ENDOGENOUS MARKET FORMATION: THEORY AND EVIDENCE FROM CHILEAN COLLEGE ADMISSION

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MOTIVATION

- Student-School Assignment
  - Lessons from Market Design are actively adopted
  - Evidence suggesting significant benefits from a well-designed centralized matching system

  → **Challenges**

  - Policy intervention is often needed
  - Some schools (e.g., charter and private schools) opt out

MOTIVATION

- Student-School Assignment
  - Lessons from Market Design are actively adopted
  - Policy intervention is often needed

- Chilean case
  - In 1967, some colleges voluntarily formed a centralized matching system (CM) and then expanded it by adding more members in 2012

  * Share of CM in college freshmen:

    100% in 1967, 50% in 2011, and 70% in 2012

RESEARCH QUESTIONS

Q1) What economic conditions make market participants voluntarily form a centralized market?

Q2) What are the impacts on students and on schools?

OUTLINE

- Key Institutional features of the Chilean system

- Analytic framework
  - Simple two-sided matching model
    * two colleges
    * heterogeneous students w.r.t. preference, test scores, and resources for application costs
  - Empirical examination for testable predictions
    * vacancy, heterogeneous effects on schools & students
    * Historical & administrative microlevel data (2010-2013)

OUTLINE

- Key findings

Q1) What economic conditions make market participants voluntarily form a centralized market?

→ * comparability between colleges

* share of students who can afford application costs

Q2) What are the impacts on students and on schools?

→ * ↓ vacancies & ↑ enrollments (raw, test-score weighted)

* Overall beneficial to all students

but even more so to students with low SES

RELATED STUDIES

- Market Design literature
  - Student-school matching *Che and Koh (2016), Hafalir et al. (2018), Ekmekci and Yenmez (2019), Avery et al. (2014), Chen et al. (2018)
  - Unraveling *Niederle and Roth (2003), Avery and Levin (2010), Fainmesser (2013), and Avery et al. (2014)

- Empirical/Experimental studies on the consequences of a change in school admission system

  * Abdulkadiroğlu et al. (2017), Chen and Kesten (2017, 2019), Machado and Szerman (2018), Tanaka et al. (2020), Knight and Schiff (2020)

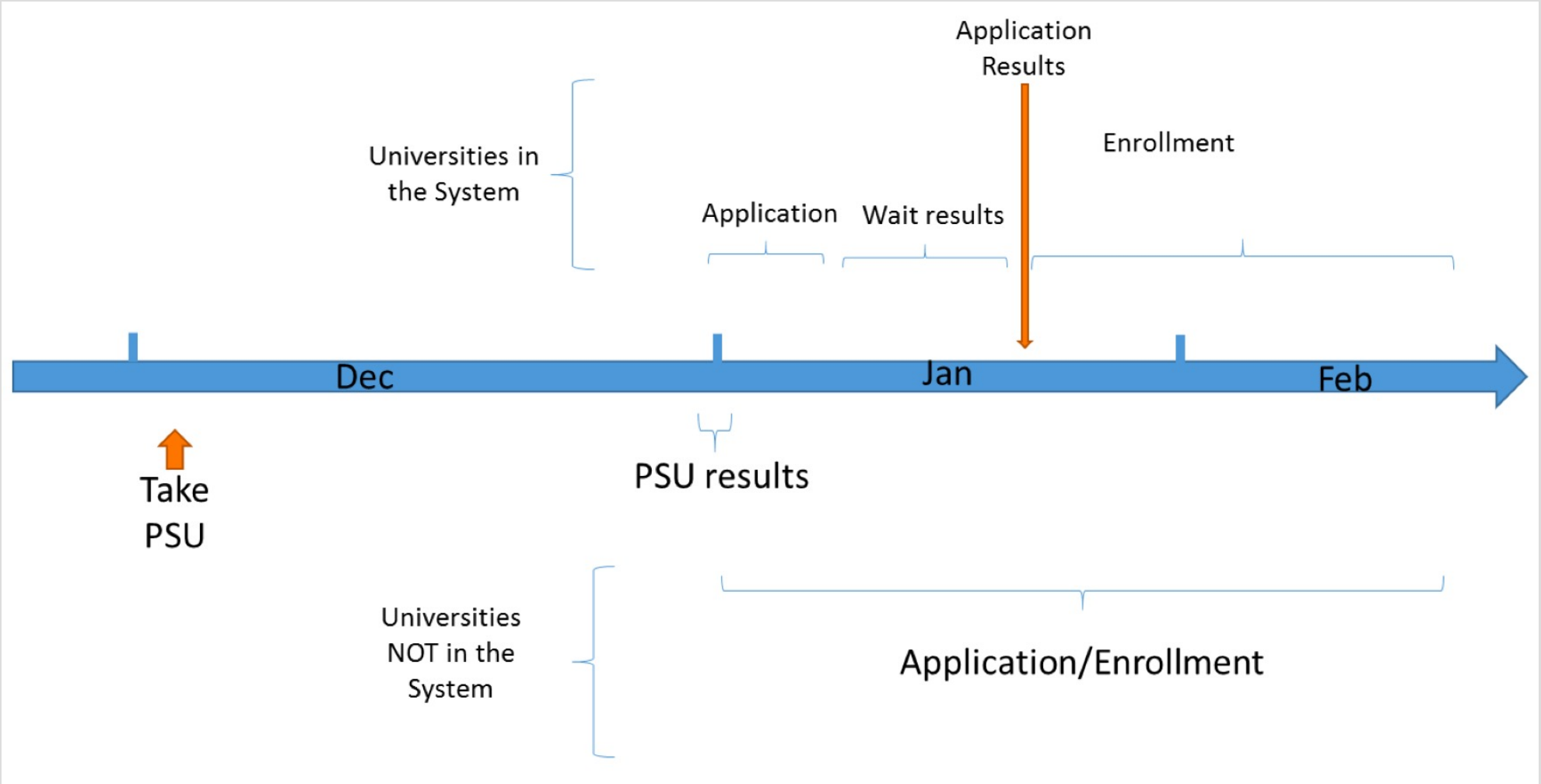
  * Chile: Figueroa et al. (2018), Bordon et al. (2016), Kapor et al. (2020)

