# Elite Colleges and Upward Mobility to Top Jobs and Top Incomes

Seth Zimmerman (Chicago Booth) in American Economic Review (Forthcoming)

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# Introduction

# Overview of the research design

- Track Chilean students from high school, through college up to the peak times of their careers
- Exploit the publication of test scores, admission outcomes and waitlist status to conduct a regression discontinuity design on college applicants in order to estimate the causal effect of elite college admission in Chile on income and leadership outcomes
- Analyze effect heterogeneity and pin down the causal mechanism(s) driving the observed effect(s)

# Motivation

- 1.8% of graduates from the two most selective universities account for roughly 41% of top leadership roles as well as 39% of the 0.1%-income percentile.
- Previous research (Dale and Krueger 2011; Zimmerman 2014) has shown that treatment effects of college on marginal students is largest for low-SES students
- Elite colleges aspire to serve as a social mobility booster

# Motivation

- 1.8% of graduates from the two most selective universities account for roughly 41% of top leadership roles as well as 39% of the 0.1%-income percentile.
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- Elite colleges aspire to serve as a social mobility booster

**Research Questions**

1. What is the **causal effects** of elite colleges on the elevated rate at which their graduates reach top positions?
2. Do elite (business) colleges **enable upward mobility** for students not from "historically advantaged" groups?

# Why Chile?

There are two key advantages of choosing Chile for this research:

**Convenient college admission process**

- Information on admission outcomes well documented and public
- Deferred acceptance algorithms with no ex-post changes
- Two elite universities with large competitive advantage over other universities

**External validity**

- Similar secondary and tertiary educational attainment to US, UK and EU countries
- Top income shares, intergenerational mobility and formality of the economy are comparable to industrial countries (in the greater Santiago area)

# Main findings

1. Elite colleges have a causal effect on their graduates success in both income and leadership roles achievements
2. Admission treatment effects are exclusive to male students with a privileged background
3. Suggestive evidence that a higher ability to form peer ties is the mechanism through which the differential treatment effect operates

# Data and Identification

# Constructing the dataset(s)

1. **Archival data** on college applications and test scores **for those who made it at least to the waitlist**
   - Admission scores and outcomes for all applicants who were admitted or made the waitlist at one of the two elite colleges (UC and PUC) from 1974 - 2001 and for all CRUCH universities from 1980 - 2001
   - Full ranking of preferences for applications from 2000 and later
   - RUTs (social security number) as identifiers
   - No information on matriculation and graduation
2. Administrative **tax records** from **2005-2013** (for individuals who are 30 - 57 years old)
3. Web-scraped **information on top executives** of publicly listed companies from **1975 - 2013**

# General Setup of RDD

- Admission score as the continuous running variable $z_i$ with a known threshold $z_0$
- Treatment assignment mechanism:

$$D_i = \begin{cases} 0 & \text{for } z_i < z_0 \\ 1 & \text{for } z_i \geq z_0 \end{cases}$$

- "Discontinuity sample" of applicants with $z_i$ in a $\delta$-neighborhood centered at the threshold
- Appropriate parametric model:

$$Y_i = \sum_{p=0}^{P} \beta_p \tilde{z}_i^p + \Delta D_i + D_i \sum_{p=0}^{P} \gamma_p \tilde{z}_i^p$$

where $\tilde{z}_i = z_i - z_0$

# Identification

Identification in a RDD analysis requires:

1. Continuity of $z, E[\beta|z_i = z], E[\gamma|z_i = z]$ and $E[\Delta|z_i = z]$ at $z_0$
2. $Y_{0i}, Y_{1i} \perp\!\!\!\perp D_i \,|z_i = z$ for $z \in (z_0 - \delta, z_0 + \delta)$
   - No anticipation or manipulation near the threshold
3. Existence of $D^+ \equiv \lim_{z \searrow z_0} E[D_i|z_i = z]$ and $D^- \equiv \lim_{z \nearrow z_0} E[D_i|z_i = z]$ and $D^+ \neq D^-$ (i.e. knowledge of the discontinuity point $z_0$)

