling pre-period. ψ_E governs the disutility of effort in that pre-period.
- Allow disutility to differ by college choice (ψ_E). May be more unpleasant to accumulate human capital for bachelor’s degree than for some college or for no-college ($\psi_3 > \psi_2 > \psi_1$)
- Individuals choose a level of S for all education options (i.e., even if they do not go to any college). *Will trade off the disutility relative to the returns of accumulating human capital.*

Individual Utility

- **Individuals maximize utility:**

$$\max_{o,S,E \in \{1,2,3\}} U_{iot}^E = \frac{W_{i(E,o,t)} (1 - S_{i(E,o,t)})^{\psi_E}}{\left(\kappa_{Eot} \varepsilon_{iE} \right)^{I_{E=2,3}}}$$

- $I_{E=2,3}$ is an indicator variable that takes the value of 1 if the individual choose to go to any college (either some college ($E=2$) or a bachelors degree ($E=3$)).
- If they go to college, they get disutility from their idiosyncratic draw of college cost (ε_{iE}) and have an occupation and education specific college cost which can vary over time (κ_{Eot})
- κ_{Eot} can represent both out of pocket monetary costs of college (tuition, fees, etc.), living expenses during college, and any psychic costs that vary systematically across occupation-education groups. For example, it may be harder in terms of effort to get a degree in engineering than a degree in art.
- Stress that tuition costs are only one part of κ_{Eot} .

Individual Utility

- **Individuals maximize utility:**

$$\max_{o,S,E \in \{1,2,3\}} U_{iot}^E = \frac{W_{i(E,o,t)} (1 - S_{i(E,o,t)})^{\psi_E}}{\left(K_{Eot} \varepsilon_{iE} \right)^{I_{E=2,3}}}$$

- ε_{iE} individual's idiosyncratic cost of going to get a bachelors degree (E=3) or getting some college (E=2)
- Proxies for both idiosyncratic “psychic” costs of going to college (hard to study) as well as potential constraints (like not being able to afford college tuition).
- *Note: In future versions, we plan to distinguish preferences from constraints. Not doing that today. Will talk more about potential decomposition below.*

Wages

- Wages ($W_{i(E,o,t)}$) differ by occupation and depends on education level ($E=1,2,3$).

$$W_{i(o,E,t)} = A_{Et} \beta_{ot} \left[\alpha_i \left(1 + S_{i(o,E,t)} \right) \right]^{\gamma_{ot}^E} \phi_{io}$$

- Each occupation faces an occupational level productivity (or demand) β_{ot} . A higher β_{ot} will raise the wages of all individuals in occupation o , holding their levels of talent and human capital fixed.
- β_{ot} can vary across occupations and over time. The extent that occupational productivities vary over time will be one of the key driving forces in our model.

Wages

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$$W_{i(o,E,t)} = A_{Et} \beta_{ot} \left[\alpha_i \left(1 + S_{i(o,E,t)} \right) \right]^{\gamma_{ot}^E} \phi_{io}$$

- ϕ_{io} is the *occupational talent* of worker i in occupation o (their comparative advantage). Higher *occupational talent* raises wages in that occupation.

Wages

- Wages ($W_{i(E,o,t)}$) differ by occupation and depends on education level ($E=1,2,3$).

$$W_{i(o,E,t)} = A_{Et} \beta_{ot} \left[\alpha_i (1 + S_{i(o,E,t)}) \right]^{\gamma_{ot}^E} \phi_{io}$$

- Worker skill: $\alpha_i(1+S_{i(o,E,t)})$ where α_i is the *innate skill* of individual i (absolute advantage) and $S_{i(o,E,t)}$ is *accumulated human capital*.
- γ_{Eot} is the return to skill in occupation o for education group E in year t .
 - Skill may be rewarded differently across occupations. Overall skill may be rewarded more as lawyers relative to retail clerks.
 - Going to college may be more valuable in some colleges (relative to no college). For example, $(\gamma_{3ot} - \gamma_{1ot}) > (\gamma_{3o't} - \gamma_{1o't})$. Going to college may give a large boost in productivity as a doctor but may have a smaller boost in productivity as a waiter.
- Movements in γ_{Eot} over time can will be a primitive driving force in our model (skill premium shocks).

Wages

- Wages ($W_{i(E,o,t)}$) differ by occupation and depends on education level ($E=1,2,3$).

$$W_{i(o,E,t)} = A_{Et} \beta_{ot} \left[\alpha_i \left(1 + S_{i(o,E,t)} \right) \right]^{\gamma_{ot}^E} \phi_{io}$$

- A_{Et} : Aggregate (non-occupational) productivity that is common across education groups.
- Normalization to match the level of wages in the data (pins down level of $A_{E=1,t}$). In calibration, normalize $A_{E=2,t} = A_{E=3,t}$ to the value of $A_{E=1,t}$
- Having the $A_{E,t}$'s will be useful for some counterfactuals in model (allows us to analyze skill demand shocks).

Individual Utility Maximization: Choose Occupation, Education and Accumulated Human Capital

$$\max_{o \in O, S \in [0,1], E \in \{1,2,3\}} \ln U_i = \ln A_{E,t} + \ln \beta_{ot} + \gamma_{ot}^E \ln(1 + S_i) + \gamma_{ot}^E \ln \alpha_i + \ln \phi_{io} \\ + \psi_E \ln(1 - S_i) - I_E \ln \kappa_{Eot} - I_E \ln \varepsilon_{iE}$$

- **FOC**: $S_{i(o,E,t)}^* = \frac{\gamma_{ot}^E - \psi_E}{\gamma_{ot}^E + \psi_E}$ *[Same for all individuals who choose o and E]*
- Time allocated to human capital development is increasing in γ_{Eot} 's. Occupations with higher γ_E will offer higher wages for that level of E . Workers need to be compensated for their time inputs. Wage variation across occupation groups and education groups will help pin down the γ_{Eot} 's.
- **Define**: $\hat{\gamma}_{ot}^E = \gamma_{ot}^E \ln \left(\frac{2\gamma_{ot}^E}{\gamma_{ot}^E + \psi_E} \right) + \psi^E \ln \left(\frac{2\psi_E}{\gamma_{ot}^E + \psi_E} \right)$

Putting it All Together: Log Utility

- Non-College Utility (E=1):

$$\ln U_{i(E=1,o,t)} = \underbrace{\left[\ln A_{E=1,t} + \ln \beta_{ot} + \hat{\gamma}_{ot}^{E=1} \right]}_{\ln V_{ot}^{E=1}} + \gamma_{ot}^{E=1} \ln \alpha_i + \ln \phi_{io}$$

- Some College Utility (E=2):

$$\ln U_{i(E=2,o,t)} = \underbrace{\left[\ln A_{E=2,t} + \ln \beta_{ot} + \hat{\gamma}_{ot}^{E=2} - \ln \kappa_{ot}^{E=2} \right]}_{\ln V_{ot}^{E=2}} + \gamma_{ot}^{E=2} \ln \alpha_i + \ln \phi_{io} - \ln \varepsilon_{i,E=2}$$

- College Utility (E=3):

$$\ln U_{i(E=3,o,t)} = \underbrace{\left[\ln A_{E=3,t} + \ln \beta_{ot} + \hat{\gamma}_{ot}^{E=3} - \ln \kappa_{ot}^{E=3} \right]}_{\ln V_{ot}^{E=3}} + \gamma_{ot}^{E=3} \ln \alpha_i + \ln \phi_{io} - \ln \varepsilon_{i,E=3}$$

Model Driving Forces and Data Moments

- **Driving forces (change over time):**

β_o , γ_{Eo} , κ_{Eo} \forall O and E (in each t) [*these are things we will change in our counterfactuals*]

Normalize β in one of the occupations to 1 (model identifies relative β 's)

*Have $6*O - 1$ parameters (in each t)*

- **Note:** Given distributional assumptions, data on (i) *share of workers in each occupation*, (ii) *educational composition of workers within each occupation*, (iii) *average wage of workers in each occupation*, (iv) *wage gap across education groups within each occupation* can be used to pin down driving forces.