INSTITUTIONAL BACKGROUND: CHILE

- Colleges
  - CRUCH: initially 8, then 25 traditional schools (~ Ivy League schools)
  - Non-CRUCH: 35 schools established mostly in the1980s
- College admission
  - Quota set at the beginning of each cycle
  - Prior to 1967: decentralized
  - From 1967 to 2011: CRUCH (CM) vs. Non-CRUCH(decentralized)
  - In 2012:
    * CRUCH invited all non-CRUCH to join its centralized system
    * 8 highly-ranked colleges joined
  - From 2012: 33 schools (50% → 70% of freshmen quota)

INSTITUTIONAL BACKGROUND: CHILE

- Competition btw CRUCH and non-CRUCH (untill 2011)



INSTITUTIONAL BACKGROUND: CHILE

- Observations
  - Unraveling:

    quotas exhausted in the same day when the national test scores are released

    i.e., students need to apply for individual colleges without knowing the outcomes from the CM(centralized matching)
  - Vacancy:

    sizable number of offers from the CM rejected & unfilled
  - Unequal opportunity:

    students from low SES/credit constraints

INSTITUTIONAL BACKGROUND: CHILE

- Competition btw CRUCH and non-CRUCH (until 2011)

Figure 1: 1 am

Figure 1: 8:30 am

- disadvantageous to students with low SES:

  * deposit, travel cost

THEORETICAL FRAMEWORK

- Colleges
  - C_i with quota q_i with $i \in \{1,2\}$
  - $q_1 + q_2 < 1$
  - $u(E) = \int s\, f(s) ds$: E is the set of enrollees, s is test score

    $\rightarrow$ both quantity and quality (test score) matter
- Students
  - Unit measure, test score (s)
  - Idiosyncratic preference: with prob. $p, C_1 \succ C_2$
  - n is share of students who can afford the application costs (k)
  - Payoffs: U^F, U^S, 0

THEORETICAL FRAMEWORK

- College admission system
  - Decentralized
    * students apply before knowing their pref.
    * application costs
    * rejected admission offers → vacancies
  - Centralized
    * students apply after knowing their pref.
    * no application costs
    * only one offer is made to an applicant

THEORETICAL FRAMEWORK

- Pros and Cons of CM (rel. to decentralized admission)
  - Colleges
    * all quotas are filled
    * less preferred college may lose top applicants
  - Students
    * by eliminating unfilled seats, more students receive admission offers
    * “rich” students now face more competition with ”poor” students

THEORETICAL FRAMEWORK

- Impact on Students

  - ↑ in effective quota size

	Affordability of Application Costs	
	Yes (Rich)	No (Poor)
Test scores		
Group 1 (Highest) - s> s_2^D	Most preferred	C_1 → Most preferred
Group 2 - s_2^C<s< s_2^D	**C_1→ Most preferred**	**C_1 → Most preferred**
Group 3 - s_1^D<s< s_2^C	C_1	C_1
Group 4 (Lowest) - s_1^C<s< s_1^D	**No college→ C_1**	**No college→ C_1**