The Average Treatment Effect is then identified as the following:

$$\lim_{\delta \to 0} E[Y_i|z_0 < z_i < z_0 + \delta] - E[Y_i|z_0 - \delta < z_i < z_0]$$
$$= E[Y_{1i} - Y_{0i}|z_i = z_0] = \Delta$$

# Baseline Model

To identify the treatment effect of admission to an elite business program, the following models are estimated with a sample pooled over the 2 institutions and all available years:

$$\mathcal{Y}_{ipc} = f_0(d_{ipc}) + \Delta\ \mathbb{1}[d_{ipc} \geq 0] + f_1(d_{ipc})\ \mathbb{1}[d_{ipc} \geq 0] + \eta_{ipc} \tag{1}$$

$\mathcal{Y}_{ipc}$ Count of leadership positions

$d_{ipc}$ Distance to program-year-specific threshold

$f_0, f_1$ Smooth polynomial function, capturing the functional forms below and above threshold respectively

# Baseline Model

To identify the treatment effect of admission to an elite business program, the following models are estimated with a sample pooled over the 2 institutions and all available years:

$$\mathcal{Y}_{ipct} = f_0(d_{ipc}) + \Delta\ \mathbb{1}[d_{ipc} \geq 0] + f_1(d_{ipc})\ \mathbb{1}[d_{ipc} \geq 0] + \eta_{ipct} \tag{2}$$

$\mathcal{Y}_{ipct}$ Income variable of interest (top income share, log income)

$d_{ipc}$ Distance to program-year-specific threshold

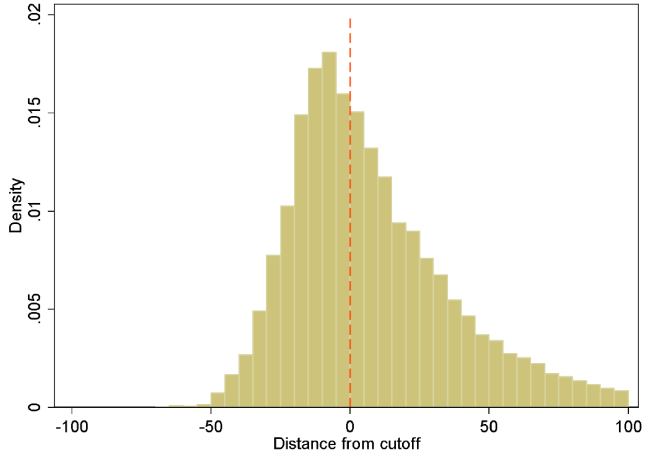
$f_0, f_1$ Smooth polynomial function, capturing the functional forms below and above threshold respectively

# What happens at the threshold?

- Probability of matriculation rises by more than 90%
- Selectivity increases significantly (both in peer SES and peer math scores)
- Large majority below the threshold is admitted to other less selective business programs (and does not switch to a different field)
- No clumping just above the threshold and predetermined covariates are balanced across the threshold

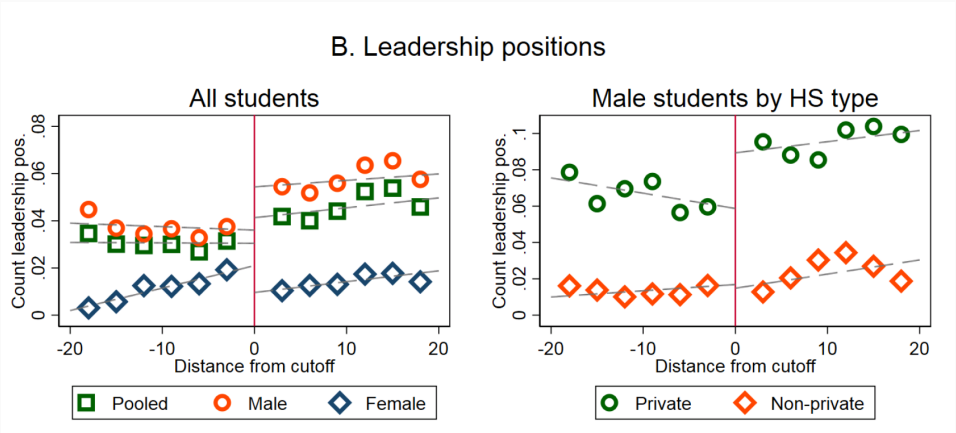
# What happens at the threshold?

