Sophistication and Cautiousness in College Applications

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Summary

Objectives.

1. This paper provides a test of equilibrium in matching mechanisms in the field. We exploit the variation from the recent Chinese college admissions reforms. The mechanism has been changed from the Immediate Acceptance (IA) mechanism to Chinese parallel mechanisms.
2. This paper proposes and estimates a parsimonious behavioral model of college applications. We incorporate strategic naïveté and pessimistic beliefs of students.

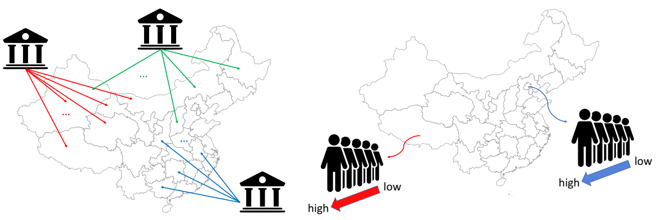
Results.

1. The equilibrium prediction is rejected. We observe that the matching became more assortative after the policy reforms.
2. Both strategic naïveté and pessimistic beliefs are important in explaining our observations. The distributional welfare effects of the reforms differ from what they could have obtained from the Deferred Acceptance (DA) mechanism.

Background and Data

Quota system in Chinese college admissions.

- Each university's seats are divided into 33 province-wide markets.
- Students participate in a centralized admission system in their province.
- Single exam score is used as common priority in each province.



Reforms of the mechanisms.

- Each province increased the number of "parallel" options e from 1 to 3, 4, 5, or 6 between 2003-2018.
- Chinese parallel mechanism with e (Chen and Kesten, 2017)

1. Run DA with the first e choices. Finalize the assignments.
2. With the remaining seats and students, run DA with the next e choices, and so on.

- e=1: IA, and e=∞: DA

Data.

- Administrative dataset with match outcomes and scores of all students admitted to universities in most provinces between 2005-2011.
- Data on the policy evolutions in all provinces.

Equilibrium

Model (of each province-wide market).

- College admissions model with a continuum of students and finite colleges.
- Every student knows her own ranking and has a common prior over the student types (preferences).

Proposition 1.

For any e, there exists a unique equilibrium matching μ^e under the parallel mechanism with e. Moreover, $\mu^e = \mu^{e'}$ for any $e, e' \in \{1, \dots, \infty\}$.

Evidence against Proposition 1.

- We need to control the potential endogeneity of e: heterogeneity in student preferences, quotas, exam difficulties etc. across provinces and years.
- Take each subset of students who could be admitted to the same set of colleges.
- Consider the following regressions:

$$g_i^j = \xi_1 + \sum_{e=3,4,5,6} \xi_2^e d_i^e + \text{(provincial fixed effects)} + \text{(year fixed effects)} + \epsilon_i$$

g_i^j: dummy of being matched to college group j, d_i^e: policy dummy

- Colleges are grouped into 12 groups according to the external ranking.

Students above all the cutoff scores

Matched college	Group 1-2	Group 3-6	Group 7-12
	(1)	(2)	(3)
Parallel option $e = 3$	0.0734***	-0.0649***	-0.00849
	(0.0104)	(0.0126)	(0.0115)
Parallel option $e = 4$	0.0653***	-0.0251	-0.0401***
	(0.0154)	(0.0166)	(0.0140)
Parallel option $e = 5$	0.0912***	-0.0667***	-0.0245**
	(0.0124)	(0.0134)	(0.0118)
Parallel option $e = 6$	0.000166	-0.0305	0.0303
	(0.0300)	(0.0332)	(0.0267)
	(0.0114)	(0.0126)	(0.0113)
Province FE	X	X	X
Year FE	X	X	X
Observations	33,660	33,660	33,660
R-squared	0.139	0.092	0.165

Students just below top 6 college groups

Matched college	Group 7	Group 8	Group 9-12
	(1)	(2)	(3)
Parallel option $e = 3$	0.0581***	0.0503***	-0.107***
	(0.00125)	(0.00268)	(0.00272)
Parallel option $e = 4$	0.0662***	0.0588***	-0.125***
	(0.00185)	(0.00356)	(0.00365)
Parallel option $e = 5$	0.138***	0.160***	-0.297***
	(0.00199)	(0.00311)	(0.00309)
Parallel option $e = 6$	0.0145***	0.0353***	-0.0493***
	(0.00183)	(0.00467)	(0.00477)
	(0.00137)	(0.00220)	(0.00237)
Province FE	X	X	X
Year FE	X	X	X
Observations	728,090	728,090	728,090
R-squared	0.089	0.045	0.068

Behavioral Types

Three behavioral types.

