College Admission in Three Chinese Provinces: Province-Specific versus Pooling Quotas*

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Abstract

Regarding college admissions in China, each college has a quota for each province. Under this province-specific quota system, students in different provinces do not compete with each other and are not differentiated after admission. As opposed to the pooling quota system, where each college has a quota for multiple provinces, the province-specific quota system may introduce unfairness and inefficiency. In this paper, I develop a model based on Pu (2018) to empirically compare the two systems in Guangxi, Hebei, and Sichuan in 2006 and 2007. I find that pooling quotas improve students' welfare and so does combining quotas for more provinces. However, students in some provinces have lower utility after pooling the quotas. Since students are treated equally after pooling, the results indicate the unfairness of the province-specific quota system. All results indicate the government should abandon the province-specific quota system.

JEL classification: D47, D61, I23, I24.

Keywords: College admission; China.

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1. Introduction

The annual college entrance examination is considered the most important exam in China. The students are assigned to colleges after the exam based on their scores and preferences. Currently, each college in China has a quota for each province. In other words, students in different provinces do not compete with each other. For example, Peking University planned to admit 31 science major students in Sichuan and 111 in Beijing in 2016,[1] while the population of Sichuan is four times larger than that of Beijing.[2] Obviously, it is more likely for a student in Beijing to be admitted by Peking University than for one in Sichuan. Additionally, the colleges do not differentiate between students after enrollment. As such, the province-specific quota is largely criticized for its unfairness as some provinces (e.g., Beijing) may have higher quotas than other provinces (e.g., Sichuan).[3] Meanwhile, its effectiveness is also debatable. Intuitively, if colleges pool quotas instead of maintaining province-specific ones, a student will have more choices (higher quota from a college), but will face fiercer competition (more students compete for each slot). In this paper, I compare social welfare under the province-specific and pooling quota systems. Furthermore, I quantify the unfairness faced by students according to their province. To the best of my knowledge, no literature has studied the province-specific and pooling quota systems, while this study indicates that ignoring this issue raises effectiveness and fairness concerns.

In the empirical analysis, I counterfactually pool college quotas for any two or all three

[1] The data are obtained from gotopku.cn.

[2] According to the 2010 population census of the People's Republic of China, the population of Sichuan is 80,418,200, whereas that of Beijing is 19,612,000.

[3] According to sina.com.cn, 24.42% of students were admitted by key universities in Beijing in 2013 – 2015, as opposed to 5.37% of students in Sichuan.

regions of Guangxi, Hebei, and Sichuan. For example, Sichuan University admits 173 students in Guangxi and 216 in Hebei. If I pool the quotas for Guangxi and Hebei, Sichuan University admits 389 students in Guangxi and Hebei. The results suggest that social welfare increases after pooling the quotas under both the deferred acceptance (DA) and Boston mechanisms (BM).[4] Additionally, pooling the quotas for more provinces always yields a higher social welfare. In most cases, the performances of BM and DA become more similar, and the advantage of BM reduces after pooling. This suggests that we can implement DA after pooling the quotas because this mechanism is Pareto efficient, justified-envy free, and strategy-proof, and we do not need to significantly sacrifice welfare.

However, not all students benefit from pooling the quotas. For instance, science majors in Hebei will lose 19.094% of their utility after pooling the quotas of the three provinces in 2007, while the utility of those in Sichuan increases by 15.162%. The results suggest unfairness before pooling the quotas, as students are treated equally after pooling.

The remainder of this paper is organized as follows: I review the relevant literature in section 2, present the model in section 3, conduct the empirical analysis in section 4, and conclude with section 5.

2. Literature review

In school matching problems, to maximize students' utility, extant literature only focuses on comparing mechanisms. Theoretically, early literature concludes that DA is a better choice. For instance, Abdulkadiroğlu and Sönmez (2003) proved that DA is Pareto efficient,

[4]See the description of the two mechanisms in Appendix A in Pu (2018)

while Ergin and Sönmez (2006) proved it is more efficient under ordinal preference. Recently, Abdulkadiroğlu, Che and Yasuda (2011, 2015) demonstrated that BM is more efficient under cardinal preference and coarse priority. Empirically, extant literature (Agarwal and Somaini, 2018; Calsamiglia, Fu and Güell, 2017; He, 2017; Hwang, 2016; Pu, 2018) has found that BM is more efficient under cardinal preference. Instead of comparing mechanisms, this study analyzes how the change in market size improves students' utility. I find that the utilities under both mechanisms increase after colleges pool the quota and form a larger market.