Figure 3: Histogram of scores relative to cutoff for elite applications



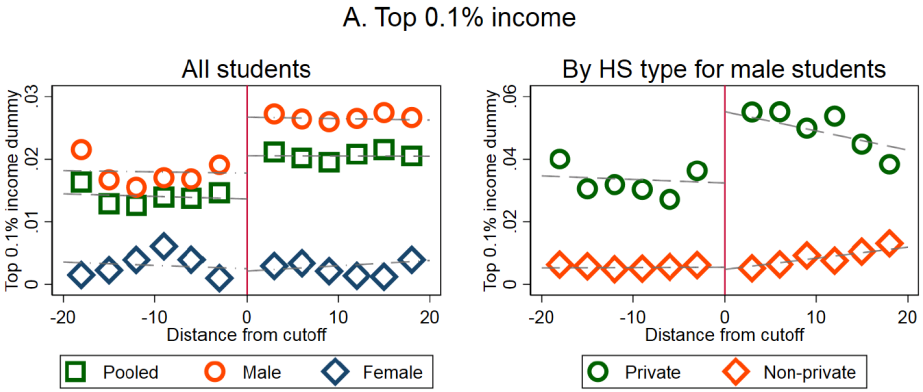
# Estimates

# Baseline regression with pooled data - Leadership

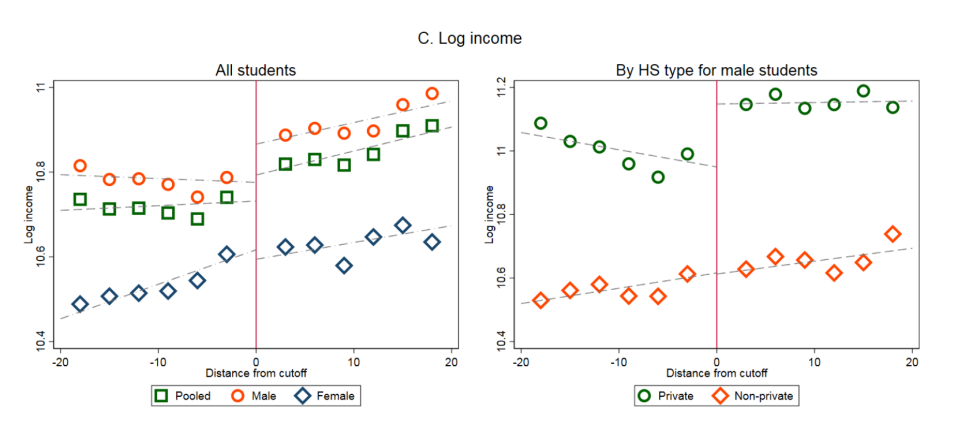


# Baseline regression with pooled data - Top 0.1%

Figure 6: Effect of admission on leadership and top income attainment



# Baseline regression with pooled data - Income



# Interpretation of the observed effects

- Large causal effect on both leadership outcomes (+44%) and top income measures (+50%)
- Zero effects for all measure for both treated women and applicants not from private high schools
- Differences in admission effects account for a large share of achievement gaps:
  - 36% and 35% of the **achievement gap by gender** for top 0.1%-income and leadership counts respectively
  - 54% and 31% of the **achievement gap by SES** for top income and leadership attainment respectively

