Using Big Data To Solve Economic and Social Problems

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Photo Credit: Florida Atlantic University
Equality of Opportunity: Conclusions

1. Tackle social mobility at a local, not just national level
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2. Improve childhood environment at all ages (not just earliest ages)
Equality of Opportunity: Conclusions

1. Tackle social mobility at a local, not just national level

2. Improve childhood environment at all ages (not just earliest ages)

3. Focus not just on schools and housing but on networks and social norms
   - Using Facebook data to understand how networks affect poverty
   - What types of friendship structures lead to better outcomes for low-income children?
   - What conditions lead to more integration in networks across socio-economic groups?
Equality of Opportunity: Conclusions

1. Tackle social mobility at a local, not just national level

2. Improve childhood environment at all ages (not just earliest ages)

3. Focus not just on schools and housing but on networks and social norms

4. Use big data to measure local progress and performance
   - Working with government agencies to create a system to monitor local trends in inequality and opportunity
   - Local area data available at www.equality-of-opportunity.org
Education and Upward Mobility
Education and Upward Mobility

- Education is widely viewed as the most important and scalable pathway to upward mobility.

- Historically, U.S. had steadily increasing levels of education, but this trend stopped around 1980.
  - Goldin and Katz 2008: *The Race Between Education and Technology*
  - Technological progress continues to make machines better, but investment in human capital has not kept pace.
  - This may be the key reason that earnings have stagnated for lower- and middle-income workers, leading to decline in upward mobility.
Today, widespread concern that education no longer “levels the playing field” of opportunity in the U.S.

- U.S. students perform worse on standardized tests on average than in many European countries despite higher spending on schools
- Sharp differences in quality of schools within America
- Rising costs of college → lack of access for low-income students
- Concern that some colleges (e.g., for-profit institutions) may not produce good outcomes
Education and Upward Mobility

- How can we improve education in America?
  - Traditionally, measuring impacts of education systematically was difficult
  - Administrative data from colleges and school districts are giving us a more scientific understanding of the “education production function”

- Start with higher education in this lecture
  - References:
    
    Chetty, Friedman, Saez, Turner, Yagan. “Mobility Report Cards: The Role of Colleges in Intergenerational Mobility” Working Paper 2017

College Mobility Report Cards

- Begin with a descriptive analysis of the role of colleges in upward mobility

- Chetty et al. (2017) construct *mobility report cards* for every college in America
  - Statistics on distribution of parents’ incomes and students’ earnings outcomes at each college

- Use de-identified tax data and Pell records covering all college students aged 18-21 from 1999-2013 (30 million students)
  - Construct statistics based on college *attendance* (not completion)
Caveat: we do not identify the causal effects ("value added") of colleges

Instead, our descriptive analysis highlights the colleges that deserve further study as potential "engines of mobility"
Mobility Report Cards: Four Sets of Results

1. Access: Parents’ Income Distributions

2. Outcomes: Students’ Earnings Distributions

3. Differences in Mobility Rates Across Colleges

4. Trends Since 2000
Access: Parents’ Income Distributions
Measuring Parents’ Incomes

- Parent income: mean pre-tax household income during five year period when child is aged 15-19

- Focus on percentile ranks, ranking parents relative to other parents with children in same birth cohort
20th Percentile = $25k
Median = $60k
60th Percentile = $74k
80th Percentile = $111k
99th Percentile = $512k

Parent Household Income Distribution
For Parents with Children in 1980 Birth Cohort

Density

Parents' Annual Household Income when Child is Age 15-19 ($)
Parent Income Distribution
Stanford University

- Percent of Students
  - Parent Income Quintile 1: 3.6%
  - Parent Income Quintile 2: 5.8%
  - Parent Income Quintile 3: 8.6%
  - Parent Income Quintile 4: 13.0%
  - Parent Income Quintile 5: 69.0%
More students from the top 1% than the bottom 50% at Ivy-Plus Colleges (Ivy + Stanford, Chicago, MIT, Duke)
Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

Stanford

Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

Stanford
Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

Parent Income Distributions by Quintile

- Stanford
- UC Berkeley

Percent of Students

Parent Income Quintile

1  2  3  4  5

1  2  3  4  5

60  70  80

At Selected Colleges
Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

- Stanford
- UC Berkeley
- SUNY-Stony Brook

Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges
Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

- Stanford
- UC Berkeley
- SUNY-Stony Brook
- Glendale Community College

Parent Income Distributions by Quintile for 1980-82 Birth Cohorts At Selected Colleges
Parent Income Distributions by Quintile for 1980-82 Birth Cohorts
At Selected Colleges

Income Segregation Across Colleges is Comparable to Segregation Across Census Tracts in Average American City
Outcomes: Students’ Earnings Distributions
Students’ Outcomes

- Measure children’s individual earnings in their mid-30s
  - Define percentile ranks by ranking children relative to others in same birth cohort