THEORETICAL FRAMEWORK

- Impact on Students

  - removing application costs → leveling the playing field

	Affordability of Application Costs	
	Yes (Rich)	No (Poor)
Test scores		
Group 1 (Highest) - s> s_2^D	Most preferred	**C_1 → Most preferred**
Group 2 - s_2^C<s< s_2^D	C_1 → Most preferred	**C_1 → Most preferred**
Group 3 - s_1^D<s< s_2^C	C_1	C_1
Group 4 (Lowest) - s_1^C<s< s_1^D	No college→ C_1	No college→ C_1

THEORETICAL FRAMEWORK

- Testable predictions
  - ↑ incentive to centralize

    if ↑ comparability btw C_1 and C_2 (i.e., $p \rightarrow 0.5$)

    & n & k are neither too large nor too small
  - ↓ Vacancies under centralized admission
  - Application costs

    → Decentralized system penalizes low SES students conditional on their test scores

    → Centralized system reduces the SES gap

EMPIRICAL ANALYSES

- Comparability

  - In 1967: only 8 CRUCH schools (effectively three)

    * 2 public schools (49%, 15%)

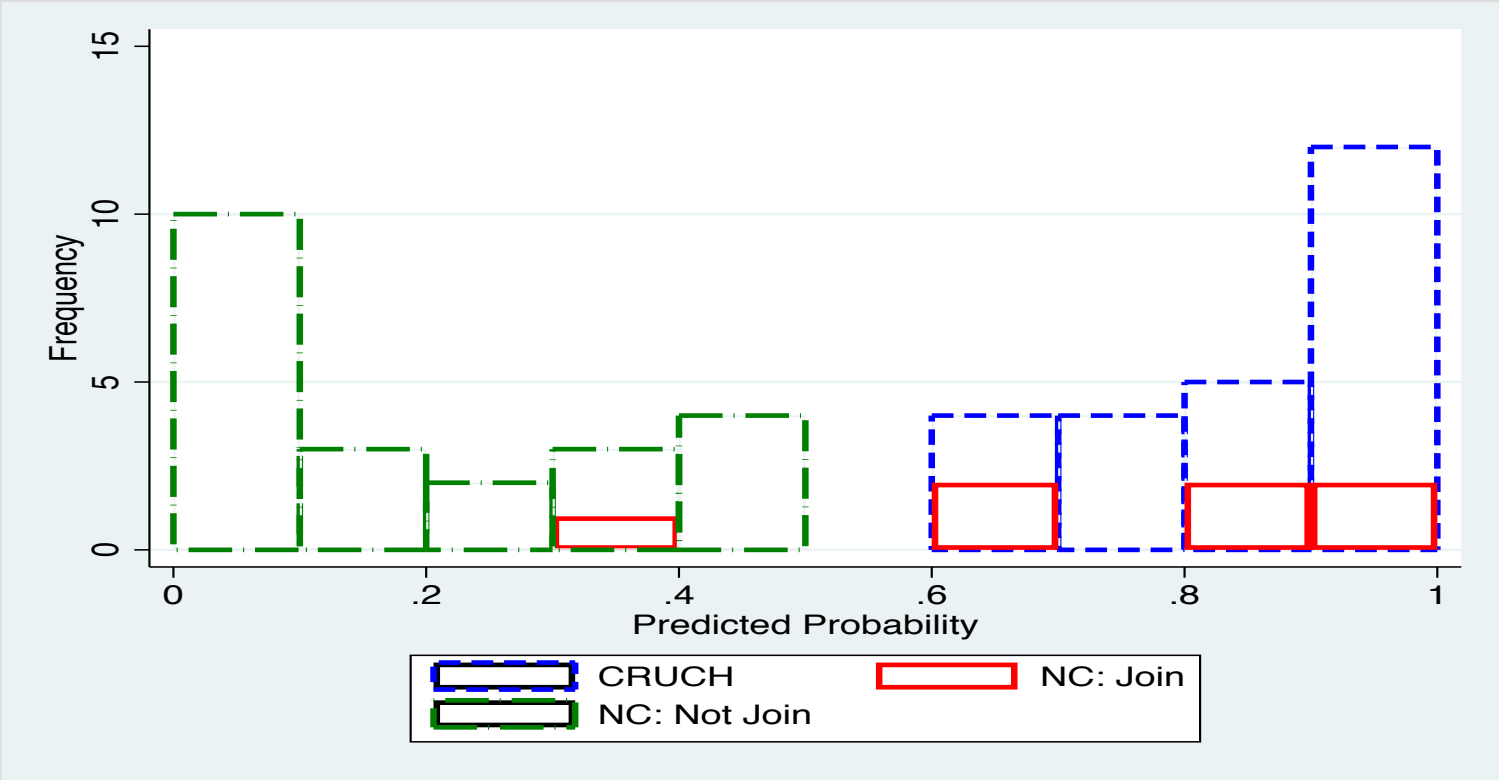
    * 6 private schools, all governed by the Catholic Church in Chile (35%)