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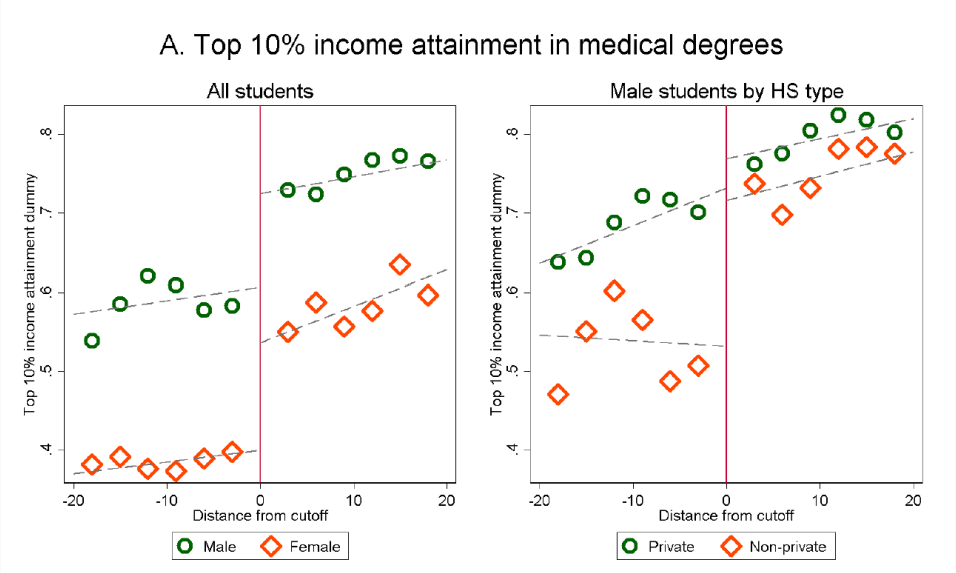
**Are differential returns to education a general feature of Chilean labor market?**

# Analysis for another field



# What explains the observed heterogeneity?

Five potential mechanisms:

1) Better academic preparation

Table 6: Heterogeneous effects by high school type and other student characteristics

| | Private HS | Math | Verbal | Santiago |
|---|---|---|---|---|
| *A. Descriptive statistics* | | | | |
| Private | | 744 | 658 | 0.819 |
| Non-private | | 736 | 653 | 0.698 |
| Gap | | 7.8 | 4.8 | 0.120 |
| Adjusted gap | | 4.5 | 3.7 | 0.114 |

# What explains the observed heterogeneity?

2) Geographic preferences or constraints

- Private high-school applicants are 12% more likely to be from greater Santiago, but the differences estimated for a Santiago-only sample are very similar

Table 6: Heterogeneous effects by high school type and other student characteristics

| | Private HS | Math | Verbal | Santiago |
|---|---|---|---|---|
| *B. Admissions effect estimates* | | | | |
| Top 0.1% | 0.0239 | 0.0002 | -0.0002 | 0.0016 |
| | (0.0073) | (0.0006) | (0.0005) | (0.0068) |
| Leadership | 0.0285 | 0.0019 | 0.0011 | 0.0014 |
| | (0.0157) | (0.0015) | (0.0013) | (0.0129) |
| Log income | 0.1646 | 0.0035 | -0.0006 | -0.0980 |
| | (0.0538) | (0.0060) | (0.0042) | (0.0634) |
| *C. Santiago only* | | | | |
| Top 0.1% | 0.0235 | | | |
| | (0.0087) | | | |
| Leadership | 0.0277 | | | |
| | (0.0170) | | | |
| Log income | 0.1931 | | | |
| | (0.0609) | | | |

# What explains the observed heterogeneity?

3) Interest in business careers

- Moving across the threshold is not associated with a significant amount of switching in career path sectors

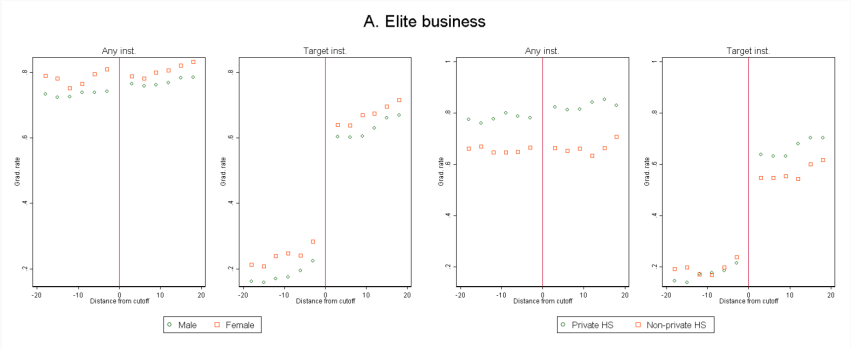
Table 7: Effect of admission on sector of employment