*Have $6*O - 1$ data moments (in each t)*

Distributional Assumptions

- **Distributional Assumptions Are Most Important Part of Model Quantification**

- *Determine both the marginal and inframarginal response to changes in model driving forces (or, eventually policy)*

- Assume distributions of skill (α_i), talent (ϕ_{io}), and idiosyncratic college costs (ε_{iE}) drawn from *time invariant distributions* such that:

- α_i is drawn from a log-normal distribution with variance σ_α

- ϕ_{io} is drawn from a Frechet distribution with shape parameter σ_ϕ (common across occ's)

- ε_{iE} are drawn from Frechet distributions with shape parameters $\sigma_{\varepsilon E}$ (two draws)

- **Use a variety of additional micro data variation to estimate these key distributional parameters.**

Data/Calibration

Approach

- *Input 1: Use data on occupational choice, education choice and wages from the 1980, 1990, and 2000 U.S. Censuses and the 2005-2019 American Community Surveys (ACSs) . Focus on men aged 25-34.*
- *Input 2: Bring in data from the NLSY-79 and NLSY-97 cohorts.* Use AFQT test scores in NLSY as a measure of ability (α_i). Allow us to get conditional moments of occupational choice, education and wages by measures of ability (again for young men).
- *Input 3: Use regional variation and shocks to occupational demand to trace out how college attendance responds.* Useful variation to pin down key distributional parameters because such variation traces out how marginal and inframarginal individuals respond with college decisions in response to shocks that can easily be mapped to the model. Helps pin down the distributional parameters of the cost distributions.
- Jointly use all inputs to pin down key model parameters and elasticities (i.e., via SMM).

Input 1:
Education, Wages and Employment
Shares of the Occupation Groups

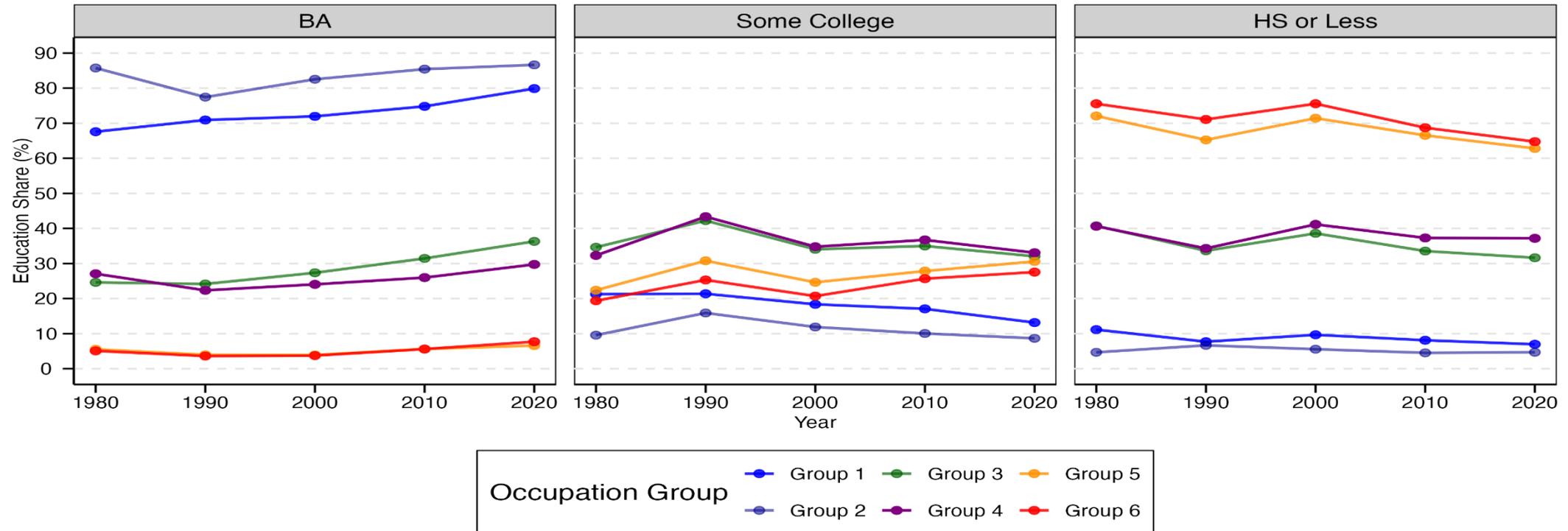
Creating Occupational Groups (Census/ACS Data)

- *Define 6 broad occupation groups.* Segment the occupations by education composition of its workers and the average income of its workers (pool years together).
- *Why create occupation groups?* Reduce the dimensionality of the data. Assumes perfect substitutability within groups but some distinction across groups.
- Education Split: Segment occupations into three education groups. Focus on men aged 25-34.
 - Step 1: Sort occupations by their bachelor share of workers. Define “**Education Group 1**” as those occupations with the highest bachelor share comprising 30% of the total workforce.
 - Step 2: Sort occupations by high school (or less) share. Define “**Education Group 3**” as those occupations with the highest high school or less share comprising 30% of total workforce.
 - Step 3: Define all other occupations (40% of workers) as “**Education Group 2**”.
- Income Split: Segment occupations in the above three education groups into high and low income. Regress log income on years of schooling for workers in each education group. Take those with positive (negative) residuals and call them high (low) income occupations within the education group.

Occupational groupings: 6 groups

- **Group 1: High Education/High Income.** Primarily includes doctors, lawyers, CEOs, engineers, finance, senior business leaders, pilots, economists, advertising, software developers
- **Group 2: High Education/Low Income.** Primarily includes teachers (primary and high school), writers, artists, clergy, social workers, therapists, other nurses, dental hygienists, librarians
- **Group 3: Mid Education/High Income.** Primarily includes scientific/medical technicians, police, fire, various supervisors in manufacturing or repair, postal workers, sales supervisors and sales reps
- **Group 4: Mid Education/Low Income.** Primarily includes most office positions (secretaries, office clerks), retail clerks/cashiers, bartenders, barbers, guards, cooks, health aids, child care, military
- **Group 5: Low Education/High Income.** Primarily includes all manufacturing positions, heavy equipment operators and repairers, mining, supervisors of construction, plumbers
- **Group 6: Low Education/Low Income.** Primarily includes remaining manufacturing, carpenters, construction, tailors, janitors, mechanics, drivers (taxi, bus, truck), stock clerks, cleaners

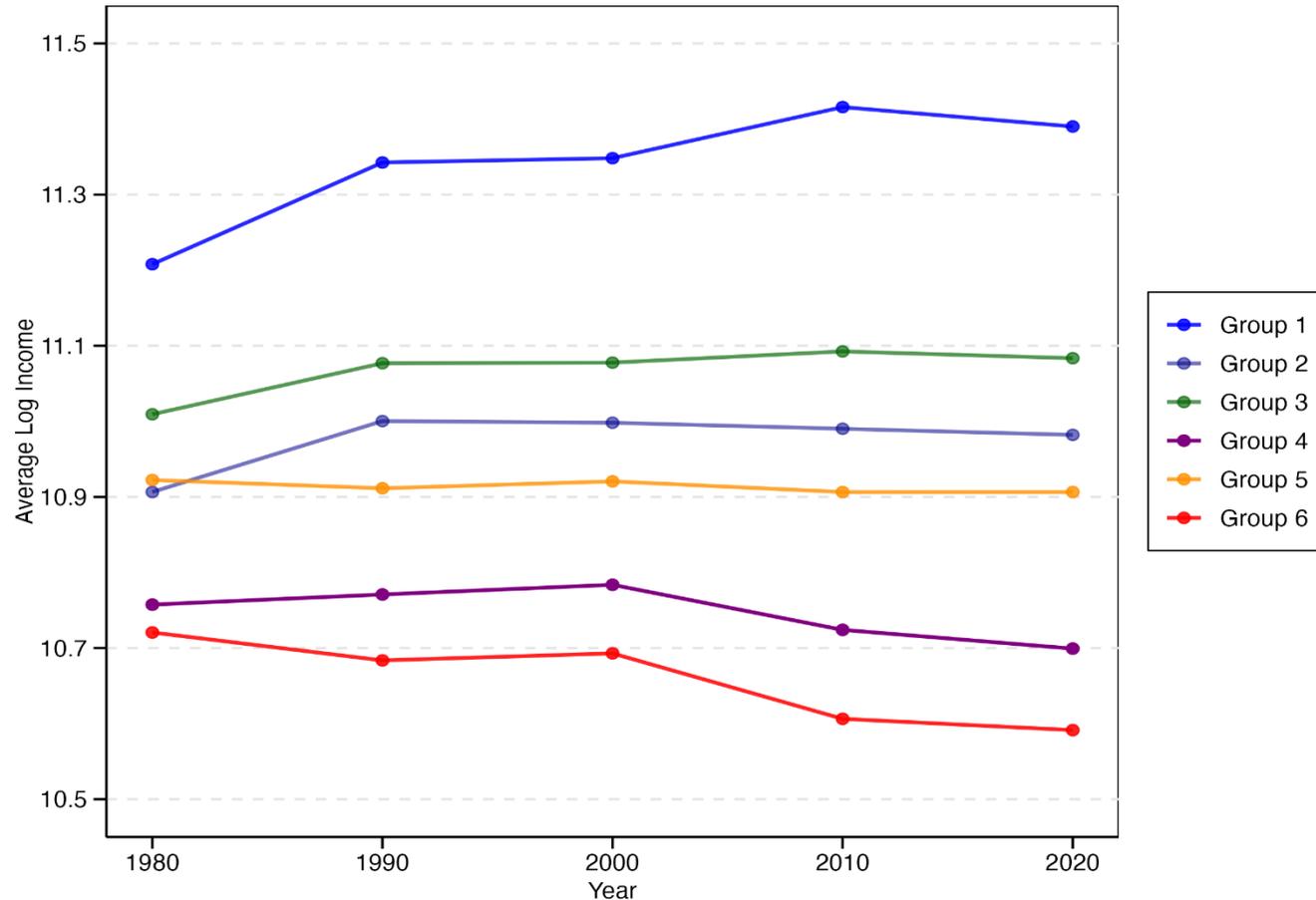
College Composition of Occupation Groups: Men 25-34