- Earnings ranks stabilize by age 30 even at top colleges
Mean Child Rank vs. Age at Income Measurement, By College Tier

Cannot Link Children to Parents
Distribution of Children’s Individual Labor Earnings at Age 34
1980 Birth Cohort

Density

Individual Earnings ($)

p20 = $1k
p50 = $28k
p80 = $58k
p99 = $197k
Children’s Outcomes: percentage of students who reach top quintile
Student Outcomes
Stanford and Columbia

Parent Income Quintile

Percent of Students

1 2 3 4 5

Stanford
Columbia
Students’ Outcomes and the “Mismatch” Hypothesis

- At any given college, students from low- and high- income families have very similar earnings outcomes.
  - Colleges effectively “level the playing field” across students with different socioeconomic backgrounds whom they admit.

- No indication of “mismatch” of low-income students who are admitted to selective colleges under current policies.
Differences in Mobility Rates Across Colleges
Mobility Report Cards

- Combine data on parents’ incomes and students’ outcomes to characterize colleges’ mobility rates
  - At which colleges in America do the largest number of children come from poor families and end up in the upper middle class?
Mobility Report Cards
Columbia vs. SUNY-Stony Brook

- **Access**: Fraction of Parents from Bottom Quintile (<$25K) = 16%

- **Top-Quintile Outcomes Rate**: Fraction of Students who Reach Top Quintile = 51%

Parent Income Quintile: 1, 2, 3, 4, 5
Define a college’s mobility rate (MR) as the fraction of its students who come from bottom quintile and end up in top quintile

Observe that:

\[
\text{Mobility Rate} = \text{Access} \times \text{Top-Quintile Outcome Rate}
\]

At SUNY: 8.4% = 16% x 51%

Frac. of Parents in Q1 and Children in Q5  Frac. of Parents in Q1  Frac. of Students who Reach Q5 Given Parents in Q1
Mobility Rates: Top-Quintile Outcome Rate vs. Access by College

Access: Percent of Parents in Bottom Quintile

Top-Quintile Outcome Rate: \( P(\text{Child in Q5} \mid \text{Par in Q1}) \)

- Columbia
- SUNY-Stony Brook
Mobility Rates: Top-Quintile Outcome Rate vs. Access by College

[Graph showing scatter plot with points for Columbia and SUNY-Stony Brook]
Mobility Rates: Top-Quintile Outcome Rate vs. Access by College

- Ivy Plus Colleges (Avg. MR = 2.2%)
- Access: Percent of Parents in Bottom Quintile
- Top-Quintile Outcome Rate: $P(\text{Child in Q5} | \text{Par in Q1})$
Mobility Rates: Top-Quintile Outcome Rate vs. Access by College

- Ivy Plus Colleges (Avg. MR = 2.2%)
- Public Flagships (Avg. MR = 1.7%)

Access: Percent of Parents in Bottom Quintile

Top-Quintile Outcome Rate: P(Child in Q5 | Par in Q1)
<table>
<thead>
<tr>
<th>College</th>
<th>Mobility Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State-Los Angeles</td>
<td>9.9%</td>
</tr>
<tr>
<td>Pace University</td>
<td>8.4%</td>
</tr>
<tr>
<td>SUNY-Stony Brook</td>
<td>8.4%</td>
</tr>
<tr>
<td>Technical Career Institutes</td>
<td>8.0%</td>
</tr>
<tr>
<td>U. Texas-Pan American</td>
<td>7.6%</td>
</tr>
<tr>
<td>CUNY System</td>
<td>7.2%</td>
</tr>
<tr>
<td>Glendale Comm. Coll.</td>
<td>7.1%</td>
</tr>
<tr>
<td>South Texas College</td>
<td>6.9%</td>
</tr>
<tr>
<td>Cal State Poly-Pomona</td>
<td>6.8%</td>
</tr>
<tr>
<td>U. Texas-El Paso</td>
<td>6.8%</td>
</tr>
<tr>
<td>Technical Career Institutes</td>
<td>6.8%</td>
</tr>
<tr>
<td>Columbia</td>
<td>3.1%</td>
</tr>
<tr>
<td>Ivy Plus Colleges</td>
<td>2.2%</td>
</tr>
<tr>
<td>Avg. College in the U.S.</td>
<td>1.9%</td>
</tr>
</tbody>
</table>
Characteristics of High-Mobility Rate Colleges

- Are there systematic differences between colleges with high vs. low mobility rates?
  - Examine correlations with a variety of college characteristics using data from Dept. of Education and other public sources
Mobility Rates: Colleges in the New York City Metro Area

SD of MR = 1.30%
SD of MR within Area = 0.97%
Characteristics of High-Mobility Rate Colleges