- Rational type: has the correct belief over the student (preference and behavioral) types and is strategically sophisticated.
- Naïve type: always reports the true preference ranking.
- Cautious type: has the pessimistic belief and is strategically sophisticated.
  - Pessimistic belief: worst case out of all the beliefs that are consistent with the equilibrium ranking of colleges

strategies \ beliefs	neutral	pessimistic
naive	Naive	Naive
sophisticated	Rational	Cautious

- Assume that the fraction of each type is independent of preferences and scores.

Equilibrium assignment probabilities.

- We obtain closed-form equilibrium assignment probabilities for the utility function with type-I extreme value errors.

Identification.

- The utility and behavioral type parameters are identified under Assumption I: the utility vector and the score are independently distributed.

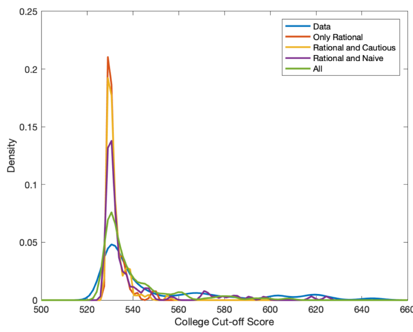
Estimations

MLE estimates from Hebei Province.

- 58% of naïve and 12% of cautious students; both significant.

Parameters	school quality	distance	naive	pessimistic
Estimates	0.0074	-4.0237e-07	0.5845	0.2876
s.e.	0.0008	1.4813e-08	0.0086	0.0105
t-stat	8.71	27.16	68.02	27.51

Model fit.



Welfare Analyses

Three welfare measures (for student with score s_i under parallel e).

1. Expected utility $EU^e(s_i)$
2. Extensive margin $\underline{P}^e(s_i)$: the probability of being assigned to the outside option
3. Intensive margin $CU^e(s_i)$: the expected utility conditional on being assigned

Proposition 2. (Direct effects.)

For any $e, e' \in \{1, \dots, \infty\}$ with $e < e'$ and student with score s_i for whom the available set and the safe set of colleges do not change between e and e', the following holds: (each subscript represents the behavioral type)

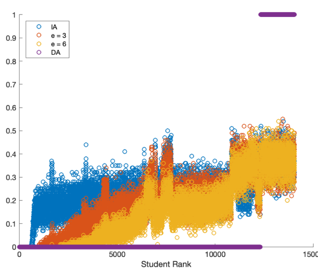
1. $EU_R^e(s_i) = EU_R^{e'}(s_i)$, $EU_N^e(s_i) \le EU_N^{e'}(s_i)$, and $EU_C^e(s_i) \le EU_C^{e'}(s_i)$.
2. $\underline{P}_R^e(s_i) = \underline{P}_R^{e'}(s_i) = 0$, $\underline{P}_N^e(s_i) \ge \underline{P}_N^{e'}(s_i)$, and $\underline{P}_C^e(s_i) = \underline{P}_C^{e'}(s_i) = 0$.
3. $CU_R^e(s_i) = CU_R^{e'}(s_i)$, $CU_N^e(s_i) \ge CU_N^{e'}(s_i)$, and $CU_C^e(s_i) \le CU_C^{e'}(s_i)$.

Proposition 3. (General equilibrium effects.)

For any regular problems and student with score s_i, the set of available colleges under the parallel mechanism with e shrinks as e increases.

- Simulations show that the implemented policies (e=3,4,5,6) changed the welfare distribution from IA, but still not all the way to the one from DA.

Extensive margin



Intensive margin