"Size matters" (Abdulkadiroğlu, 2013)the difference between the two mechanisms may disappear in a large market. The random serial dictatorship mechanism (RS) is strategy-proof, but not efficient, whereas the probabilistic serial mechanism is efficient, but not strategy-proof. Che and Kojima (2010) proved that the two mechanisms are equivalent in a large market, and thus nearly no efficiency losses arise from implementing RS in this case. Pu (2018) provided a similar result. DA is Pareto efficient, justified-envy free, and strategy-proof, while BM is more efficient under cardinal preference. Further, the author proved that the performances of BM and DA are the same, and most students report true preferences when each college admits a large number of students. However, to the best of my knowledge, the literature only analyzed the problem theoretically. In this study, I empirically compare the differences in the performances of BM and DA before and after pooling quotas. I find that the differences diminish after pooling, consistent with the theorem of Pu (2018).

3. Model

3.1. Boston Mechanism

In the BM, I assume the number of students to be infinite. The second choice of a student will never be considered because quotas will always be filled up by the first choices of students. The students will select their first choice strategically to maximize their utilities. Consistent with Pu (2018), the utility of the ith ranked student (student i thereafter) in each province p selecting college l as his/her first choice is

$$U_{ilp} = (\xi_{lp} + \varepsilon_{ilp})\mathbb{P}_l^a(i, \boldsymbol{A}_p) - \inf \mathbb{1}\Big(\mathbb{P}_l^a(i, \boldsymbol{A}_p) < 0.01\Big),$$

where ξ_{lp} is the fixed effect of college l in province p, as estimated in Pu (2018). ε_{ilp} is the private preference of student i, which is i.i.d. random to economists. $\xi_{lp} + \varepsilon_{ilp}$ is the utility student i receives if admitted. If student i is rejected, I assume student i receives zero. Therefore, $(\xi_{lp} + \varepsilon_{ilp})\mathbb{P}_l^a(i, \boldsymbol{A}_p)$ is the expected utility from applying to college l, in which $\mathbb{P}_l^a(i, \boldsymbol{A}_p)$ is the students probability of being admitted by college l. The student rules out college l from his/her candidate list if the admission probability is too low. Similar to the utility of rejection, students receive zero from the outside option (i.e., $U_{i0p} = 0$).

A student will maximize his/her utility, so he/she selects $l^* = \arg\max_l U_{ilp}$. Since I am unable to observe the private preference of the student, I can only calculate the probability of choosing college l ($\mathbb{P}_l^c(i, \boldsymbol{A}_p)$) and the respective expected utility ($\mathbb{E}\Big(\max(U_{ilp})|\boldsymbol{\varepsilon}_{ip}\Big)$), where I use the relationship between admission and choice probabilities from Lemma 1 in

Pu (2018):

$$\mathbb{P}_l^a(i, A_{lp}; A_{-lp}) = \mathbb{P}_l^a(i-1, A_{lp}; A_{-lp})(1-\mathbb{P}_l^c(i-1, \boldsymbol{A}_p)) + \mathbb{P}_l^a(i-1, A_{lp}-1; A_{-lp})\mathbb{P}_l^c(i-1, \boldsymbol{A}_p),$$

where A_{lp} is college l's quota in province p. In other words, this recursive function indicates that the admission probability of student i depends on the choice probabilities of the students ranked higher than him/her.

I sum up the expected utilities of all students and yield the welfare of students under BM in province p as:

$$W_p^B = \sum_i \mathbb{E}\Big(\max(U_{ilp}) | \boldsymbol{\varepsilon}_{ip} \Big).$$