| | All | | Private HS | | Non-private HS | |
|---|---|---|---|---|---|---|
| Name | BL | Effect | BL | Effect | BL | Effect |
| Real estate/rental/business activities | 0.169 | 0.005 | 0.163 | 0.020 | 0.163 | 0.008 |
| | | (0.008) | | (0.014) | | (0.013) |
| Wholesale/retail trade | 0.158 | 0.000 | 0.164 | 0.011 | 0.149 | -0.008 |
| | | (0.009) | | (0.014) | | (0.013) |
| Finance | 0.126 | 0.009 | 0.143 | 0.017 | 0.100 | 0.006 |
| | | (0.008) | | (0.014) | | (0.012) |
| Public administration | 0.115 | -0.029 | 0.084 | -0.028 | 0.148 | -0.028 |
| | | (0.008) | | (0.011) | | (0.015) |
| Construction | 0.075 | 0.001 | 0.081 | -0.011 | 0.074 | 0.005 |
| | | (0.006) | | (0.011) | | (0.010) |
| Manufacturing (non-metallic) | 0.069 | 0.009 | 0.089 | 0.005 | 0.058 | 0.006 |
| | | (0.006) | | (0.011) | | (0.009) |
| Teaching | 0.064 | -0.002 | 0.053 | -0.016 | 0.076 | 0.005 |
| | | (0.006) | | (0.008) | | (0.010) |
| Transport/storage/communication | 0.050 | 0.005 | 0.048 | 0.003 | 0.056 | 0.000 |
| | | (0.005) | | (0.008) | | (0.009) |
| Manufacturing (metallic) | 0.039 | -0.002 | 0.038 | 0.004 | 0.036 | -0.006 |
| | | (0.004) | | (0.008) | | (0.006) |
| Other community service | 0.037 | 0.001 | 0.032 | -0.003 | 0.049 | -0.001 |
| | | (0.005) | | (0.007) | | (0.008) |
| Utilities | 0.027 | 0.001 | 0.027 | 0.003 | 0.028 | 0.003 |
| | | (0.004) | | (0.007) | | (0.007) |
| Mining | 0.020 | 0.007 | 0.017 | 0.009 | 0.022 | 0.007 |
| | | (0.004) | | (0.006) | | (0.006) |
| Agriculture | 0.018 | 0.002 | 0.027 | -0.005 | 0.009 | 0.007 |
| | | (0.003) | | (0.006) | | (0.004) |
| Social services and health | 0.018 | -0.003 | 0.017 | -0.005 | 0.020 | -0.002 |
| | | (0.003) | | (0.005) | | (0.006) |
| Index | 0.017 | 0.001 | 0.019 | 0.002 | 0.016 | 0.001 |
| | | (0.000) | | (0.001) | | (0.001) |
| Have sector data | 0.711 | 0.007 | 0.730 | 0.017 | 0.707 | 0.003 |
| | | (0.007) | | (0.010) | | (0.011) |
| N | | 36273 | | 13702 | | 14723 |

# What explains the observed heterogeneity?

4) Academic success in college

College completion rates are higher among women and moreover do not deteriorate the treatment effects for medical programs.



# What explains the observed heterogeneity?

5) Success in forming peer ties

# The mechanism of peer ties formation

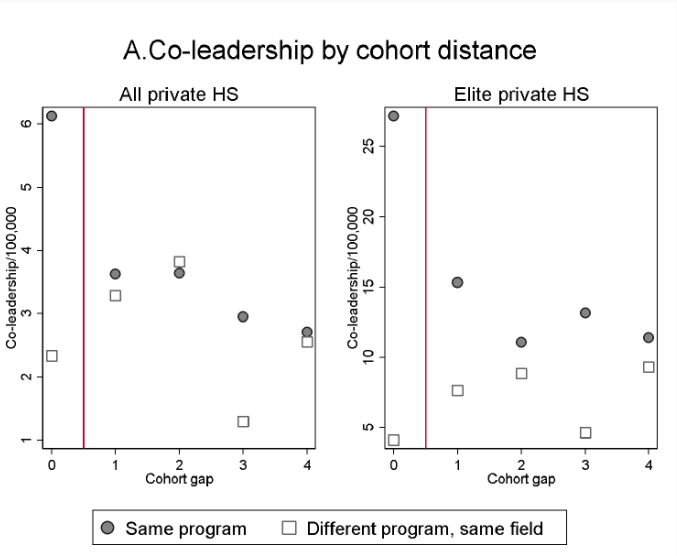
**Why would peer ties raise expected outcomes?**