- Are there systematic differences between colleges with high vs. low mobility rates?
  - Examine correlations with a variety of college characteristics using data from Dept. of Education and other public sources
  - For other characteristics, quantify relationship using correlation coefficient
Fictional Example 1: Correlation = 0
Fictional Example 2: Correlation = 1
Fictional Example 3: Correlation = 0.5
Fictional Example 4: Correlation = -1
Correlates of Top 20% Mobility Rate

- Public
- For-Profit
- 4-Year College

X-axis: Magnitude of Correlation
Y-axis: College Type

Legend:
- Red: Negative Correlation
- Green: Positive Correlation
Mobility Rates at Public vs. Private Colleges

- Public Colleges
- Private Non-Profit Colleges
- Private For-Profit Colleges

Access: Percent of Parents in Bottom Quintile

Top-Quintile Outcome Rate: P(Child in Q5 | Par in Q1)
Upper-Tail Earnings Outcomes

- Now examine mobility rates for upper-tail outcomes: fraction of students who come from bottom quintile and reach top 1%
  - Obviously not the only measure of “success,” but a simple statistic that can be constructed with available data
Access and Upper-Tail Outcomes Across Colleges

Upper-Tail Outcome Rate: $P(\text{Top 1% | Bottom 20%})$

Access: Percent of Parents in Bottom Quintile

- Stanford
- Penn
- Columbia
- Princeton
- MIT
- Dartmouth
- Harvard
- Duke
- Chicago
- Yale
- Cornell
- UC Berkeley
- Brown
- Michigan
- SUNY-Stony Brook
- Cal State-Los Angeles

Cal State-Los Angeles
Top 10 Colleges in America By Upper-Tail (Top 1%) Mobility Rate

Note: Among colleges with 300 or more students per class
Correlates of Top 1% Mobility Rate

- Positive Correlation
- Negative Correlation

**College Type**
- Public
- For-Profit
- 4-Year College

**Selectivity**
- Rejection Rate
- Rejection Rate, Public
- Rejection Rate, Private

**Institutional Characteristics**
- Enrollment
- Completion Rate
- Avg. Faculty Salary
- STEM Major Share

**Expend. & Cost**
- Instr. Exp. per Student
- Net Cost for Poor
- Sticker Price
Two Educational Models for Mobility

- Two distinct models associated with different types of mobility
  - Highest rates of top-quintile mobility: certain (but not all) mid-tier public schools, such as Cal-State and CUNY
  - Highest rates of upper-tail mobility: elite private colleges such as Stanford
Trends in Access
Changes Over Time

- Significant policy changes in higher education since 2000
  - Expansions in financial aid and low-income outreach at elite private colleges
  - Budget cuts and tuition increases at many public colleges
- Have these changes affected access?
Trends in Low-Income Access from 2000-2011 at Selected Colleges

Percent of Parents in the Bottom Quintile

Year when Child was 20

Stanford
Trends in Low-Income Access from 2000-2011 at Selected Colleges

Percent of Parents in the Bottom Quintile

Year when Child was 20

Stanford

Harvard
Trends in Low-Income Access from 2000-2011 at Selected Colleges

Percent of Parents in the Bottom Quintile

Year when Child was 20

Stanford

Harvard
Trends in Low-Income Access from 2000-2011 at Selected Colleges

- Stanford
- Harvard
- UC-Berkeley
- SUNY-Stony Brook
- Cal State-LA

Year when Child was 20

Percent of Parents in the Bottom Quintile

Trends in Bottom 60% Access from 2000-2011 at Selected Colleges

- Stanford
- Harvard
- UC-Berkeley
- SUNY-Stony Brook
- Cal State-LA
Mobility Report Cards: Lessons

1. Low-income students admitted to selective colleges do not appear over-placed, based on their earnings outcomes

   - Provides support for policies that seek to bring more such students to selective colleges
Mobility Report Cards: Lessons

1. Low-income students admitted to selective colleges do not appear over-placed, based on their earnings outcomes

2. Efforts to expand low-income access often focus on elite colleges
   - But the high-mobility-rate colleges identified here may provide a more scalable model for upward mobility, broadly defined
   - Median instructional expenditures: $87,000 at Ivy-Plus vs. $6,500 at highest-mobility-rate colleges
Mobility Report Cards: Lessons

1. Low-income students admitted to selective colleges do not appear over-placed, based on their earnings outcomes

2. Efforts to expand low-income access often focus on elite colleges

3. Elite colleges provide a unique pathway to upper-tail outcomes

   - Important to understand how to expand access to such institutions for talented students from low-income families
Mobility Report Cards: Lessons

1. Low-income students admitted to selective colleges do not appear over-placed, based on their earnings outcomes

2. Efforts to expand low-income access often focus on elite colleges

3. Elite colleges provide a unique pathway to upper-tail outcomes

4. Recent unfavorable trends in access call for a re-evaluation of policies at the national, state, and college level
   - Ex: changes in admissions criteria, expansions of transfers from the community college system, interventions at earlier ages