■ Notes:

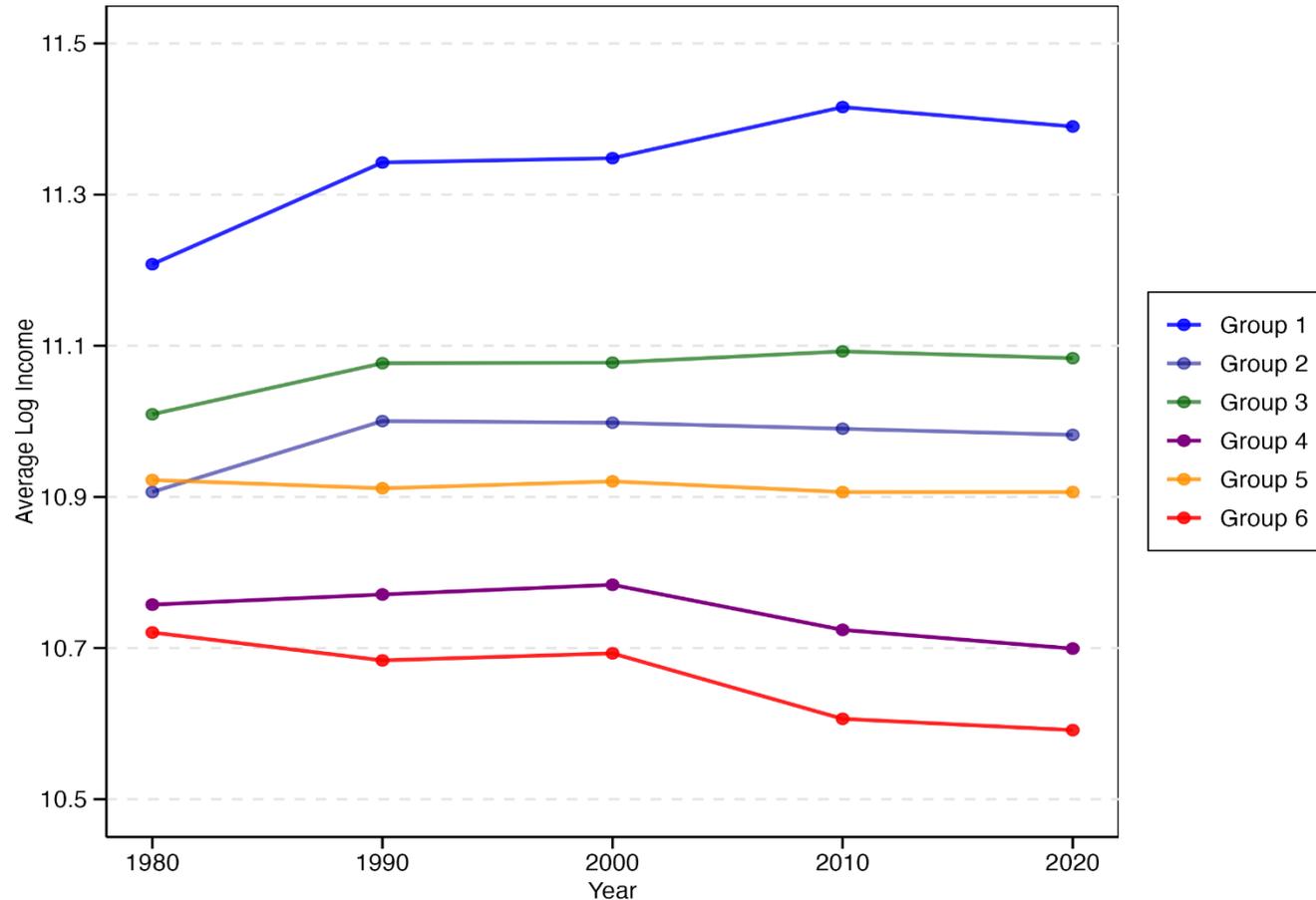
1. *Occupation by education shares are not surprising given the way we defined groups.*
2. *Occupation education shares are relatively constant over time.*

Log Income Across Occupation Groups: Men 25-34



- **Non-monotonic income ranking across education bins.**
- For example, group 3 (e.g., science and medical technicians; manufacturing/sales supervisors; police) is middle education but has higher income on average than group 2 (e.g., teachers and social workers)
- Likewise, group 5 (manufacturers and construction) which is low education makes more on average than group 4 (office workers, etc.)

Log Income Across Occupation Groups: Men 25-34



- **Non-monotonic income ranking across education bins.**
 - For example, group 3 (e.g., science and medical technicians; manufacturing/sales supervisors; police) is middle education but has higher income on average than group 2 (e.g., teachers and social workers)
 - Likewise, group 5 (manufacturers and construction) which is low education makes more on average than group 4 (office workers, etc.)

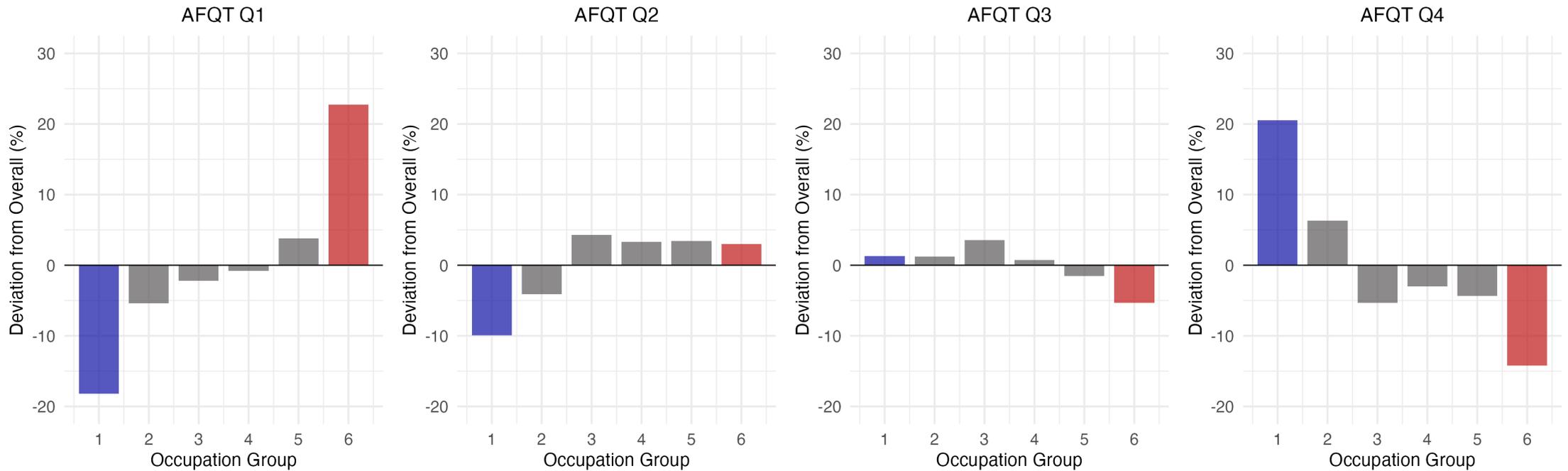
■ **Note: Employment shares of these groups shifted sharply over time**

Input 2:
Use AFQT Data from NLSY

NLSY Data

- Surveys a cohort of individuals who were in their mid-to-late teenage years in 1979 (NLSY79) and then follows them over their lifecycle. A separate cohort was similarly surveyed in 1997 (NLSY97).
- Each of these cohorts was given the armed forces qualifying test (AFQT) in their initial survey wave (basically when they were 15-ish). Can observe outcomes later in their life (~early 30s)
- *We can examine the college attainment rates, occupational choices, and wages of individuals in different AFQT quartiles.* Focus on outcomes for men when they are around 30s.
- *Use as model target when estimating parameters:* Treat AFQT as a proxy for ‘ability’ (α_i) in year t . We will compare NLSY79 data to our model predictions in 1990. We will compare NLSY97 data to our model predictions in 2018.
- The extent to which occupational sorting varies with AFQT will help pin down the dispersion of ability (σ_α).