- Ties to businesses through which elite students can refer college peers
- Peers more productive working together
- Working with peers incentivizes good work ethic

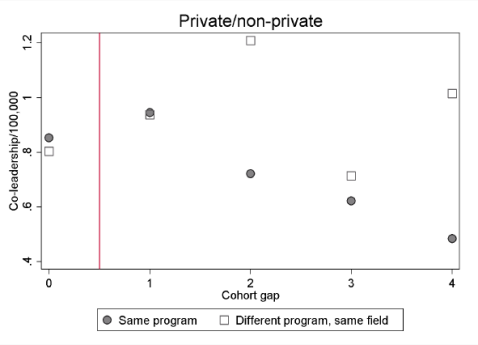
To test this:

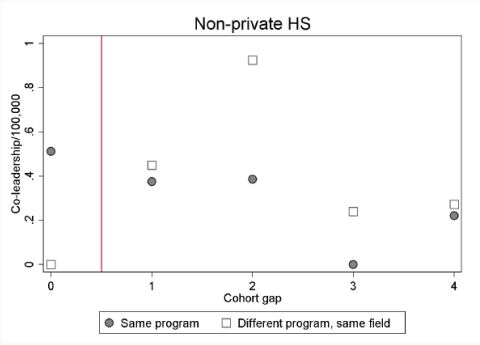
- Compare co-leadership rates (i.e. the probability that a pair of two students lead the same firm at the same time) for different groups
- Classify a pair of students as *peers* if both have studied the same program in the same cohort

# The mechanism of peer ties formation



# The mechanism of peer ties formation



# Relation to the Roy Framework

# Essential Heterogeneity and Self-Selection

From the identification assumption 2 we have:

$$Y_{0i}, Y_{1i} \perp\!\!\!\perp D_i \,|z_i = z \text{ for } z \in (z_0 - \delta, z_0 + \delta)$$
$$\Leftrightarrow Y_{1i} - Y_{0i} \perp\!\!\!\perp D_i \,|z_i = z \text{ for } z \in (z_0 - \delta, z_0 + \delta)$$

$\Rightarrow$ No essential heterogeneity in admission assignment

**But**

- "Self-selection" into application based on unobservables such as perception of college costs and in particular ability to form peer relationships still possible
- Majority of elite business college admits being male from private HS suggests positive selection into "being considered for treatment"

# Conclusion

# Conclusion

- Elite business programs have a large causal impact on graduates' probability to lead large businesses and join top income groups - if they are men from a privileged background
- The dramatic heterogeneity in group-specific treatment effects can solely be explained by potential differences in the ability to form peer relationships
- Despite the imprecision of the "SES-indicator", elite business degrees appear to cement rather than loosen upward mobility

# Questions?

## References


- Dale, S. and A. B. Krueger (2011). *Estimating the return to college selectivity over the career using administrative earnings data*. Tech. rep. National Bureau of Economic Research.
- Zimmerman, S. D. (2014). "The returns to college admission for academically marginal students". In: *Journal of Labor Economics* 32.4, pp. 711–754.

# Notation

Setting does not allow for "self-selection" into admission, but into application.

Potential Outcomes

$$\mathcal{Y}_{elite} = \mu_1(X) + U_1$$
$$\mathcal{Y}_{noelite} = \mu_0(X) + U_0$$

Observed Outcome

$$Y = DY_1 + (1 - D)Y_0$$

Choice

$$D = \mathrm{I}[\mu_D(X, Z) - V > 0]$$