Then, let us consider the colleges pool quotas in several provinces, that is, the colleges allocate a quota $\boldsymbol{A}_{\tilde{p}} = \sum_{j\in\{1,2,\ldots,J\}} \boldsymbol{A}_{p_j}$ to the students in provinces 1, 2, ..., and J. Student i in province p_j will be randomly assigned a rank $\tilde{i}$ in the super province $\tilde{p}$, provided that: 1) if $i < i'$ in province j, $\tilde{i} < \tilde{i}'$; and 2) if $i > i'$ in province j, $\tilde{i} > \tilde{i}'$. This assignment ensures that the ranking of students in a province remains the same after pooling. Additionally, the students in each province will also maintain their preferences after pooling, and the utility of student $\tilde{i}$ selecting college l as his/her first choice is

$$U_{\tilde{i}l\tilde{p}} = (\xi_{lp} + \varepsilon_{ilp})\mathbb{P}_l^a(\tilde{i}, \boldsymbol{A}_{\tilde{p}}) - \inf \mathbb{1}\Big(\mathbb{P}_l^a(\tilde{i}, \boldsymbol{A}_{\tilde{p}}) < 0.01\Big),$$

where the utility that he/she can receive from college l, if admitted after pooling (i.e.,

$\xi_{lp} + \varepsilon_{ilp}$), is the same as the utility received as student i in province p before pooling. I can calculate his/her expected utility $\mathbb{E}\Big(\max(U_{\tilde{i}l\tilde{p}})|\boldsymbol{\varepsilon}_{ip}\Big)$ and the welfare of all students as:

$$W_{\tilde{p}}^{B} = \sum_{\tilde{i}} \mathbb{E}\Big(\max(U_{\tilde{i}l\tilde{p}})|\boldsymbol{\varepsilon}_{ip}\Big).$$

3.2. Deferred Acceptance Mechanism

Under DA, students will report their true preferences (Dubins and Freedman, 1981) and be assigned to the best available colleges according to rank. The utility of student i in province p admitted by college l is:

$$V_{ilp} = \xi_{lp} + \varepsilon_{ilp},$$

where I do not include the admission probability ($\mathbb{P}_l^a(i, \boldsymbol{A}_p)$) in the model as I did in BM because the students will report their preferences truthfully without considering admission probabilities. However, a student may not be able to choose all colleges, as college l may already admit sufficient students prior to student i. I denote the available quota of college l when student i chooses by A_{il}. If and only if $A_{il} > 0$, college l is available to student i. Therefore, student i will be assigned to the best available college l_i, satisfying

$$l_i = \underset{l \in \{l' : A_{il'} > 0\} \bigcup \{0\}}{\arg\max} V_{il'p},$$

where $\boldsymbol{A}_i$ is defined recursively: 1) $\boldsymbol{A}_1 = \boldsymbol{A}$, 2) $A_{(i'+1)l_{i'}} = A_{i'l_{i'}} - 1$, and 3) $A_{(i'+1)l_{-i'}} = A_{i'l_{-i'}}$ for all i'. In other words, if student i' chooses college $l_{i'}$, the available quota of this college

for student $i'+1$ deducts one slot, while that of other colleges remains the same with that for student i'. As economists are unable to observe private preferences, I can only calculate student i's expected utility $\mathbb{E}(V_{il_ip}|\boldsymbol{\varepsilon}_{1p}, \boldsymbol{\varepsilon}_{2p}, \ldots, \boldsymbol{\varepsilon}_{ip})$. Here, the expected utility, as well as the choice of student i, depends on the choices of other students, instead of the choice probabilities of other students, as in BM. Therefore, the utility of student i also depends on the private preferences of all students ranked higher than him/her. Then, I add the expected utilities of all students to yield the welfare of students under DA in province p:

$$W_p^D = \sum_i \mathbb{E}(V_{il_ip}|\boldsymbol{\varepsilon}_{1p}, \boldsymbol{\varepsilon}_{2p}, \ldots, \boldsymbol{\varepsilon}_{ip}).$$

If the colleges pool quotas, student i in province p_j will be assigned a rank $\tilde{i}$ in the super province $\tilde{p}$, as in BM. His/her utility of being admitted by college l is:

$$V_{\tilde{i}l\tilde{p}} = V_{ilp} = \xi_{lp} + \varepsilon_{ilp}.$$

In other words, his/her preference will not change after pooling. Additionally, he/she will choose the best available college as:

$$l_{\tilde{i}} = \underset{l \in \{l': A_{\tilde{i}l'} > 0\} \bigcup \{0\}}{\arg\max} V_{\tilde{i}l'\tilde{p}}.$$