Occupational Sorting by AFQT Quartiles, NLYS97



- Figure shows the *relative* occupational sorting (compared to overall average) of different AFQT groups.
- **Take away:** Those with high AFQT (AFQT Q4) are much more likely to sort into occupation 1 and much less likely to sort into occupation 6. The reverse is true for those with low AFQT.

Relative Income by Education Group and AFQT Quartile: NLSY

| AFQT or $\phi_{o=1}$ Quartile | NSLY97 Data Relative Income E = 1 | NSLY97 Data Relative Income E = 2 | NSLY97 Data Relative Income E = 3 |
|----------------------------------|---|---|---|
| Q1 | 1.00 (14.7%) | 1.06 (4.9%) | 1.50 (1.2%) |
| Q2 | 1.22 (12.6%) | 1.26 (7.4%) | 1.52 (4.9%) |
| Q3 | 1.25 (7.4%) | 1.37 (8.2%) | 1.48 (10.0%) |
| Q4 | 1.31 (3.4%) | 1.23 (5.0%) | 1.83 (20.4%) |

- **Note 1:** Share of population in each cell in **red parentheses**.
- **Note 2:** Income levels normalized to 1 for AFQT Q1 and E = 1

- *Notes: These moments will be useful in pinning down the dispersion of absolute advantage (σ_α).*

Input 3:
**Use Industry Shocks to See How
Education Responds**

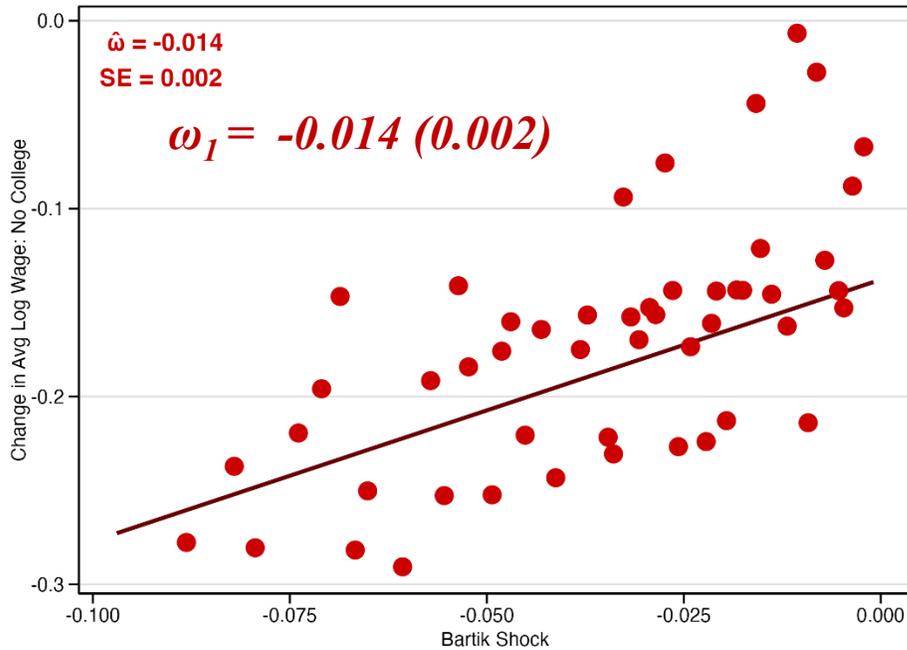
Identification

- Evolving literature showing that local labor demand shocks can affect college attainment (e.g., Charles, Hurst and Notowidigdo: AER 2018 and EJ 2019)
- We will use similar identification to identify the education response of large labor demand shocks on wages (by education group), share with some college, and share with a bachelor's degree.
- Use regional variation (750-ish commuting zones). Use a shift-share design (i.e., Bartik shocks) – interact national changes in 3-digit manufacturing industry m employment share between 2000 and 2010 with m shares in 2000.

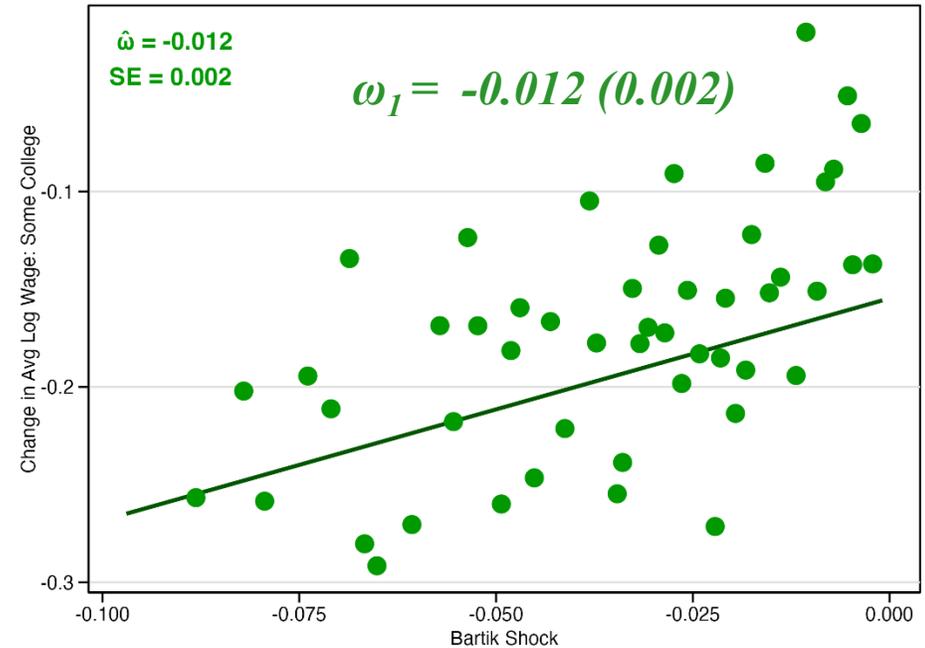
$$\Delta Z_{j,t} = \sum_{m \in M} share_{m,j,t=2000} * (Emp_{m,2010}^{USA} - Emp_{m,2000}^{USA})$$

- Outcome (1): Change of log wages of 25-34 year olds in different education groups between 2000 and 2012 within the commuting zone.
- Outcome (2): Changes in share of 25-34 year olds in different education groups between 2000 and 2012.

Regression 1: $\Delta \ln W_{E,j,t} = \delta_1 + \omega_1^E \Delta Z_{jt} + \xi_{1j}$