  - In 2012: CRUCH, non-CRUCH(join), non-CRUCH(not)

Types	CRUCH	Non-CRUCH	
Centralized Admission (no. of colleges)	Yes (25)	Yes (7)	No (23)
	[Type1] (1)	[Type2] (2)	[Type3] (3)
Panel A. 2010–2011			
No. of majors offered	32.78	24.50	19.72
No. of new enrollees	2,179.42	2,642.50	1,873.63
PSU of new enrollees	587.79	610.74	497.21
Sum of PSU (thousand)	1,266.91	1,443.42	818.22
Share of students aged over 20	24.51%	23.08%	45.54%
Tuition (2009 USD)	4,091.87	6,541.59	3,940.43

EMPIRICAL ANALYSES

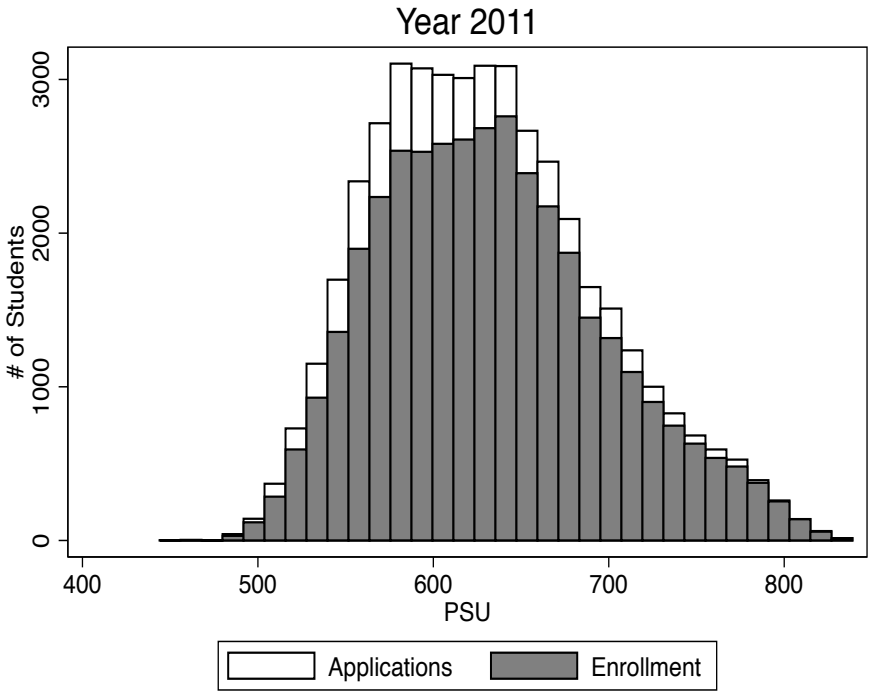
- Comparability
  - Linear Prob Model (2011 data): 1 if participated, 0 otherwise
  - Predicted probability: CRUCH vs. non-CRUCH