Then, I can calculate the expected utility as $\mathbb{E}(V_{\tilde{i}l_{\tilde{i}}\tilde{p}}|\boldsymbol{\varepsilon}_{\tilde{1}\tilde{p}}, \boldsymbol{\varepsilon}_{\tilde{2}\tilde{p}}, \ldots, \boldsymbol{\varepsilon}_{\tilde{i}\tilde{p}})$,

and the social welfare of all the students as:

$$W_{\tilde{p}}^D = \sum_{\tilde{i}} \mathbb{E}(V_{\tilde{i}l_{\tilde{i}}\tilde{p}}|\boldsymbol{\varepsilon}_{\tilde{1}\tilde{p}}, \boldsymbol{\varepsilon}_{\tilde{2}\tilde{p}}, \ldots, \boldsymbol{\varepsilon}_{\tilde{i}\tilde{p}}).$$

In the empirical section, I compare the welfare under pooling quotas (i.e., $W_{\tilde{p}}^B$ and $W_{\tilde{p}}^D$) and that under province-specific quotas (i.e., $\sum_j W_{p_j}^B$ and $\sum_j W_{p_j}^D$). If the former is larger, students receive higher utility under the pooling quotas. To enhance their utility, I suggest pooling quotas.

4. Empirical Results

I use the same data as Pu (2018).[5] The data contain three Chinese provinces (Guangxi, Hebei, and Sichuan) in two years (2006 and 2007). I report the results in Table I and II. In Table I, I report the total welfare of each of the three provinces under each of the two mechanisms before pooling the quotas for the upper half of the first three columns in each panel. I compare total welfare before and after pooling the quotas in the following columns. In Table II, I compare the welfares of students in one province before and after pooling the quotas.

From Table I, total welfare significantly increases only if I pool the quotas. For example, for arts major students in 2006, their welfare in Guangxi and Hebei will increase by 9.182% under BM and 10.452% under DA after pooling the quotas of the two provinces. If I pool the quotas of all three provinces, welfare will increase by 7.628% under BM and 9.388% under DA. I emphasize that the results do not suggest that pooling the quotas of the two provinces is better than doing it for all three provinces. In the lower half of each panel, I compare the welfare after pooling the quotas of the two provinces and of the three provinces. Welfare increases by 2.329% under BM and 3.310% under DA if I pool the quotas of all the three

[5]See the data description in section 5.1 in Pu (2018).

provinces instead of pooling the quotas of only Guangxi and Hebei. In fact, the results show that welfare increases more if I pool the quotas of more provinces.

Additionally, most (23 out of 28) results suggest that welfare increases more under DA than under BM. In Theorem 7 of Pu (2018), the results of the two mechanisms will become more similar when colleges admit more students, and the colleges admit more students after pooling the quotas. Therefore, the advantage of BM decreases, and the results verify the theory empirically.

As shown in Table II, the students in some provinces may benefit from the pooling quotas, while others may receive lower utility. For instance, science major students in Sichuan always benefit from the pooling quotas, whereas students in Hebei always receive lower utility from pooling the quotas. Since the students in different provinces are treated similarly after pooling the quotas, the results indicate an unfairness before pooling, that is, students in Sichuan may have fewer opportunities than those in Hebei under the province-specific quota system.

Table I: Total Welfare Change after Pooling Quotas

Panel A: Total Welfare Change after Pooling Quotas under Boston Mechanism

Year	Major		$\overline{W}^B_G$[a]	$\overline{W}^B_H$	$\overline{W}^B_S$	$\overline{W}^B_G+\overline{W}^B_H$	$\overline{W}^B_{\{G,H\}}$	Δ%	$\overline{W}^B_G+\overline{W}^B_S$	$\overline{W}^B_{\{G,S\}}$	Δ%	$\overline{W}^B_H+\overline{W}^B_S$	$\overline{W}^B_{\{H,S\}}$	Δ%
2006	Arts	Estimates	4731.25	2889.47	5801.70	7620.72	8316.15	9.126%	10532.95	10979.60	4.241%	8691.18	8844.73	1.767%
		Std.	–	–	–	–	3.29	0.043%	–	1.04	0.010%	–	0.33	0.004%
	Science	Estimates	14301.41	13287.77	41577.92	27589.18	28703.90	4.040%	55879.33	56848.53	1.734%	54865.69	58142.38	5.972%
		Std.	–	–	–	–	1.31	0.005%	–	1.64	0.003%	–	3.38	0.006%
2007	Arts	Estimates	4731.25	2889.47	5801.70	7620.72	8317.38	9.142%	10532.95	10980.51	4.249%	8691.18	8844.42	1.763%
		Std.	–	–	–	–	3.19	0.042%	–	0.99	0.009%	–	0.35	0.004%
	Science	Estimates	14304.51	15487.14	45807.87	29791.65	30460.28	2.244%	60112.39	61929.76	3.023%	61295.01	63814.81	4.111%
		Std.	–	–	–	–	0.86	0.003%	–	2.96	0.005%	–	4.20	0.007%