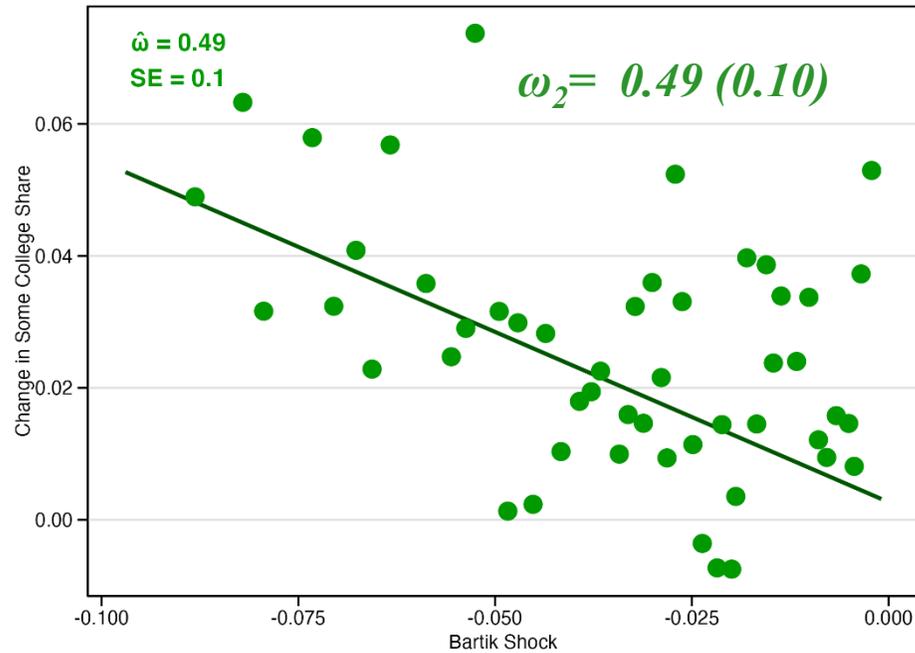
Panel A: Non-College Log Wages



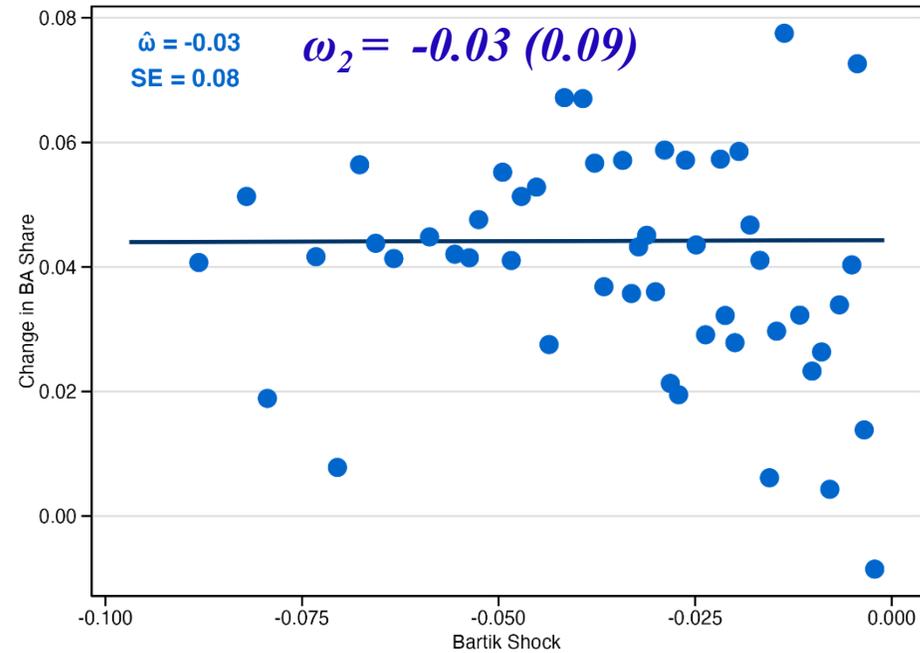
Panel B: Some-College Log Wages

- Outcome (1): Change of log wages of 25-34 year olds in different education groups between 2000 and 2012 within the commuting zone.
- Average ΔZ during this period: -0.039 .
- Implication: Average wage change of non-college men to average Z change: $5.3\% = \Delta \bar{Z}_t \hat{\omega}_1^{E=1}$

Regression 2: $\Delta E_j = \delta_2 + \omega_2^E \Delta Z_{jt} + \xi_{2j}$



Panel A: Share Some College



Panel B: Share Bachelors Degree

- Outcome (1): Change of education share of 25-34 year olds (for different education groups) between 2000 and 2012 within the commuting zone.
- Average ΔZ during this period: -0.039 .
- Implication: Average change in some-college share for men to average Z change: $1.9 \text{ p.p.} = \Delta \bar{Z}_t \hat{\omega}_2^{E=2}$

Mapping to Model

- Summary: Using cross regional variation, the average decline in ΔZ_{jt} (~ 4 p.p.) leads to average decline of wages of non-college men of 5.3% and an increase in the share of men with some college of 1.9 p.p.
- Match such effects within model. In model, A_E 's are education group specific labor demand shocks.
- Step 1: Vary A_E in the model so that it generates a 5.3% average wage decline.
Define that level as: $\widehat{\Delta A_{E=1,1}}$
- Step 2: Given rest of model parameters estimated, chose the level of dispersion of college costs (σ_ε) so that the share of men with some college increases by 1.9 percentage points in response to $\widehat{\Delta A_{E=1,1}}$
- Note: Iterate over this step in model calibration until the estimation converges (SMM).
- Note: Within model, the shock to $\widehat{\Delta A_{E=1,1}}$ has little effect on the share getting a bachelor's degree (just like in the data). *This was an untargeted moment.*

Model Results

Estimates of Parameters for Key Elasticities

- Model matches Census and NLSY data very well (in appendix of slides if interested).

- Model estimates of key elasticity parameters:

[*Absolute Advantage Dispersion*]

- Variance of log normal of α distribution $(\sigma_\alpha) = 0.3$

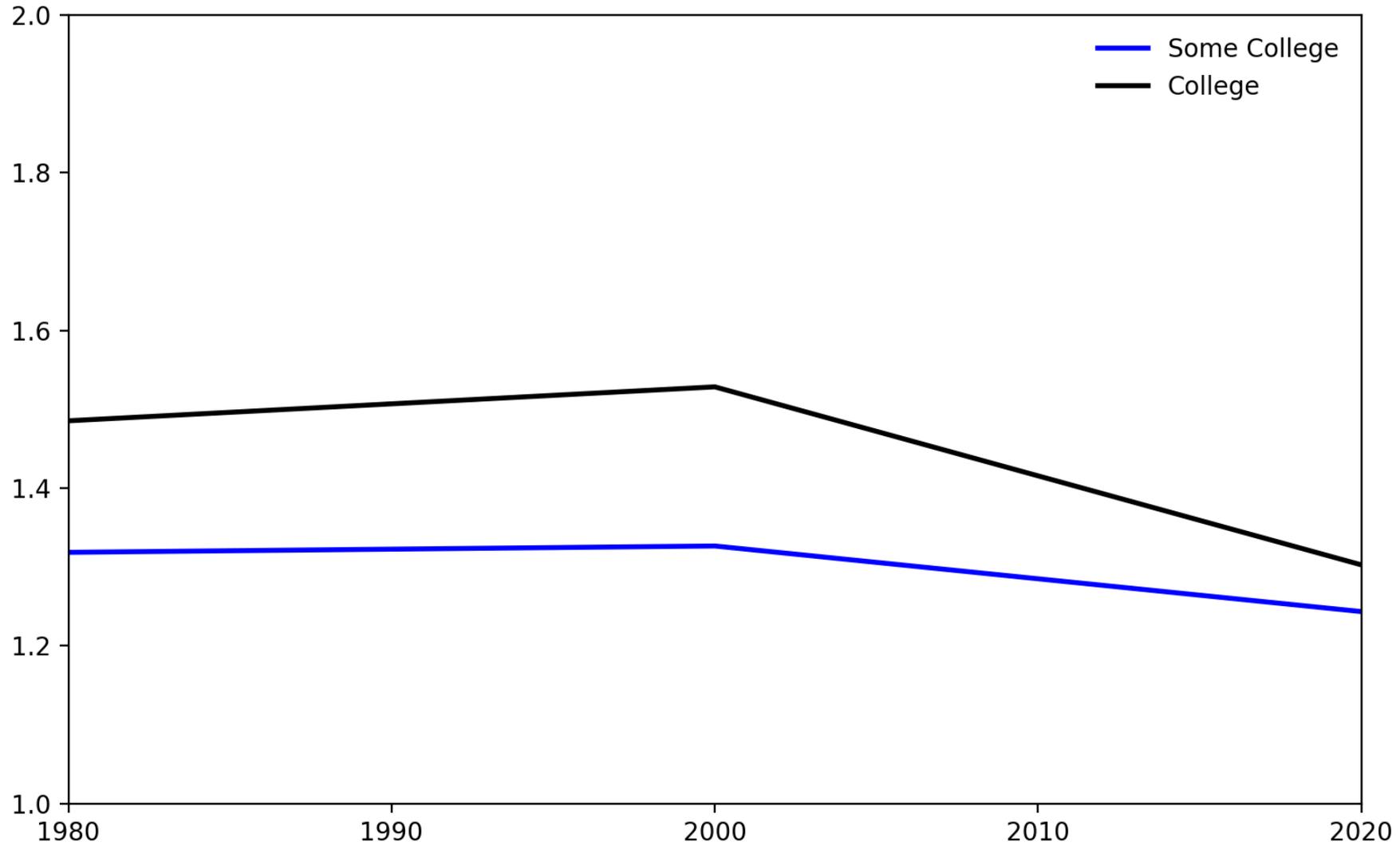
[*Comparative Advantage Dispersion*]

- Shape parameter of Frechet distribution for ϕ 's $(\sigma_\phi \hat{s}) = 5.1$

[*Idiosyncratic College Cost Dispersion*]

- Shape parameter of Frechet distribution of idiosyncratic bachelor cost $(\sigma_{\varepsilon, E=2} \hat{s}) = 1.3$
- Shape parameter of Frechet distribution of idiosyncratic some college cost $(\sigma_{\varepsilon, E=2} \hat{s}) = 2.4$

Model Estimates of Average College Costs (κ_{oE}) By Education



Interpreting “College Costs”

- Composite of the average monetary and average psychic costs associated with going to college (total cost for an individual going to college is $\kappa_{ot} + \varepsilon_{iot}$).
- Tuition is only one part of the average monetary costs (e.g., lost wages should also be important).
- Within the model, the units of the κ 's are the same as the units of wages.
- Median log wage is 11.00 (about \$60,000/year) in 2018. The average worker will get that wage for about 40 years. So, think about lifetime earnings for the median worker being about \$2.4 million.
- *Average $\kappa_{o,E=3} = 1.4$* . Implies costs for bachelors for occ 1 are roughly 1.4/11 of \$2.4 million which is about **\$300,000** (inclusive of monetary and psychic costs) in 2018!
- **\$300,000** represents actual average tuition costs, fees, additional expenses, lost wages, and the psychic costs of going to college implied by the model in 2018. Average tuition is about \$45,000 for four years of college (inclusive of scholarships).