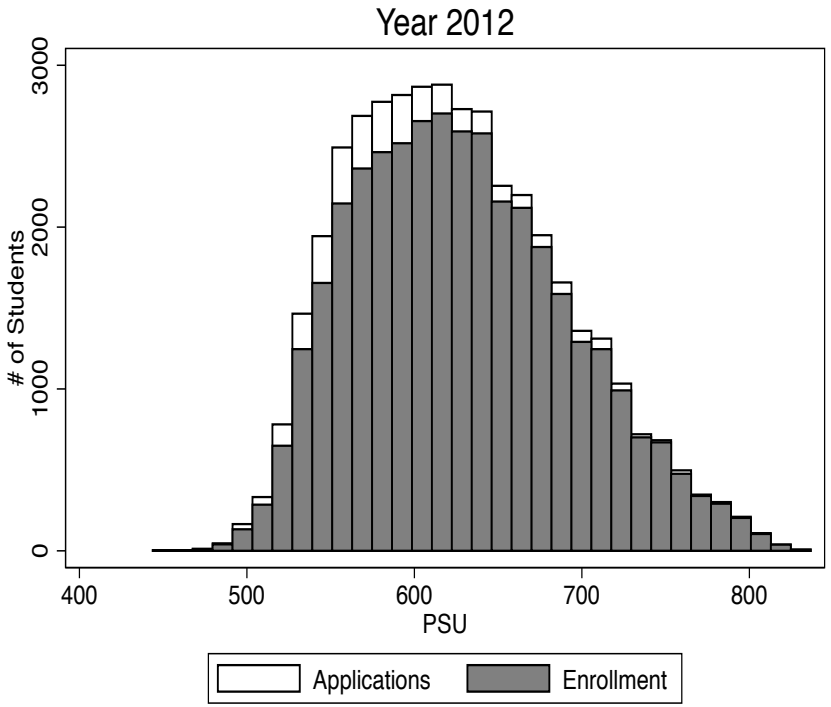
EMPIRICAL ANALYSES

- Incentives to Expand (or Participate in) the CM
  - Vacancy (CRUCH): 14.8% (2011) →7.7% (2012)

Before (14.8%)



After (7.7%)



EMPIRICAL ANALYSES

- Incentives to Expand (or Participate in) the CM
  - Payoffs $Y_{c,t} = \alpha + \beta_i Post_t x\ 1(Type_c = i) + \theta_c + \varepsilon_{c,t}$

2010, 11 vs. 2012, 13 | 2008. 9 vs. 2010, 11

Outcome	**Sum of test scores (1,000 pts.) Main**	# of Enrollees (person)	Avg scores (1 pt.)	**Sum of test scores (1,000 pts.) Falsification**
	(1)	(2)	(3)	**(4)**
Post x CRUCH (a)	-20.38	57.48	-8.56***	62.17*
	(30.91)	(64.93)	(1.38)	(33.79)
x non-CRUCH: join (b)	85.05	273.79**	-3.29	117.71*
	(58.42)	(122.71)	(2.61)	(63.86)
x non-CRUCH: not join (c)	-156.72***	-188.89***	-11.22***	182.24***
	(32.23)	(67.70)	(1.442)	(35.23)
Test (p-val)				
(a) = (b)	0.113	0.121	0.076	0.443
(a) = (c)	0.003	0.009	0.185	0.015
(b) = (c)	0.000	0.001	0.009	0.377
Mean Dep. V.	1,070	2,101	548	1,042
R^2	0.98	0.98	0.99	0.98
N	220	220	220	220

EMPIRICAL ANALYSES

- Student Outcomes by SES(app. high school type)

$$Y_{i,s,t} = \alpha_s + \beta_s Post_t \times 1(HS_{i,s,t} = s) + \gamma X_{i,s,t} + \varepsilon_{i,s,t}$$

$$with\ s\ \in Public(L) \in, Voucher(M), Private(H)$$

Outcome	Prestige	Enrollment: Type2	Prestige: Falsification	Preference ranking
	(1)	(2)	(3)	(4)
Post	2.533**	-0.009	-1.471*	0.083
	(0.538)	(0.009)	(0.591)	(0.063)
Post x Voucher	2.146**	0.027	-0.688	-0.206**
	(0.468)	(0.017)	(0.585)	(0.045)
x Public	2.342***	0.021	-0.420	-0.186**
	(0.343)	(0.015)	(0.450)	(0.047)
Voucher	-3.764***	-0.263***	-3.080***	0.322***
↓ 2.6% in income	(0.166)	(0.003)	(0.492)	(0.050)
Public	-2.616***	-0.295***	-2.214***	0.280***
	(0.147)	(0.004)	(0.362)	(0.048)
Test Score(PSU)	0.272***	-0.000**	0.272***	-0.000
	(0.003)	(0.000)	(0.003)	(0.000)
Mean Dep. V.	55.09	0.17	53.55	2.10
R^2	0.58	0.13	0.60	0.02
N	374,103	374,103	378,102	321,822

CONCLUSIONS

- Voluntary adoption of centralized matching
  - Theoretical and empirical analyses
- Policy implications & future work
  - Link btw market competition & efficiency
  - New policy tool to reduce inequality

EMPIRICAL ANALYSES

- Comparability

- Share of non-CRUCH in freshmen enrollments (p, n, & k)