Year	Major		$\overline{W}^B_G+\overline{W}^B_{\{H,S\}}$	$\overline{W}^B_{\{G,H,S\}}$	Δ%	$\overline{W}^B_H+\overline{W}^B_{\{G,S\}}$	$\overline{W}^B_{\{G,H,S\}}$	Δ%	$\overline{W}^B_S+\overline{W}^B_{\{G,H\}}$	$\overline{W}^B_{\{G,H,S\}}$	Δ%	$\overline{W}^B_G+\overline{W}^B_H+\overline{W}^B_S$	$\overline{W}^B_{\{G,H,S\}}$	Δ%
2006	Arts	Estimates	13575.98	14446.54	6.413%	13869.08	14446.54	4.164%	14117.85	14446.54	2.329%	13422.42	14446.54	7.630%
		Std.	0.33	3.30	0.024%	1.04	3.30	0.025%	3.29	3.30	0.034%	–	3.30	0.025%
	Science	Estimates	72443.79	73475.35	1.424%	70136.30	73475.35	4.761%	70281.82	73475.35	4.544%	69167.09	73475.35	6.229%
		Std.	3.38	3.88	0.007%	1.64	3.88	0.006%	1.31	3.88	0.006%	–	3.88	0.006%
2007	Arts	Estimates	13575.67	14446.13	6.412%	13869.98	14446.13	4.154%	14119.08	14446.13	2.317%	13422.42	14446.13	7.627%
		Std.	0.35	3.41	0.025%	0.99	3.41	0.025%	3.19	3.41	0.034%	–	3.41	0.025%
	Science	Estimates	78119.32	79679.19	1.997%	77416.90	79679.19	2.922%	76268.16	79679.19	4.472%	75599.52	79679.19	5.396%
		Std.	4.20	5.01	0.008%	2.96	5.01	0.008%	0.86	5.01	0.007%	–	5.01	0.007%

Panel B: Total Welfare Change after Pooling Quotas under Deferred Acceptance Mechanism

Year	Major		$\overline{W}^D_G$	$\overline{W}^D_H$	$\overline{W}^D_S$	$\overline{W}^D_G+\overline{W}^D_H$	$\overline{W}^D_{\{G,H\}}$	Δ%	$\overline{W}^D_G+\overline{W}^D_S$	$\overline{W}^D_{\{G,S\}}$	Δ%	$\overline{W}^D_H+\overline{W}^D_S$	$\overline{W}^D_{\{H,S\}}$	Δ%
2006	Arts	Estimates	4416.74	2769.67	5578.75	7186.41	7937.56	10.452%	9995.49	10517.91	5.227%	8348.42	8557.92	2.509%
		Std.	–	–	–	–	2.66	0.037%	–	0.73	0.007%	–	0.21	0.003%
	Science	Estimates	13838.78	13063.57	40184.56	26902.35	28147.25	4.627%	54023.34	55386.28	2.523%	53248.13	56933.32	6.921%
		Std.	–	–	–	–	0.99	0.004%	–	1.16	0.002%	–	2.12	0.004%
2007	Arts	Estimates	4218.70	2511.96	6285.91	6730.66	6910.27	2.669%	10504.61	10755.68	2.390%	8797.87	9148.51	3.986%
		Std.	–	–	–	–	0.45	0.007%	–	0.26	0.002%	–	0.68	0.008%
	Science	Estimates	14026.28	14944.07	44201.94	28970.35	29820.67	2.935%	58228.22	60570.71	4.023%	59146.01	62300.06	5.333%
		Std.	–	–	–	–	0.67	0.002%	–	2.03	0.003%	–	3.13	0.005%