Bachelor Degree Shares: NLSY Data vs Model Predictions

Data

| AFQT Quartile | NLSY79 | NLSY97 | Change |
|------------------|--------|--------|--------|
| 1 | 0.02 | 0.06 | 0.04 |
| 2 | 0.07 | 0.20 | 0.13 |
| 3 | 0.23 | 0.39 | 0.16 |
| 4 | 0.61 | 0.71 | 0.10 |

Model

| $\phi_{0=1}$ Quartile | 1990 | 2018 | Change |
|--------------------------|------|------|--------|
| 1 | 0.23 | 0.31 | 0.09 |
| 2 | 0.27 | 0.41 | 0.14 |
| 3 | 0.33 | 0.44 | 0.10 |
| 4 | 0.43 | 0.50 | 0.07 |

- *Untargeted moment: Ok-ish [Need to potentially add correlation between absolute and comparative advantage].*

Replication of Marginal Income Effects from Mountjoy QJE 2025

1. Uses admission data from 35 public universities (2 year and 4 year) in Texas.
2. Shows that there are clear test score (SAT/ACT) thresholds for admission at the various schools (there are discreet jumps in admission rates above the cutoffs relative to below).
3. Paper uses these cutoffs in an RD design to look at the “causal” effect of going to different types of college on (i) four year bachelor completion, (2) two year bachelor completion, and (3) earnings (8-10 years in the future).
4. RD finds that going to college increases lifetime earnings by about 9%! Most of the effect is on the margin of going to bachelor’s degree relative to associate’s degree.
5. Can replicate his RD in our paper (next slide)

Replication of Marginal Income Effects from Mountjoy QJE 2025

■ What we do:

- Look at all $\{o, E\}$ margins our paper. We have 10 of them (occ1-bachelors, occ2-bachelors, oc3-bachelors, occ4-some college, etc.).
- Find people on the margin (just below) for each of the margins.
- Focus on the people who if we increased their α a little they would move above the margin. In this counterfactual we are treating α like a noisy measured test score.
- We then compute the change in earnings and utility for these people

■ Results:

| | | | |
|--------------------------|------|------------------|------|
| “Lifetime” Earnings Gain | 6.7% | Mountjoy number: | 8.7% |
| Utility Gain | 0.3% | | |

- *Why are lifetime earnings effect larger?* Does not include effort and psychic costs of going to college.

**Use the Model to Do a Few
Illustrative Policy Counterfactuals**

Three Policies Subsidizing the Cost of Education (reduce the κ_o 's)

1. Reduce all $\kappa_{E=3,0}$'s by \$20,000 and all $\kappa_{E=2,0}$'s by \$10,000. Think of a broad policy to reduce the cost of tuition in a general way. [Metaphor: a \$5,000 per year subsidy for both bachelor's degree (assume 4 years) and some college (assume 2 years)].
2. Reduce all $\kappa_{E=2,0}$'s and $\kappa_{E=3,0}$'s by \$10,000 [policy targeting free “some college” (associates) degrees – assume people who get an associates degree could go on and spend the last two years in a bachelor's program.]
3. Reduce all $\kappa_{E=3,0}$'s by \$20,000 [policy targeting only bachelor's degree]
4. Reduce only $\kappa_{3,0=1}$ by \$20,000 [policy targeting only bachelor's degree for “STEM+”]
5. Reduce all $\kappa_{E=3,0}$'s by \$20,000 and all $\kappa_{E=2,0}$'s by \$10,000 only for those with high α_i (top quartile).
6. Reduce all $\kappa_{E=3,0}$'s by \$20,000 and all $\kappa_{E=2,0}$'s by \$10,000 only for those with high α_i (top quartile) and high ε_i (top quartile).

Various Policies Subsidizing the Cost of Education (Part 1)

| | | Policy 1: $\kappa_{E=3,0}$'s \downarrow \$20,000 & $\kappa_{E=3,0}$'s \downarrow \$10,000 | | | | Policy 2 All $\kappa_{E,0}$'s \downarrow \$10,000 | | | |
|-------------------------------|---------------------------|---|--|---|---|--|--|---|---|
| Ex-Ante Income Quartile | Initial Bach. Share | Δ <i>Bach. Share</i> (p.p.) | Δ <i>Some College Share</i> (p.p.) | Δ <i>Log Wages</i> (p.p.) | Δ <i>Log Utility</i> (p.p.) | Δ <i>Bach. Share</i> (p.p.) | Δ <i>Some College Share</i> (p.p.) | Δ <i>Log Wages</i> (p.p.) | Δ <i>Log Utility</i> (p.p.) |
| All | 43% | 2.3 | -0.4 | 1.3 | 4.0 | 0.9 | 0.05 | 0.6 | 2.0 |
| Q1 | 15% | 3.4 | -0.6 | 2.8 | 1.6 | 1.3 | 0.03 | 1.2 | 0.8 |
| Q2 | 35% | 2.6 | -0.5 | 1.5 | 3.4 | 1.0 | 0.06 | 0.6 | 1.8 |
| Q3 | 51% | 1.9 | -0.4 | 0.7 | 4.8 | 0.7 | 0.07 | 0.3 | 2.5 |
| Q4 | 70% | 1.2 | -0.2 | 0.2 | 6.5 | 0.5 | 0.04 | 0.1 | 3.2 |
| Cost | | <i>\$390,000 per new bachelors degree</i> | | | | <i>\$490,000 per new bachelors degree</i> | | | |

Various Policies Subsidizing the Cost of Education (Part 1)

| | | Policy 1: $\kappa_{E=3,0}$'s \downarrow \$20,000 & $\kappa_{E=3,0}$'s \downarrow \$10,000 | | | | Policy 2 All $\kappa_{E,0}$'s \downarrow \$10,000 | | | |
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| Cost | <i>\$390,000 per new bachelors degree</i> | | | | <i>\$490,000 per new bachelors degree</i> | | | | |

Various Policies Subsidizing the Cost of Education (Part 1)

| Ex-Ante Income Quartile | Policy 3 $\kappa_{E=3,0}$'s ↓ \$20,000 | | | | Policy 4 All $\kappa_{E=3,0=1}$ ↓ \$20,000 | | | |
|-------------------------------|--|--|---------------------------------|-----------------------------------|---|--|---------------------------------|-----------------------------------|
| | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> |
| All | 2.7 | -0.8 | 1.4 | 4.0 | 1.5 | -0.5 | 4.4 | 2.3 |
| Q1 | 3.8 | -1.0 | 3.0 | 1.5 | 3.0 | -0.8 | 5.8 | 0.8 |
| Q2 | 3.0 | -1.0 | 1.7 | 3.3 | 1.9 | -0.7 | 6.0 | 1.7 |
| Q3 | 2.2 | -0.8 | 0.8 | 4.8 | 1.0 | -0.4 | 4.1 | 2.7 |
| Q4 | 1.5 | -0.5 | 0.2 | 6.4 | 0.3 | -0.1 | 1.7 | 4.0 |
| Cost | <i>\$342,000 per new bachelors degree</i> | | | | <i>\$320,000 per new bachelors degree</i> | | | |

Various Policies Subsidizing the Cost of Education (Part 1)

| | Policy 3 $\kappa_{E=3,0}$'s ↓ \$20,000 | | | | Policy 4 All $\kappa_{E=3,0=1}$ ↓ \$20,000 | | | |
|-------------------------------|--|--|---------------------------------|-----------------------------------|---|--|---------------------------------|-----------------------------------|
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| Ex-Ante Income Quartile | | | | | | | | |
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| Q2 | 3.0 | -1.0 | 1.7 | 3.3 | 1.9 | -0.7 | 6.0 | 1.7 |
| Q3 | 2.2 | -0.8 | 0.8 | 4.8 | 1.0 | -0.4 | 4.1 | 2.7 |
| Q4 | 1.5 | -0.5 | 0.2 | 6.4 | 0.3 | -0.1 | 1.7 | 4.0 |
| Cost | <i>\$342,000 per new bachelors degree</i> | | | | <i>\$320,000 per new bachelors degree</i> | | | |

Various Policies Subsidizing the Cost of Education (Part 1)

| Ex-Ante Income Quartile | Policy 5 Policy 1 for only high α_i | | | | Policy 6 Policy 1 for only high α_i w/ high ε_i | | | |
|-------------------------------|---|--|---------------------------------|-----------------------------------|---|--|---------------------------------|-----------------------------------|
| | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> |
| All | 0.6 | -0.1 | 0.2 | 1.0 | 0.2 | 0 | 0.2 | 0.1 |
| Q1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Q2 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0.1 | 0 |
| Q3 | 1.0 | -0.2 | 0.4 | 1.0 | 0.6 | 0 | 0.5 | 0 |
| Q4 | 1.2 | -0.2 | 0.2 | 3.1 | 0.2 | 0 | 0.2 | 0.2 |
| Cost | <i>\$520,000 per new bachelors degree</i> | | | | <i>\$270,000 per new bachelors degree</i> | | | |

Various Policies Subsidizing the Cost of Education (Part 1)

| | Policy 5 | | | | Policy 6 | | | |
|-------------------------------|---|--|---------------------------------|-----------------------------------|--|--|---------------------------------|-----------------------------------|
| | Policy 1 for only high α_i | | | | Policy 1 for only high α_i w/ high ε_i | | | |
| Ex-Ante Income Quartile | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> | <i>Bach. Share (p.p.)</i> | <i>Some College Share (p.p.)</i> | <i>Log Wages (p.p.)</i> | <i>Log Utility (p.p.)</i> |
| All | 0.6 | -0.1 | 0.2 | 1.0 | 0.2 | 0 | 0.2 | 0.1 |
| Q1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Q2 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0.1 | 0 |
| Q3 | 1.0 | -0.2 | 0.4 | 1.0 | 0.6 | 0 | 0.5 | 0 |
| Q4 | 1.2 | -0.2 | 0.2 | 3.1 | 0.2 | 0 | 0.2 | 0.2 |
| Cost | <i>\$520,000 per new bachelors degree</i> | | | | <i>\$270,000 per new bachelors degree</i> | | | |

**Counterfactuals:
Understanding the Trends in the Skill
Premium and the Bachelor Share**

What Drives the Changes in Bachelors Share Over Time

- Results in progress.....
- Initial results suggest that declining demand for manufacturing and routine jobs are pushing some people to college during the 2000s.
- These new college graduates are primarily not going to occupation 1 jobs (STEM +)
- Some role for declining college costs as well.

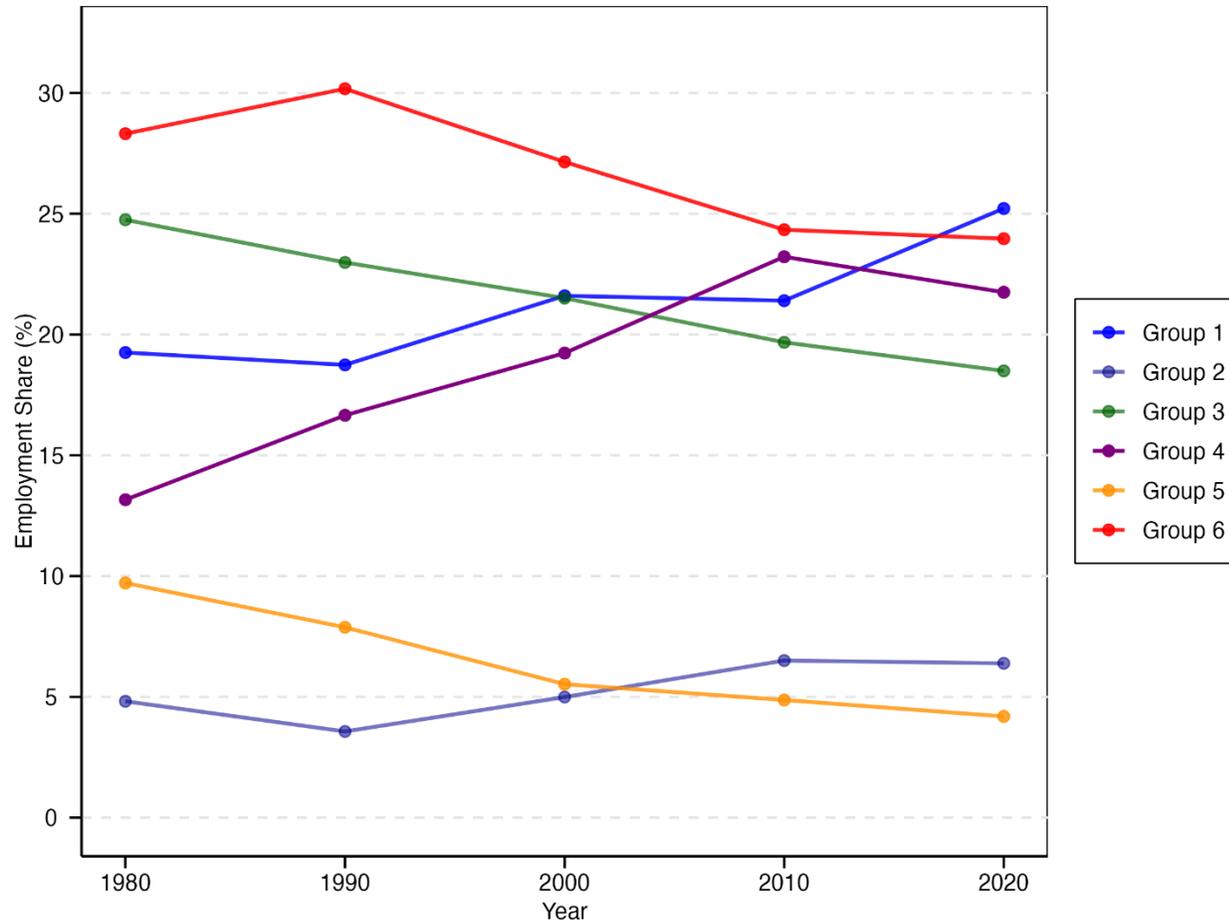
Conclusion

Conclusion

- Goal is to provide a framework to assess large changes in policies designed to promote college attendance.
- Allow for the fact that people have comparative and absolute advantage differences that affect their return to college. Also allow for people to have heterogeneous costs of going to college.
- Framework shows that policies designed to expand broad based access to college are very costly, do not stimulate much college attendance, and have benefits – to the extent that they occur – that accrue to high income individuals that were inframarginal.
- Even targeted programs have relatively low ROI.
- Non-pecuniary (psychic) costs of going to college are estimated to be much larger than the monetary costs. Understanding those costs are important to assess whether there is a role for policy.
- Future work: Try to isolate the monetary costs from the other costs to better allow for potentially binding liquidity constraints.

Extra Slides

Employment Shares Across Occupation Groups: Men 25-54



- A few things to keep in mind...
- Occupation shares of occupations 3, 5 and 6 plummeted during this period (post 1990 or 2000).
- Workers in these occupations needed to reallocate to other occupations.
- Share in group 1 and 4 increased throughout.
- Share in occupation 2 was relatively constant

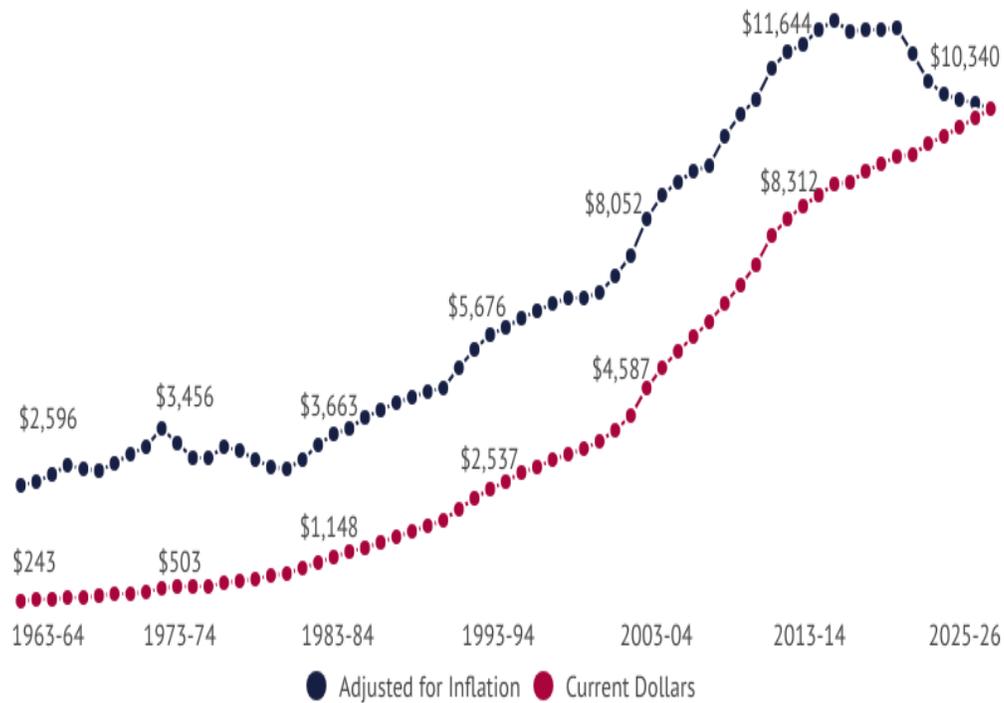
Average Wages in an Occupation by Education Group

$$\bar{W}_{o,E,t} = \frac{A_{Et} \beta_{ot} \sum_{i \in o,E,t} \left[\alpha_i \left(1 + \frac{\gamma^E - \psi_E}{\gamma^E + \psi_E} \right) \right]^{\gamma_{ot}^E} \phi_{io}}{N_{o,E,t}}$$

- Classic “Roy” Model of Sorting; $N_{o,E,t}$ = number of individuals working in occ o of education E in period t
- *An increase in β_{ot} or γ_{ot}^E (holding all else equal) will:*
 - **Effect 1:** Increase average wages in an occupation-education group (direct effect)
 - **Effect 2:** Decrease average wages in an occupation (indirect effect due to sorting as *average α_i and ϕ_{io} decline*)
- Depending on distributional assumptions of “talent” and “innate ability”, how average wage in an occupation responds to occupational productivity can be theoretically ambiguous.

Inflation Adjusted Tuition and Fees (Black Dotted Line) Public 1963-2025

Average Annual Tuition & Fees at Public 4-Year Institutions



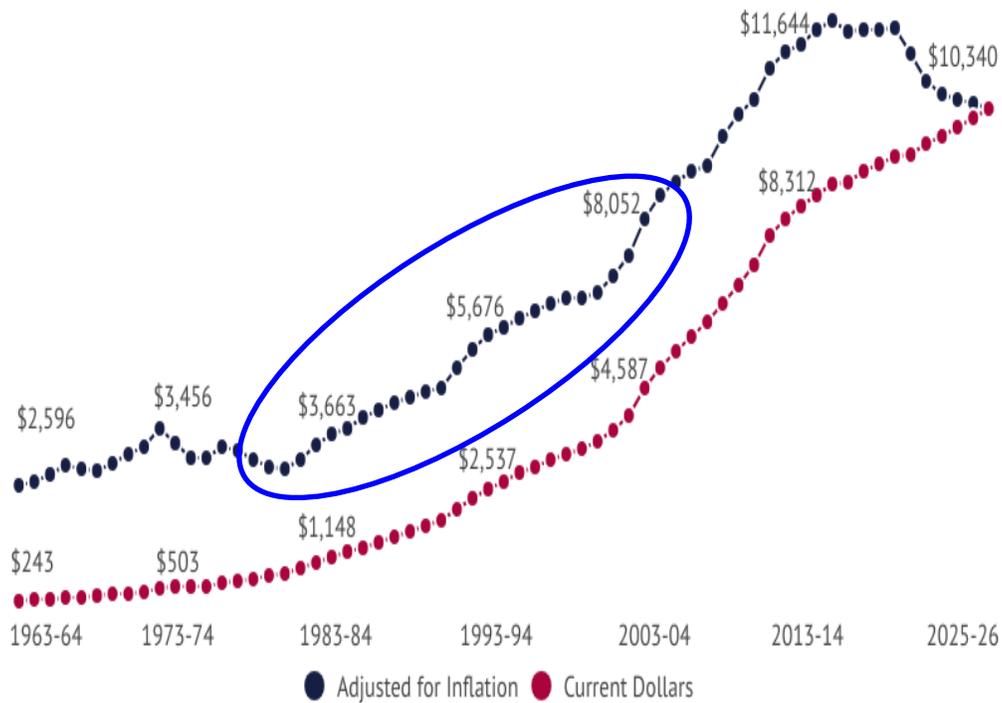
- College tuition costs were rising sharply in the 1980-2000 period (similar pattern for private universities with a higher level)

Education Data Initiative source: Federal Reserve Bank of St. Louis and National Center for Education Statistics with EDI projections

Data: Melanie Hanson, "Average Cost of College by Year"
EducationData.org, 2025-09-23,

Inflation Adjusted Tuition and Fees (Black Dotted Line) Public 1963-2025

Average Annual Tuition & Fees at Public 4-Year Institutions



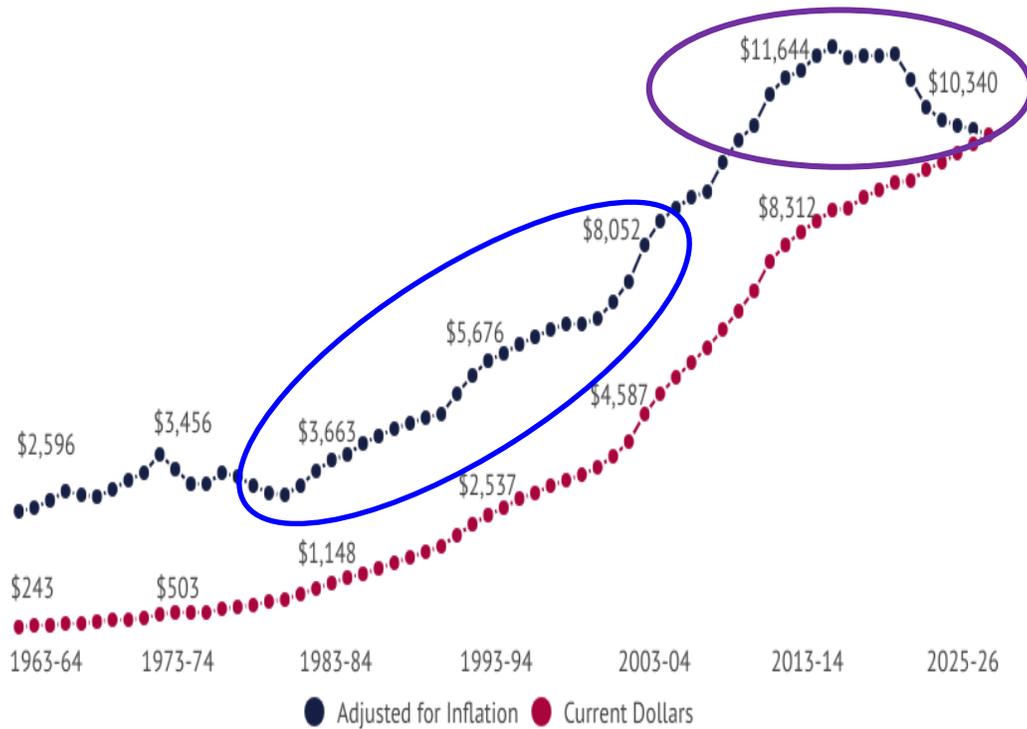
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Inflation Adjusted Tuition and Fees (Black Dotted Line) Public 1963-2025

Average Annual Tuition & Fees at Public 4-Year Institutions



Education Data Initiative source: Federal Reserve Bank of St. Louis and National Center for Education Statistics with EDI projections

- *College tuition costs were rising sharply in the 1980-2000 period (similar pattern for private universities with a higher level)*
- *College tuition costs were relatively flat in the 2000-2020 period (similar pattern for private universities).*
- *Tuition costs were even flatter after accounting for increased financial aid since early 2000s (see US College Board Data)*

*Data: Melanie Hanson, "Average Cost of College by Year"
EducationData.org, 2025-09-23,*