Year	Major		$\overline{W}^D_G+\overline{W}^D_{\{H,S\}}$	$\overline{W}^D_{\{G,H,S\}}$	Δ%	$\overline{W}^D_H+\overline{W}^D_{\{G,S\}}$	$\overline{W}^D_{\{G,H,S\}}$	Δ%	$\overline{W}^D_S+\overline{W}^D_{\{G,H\}}$	$\overline{W}^D_{\{G,H,S\}}$	Δ%	$\overline{W}^D_G+\overline{W}^D_H+\overline{W}^D_S$	$\overline{W}^D_{\{G,H,S\}}$	Δ%
2006	Arts	Estimates	12974.65	13963.58	7.622%	13287.58	13963.58	5.087%	13516.31	13963.58	3.310%	12765.16	13963.58	9.388%
		Std.	0.21	2.82	0.022%	0.73	2.82	0.022%	2.66	2.82	0.030%	–	2.82	0.022%
	Science	Estimates	70772.10	72077.46	1.844%	68449.85	72077.46	5.300%	68331.81	72077.46	5.482%	67086.91	72077.46	7.439%
		Std.	2.12	2.54	0.005%	1.17	2.54	0.004%	0.98	2.54	0.004%	–	2.54	0.004%
2007	Arts	Estimates	13367.21	13655.47	2.157%	13267.64	13655.47	2.923%	13196.18	13655.47	3.480%	13016.57	13655.47	4.908%
		Std.	0.68	0.83	0.008%	0.26	0.83	0.007%	0.46	0.83	0.007%	–	0.83	0.006%
	Science	Estimates	76326.33	78270.97	2.548%	75514.79	78270.97	3.650%	74022.60	78270.97	5.739%	73172.29	78270.97	6.968%
		Std.	3.13	3.27	0.006%	2.04	3.27	0.005%	0.68	3.27	0.005%	–	3.27	0.004%

[a] Student i will be randomly assigned a rank $\tilde{i}$ in the super province $\tilde{p}$ after pooling the quotas, which contributes the randomness to the total welfare ($W^{\bullet}_{\bullet}$). I report the mean ($\overline{W}^{\bullet}_{\bullet}$) and its standard error of the total welfares from 114 (BM) or 224 (DA) repetitions .

Table II: Provincial Welfare Change after Pooling Quotas

Panel A: Provincial Welfare Change after Pooling Quotas under Boston Mechanism

Year	Major		$\overline{W}^B_G$ [a]	$\overline{W}^B_{G\{G,H\}}$ [b]	Δ%	$\overline{W}^B_{G\{G,S\}}$	Δ%	$\overline{W}^B_{G\{G,H,S\}}$	Δ%
2006	Arts	Estimates	4731.25	5966.62	26.111%	5952.96	25.822%	6641.31	40.371%
		Std.	–	5.39	0.114%	3.82	0.081%	7.00	0.148%
	Science	Estimates	14301.41	17065.04	19.324%	14287.60	-0.097%	15418.03	7.808%
		Std.	–	5.94	0.042%	6.26	0.044%	7.25	0.051%
2007	Arts	Estimates	4731.25	5962.87	26.032%	5954.75	25.860%	6628.48	40.100%
		Std.	–	5.78	0.122%	4.35	0.092%	6.95	0.147%
	Science	Estimates	14304.51	15441.07	7.945%	13646.75	-4.598%	14400.42	0.670%
		Std.	–	5.88	0.041%	6.02	0.042%	7.77	0.054%

Year	Major		$\overline{W}^B_H$	$\overline{W}^B_{H\{G,H\}}$	Δ%	$\overline{W}^B_{H\{H,S\}}$	Δ%	$\overline{W}^B_{H\{G,H,S\}}$	Δ%
2006	Arts	Estimates	2889.47	2353.84	-18.538%	2745.45	-4.984%	2439.92	-15.558%
		Std.	–	2.67	0.092%	2.33	0.081%	3.67	0.127%
	Science	Estimates	13287.77	11638.37	-12.413%	10674.09	-19.670%	10387.24	-21.829%
		Std.	–	5.34	0.040%	5.82	0.044%	6.86	0.052%
2007	Arts	Estimates	2889.47	2357.18	-18.422%	2747.23	-4.923%	2444.69	-15.393%
		Std.	–	2.75	0.095%	2.50	0.087%	3.30	0.114%
	Science	Estimates	15487.14	15018.17	-3.028%	12383.94	-20.037%	12530.03	-19.094%
		Std.	–	6.25	0.040%	7.44	0.048%	8.37	0.054%

Year	Major		$\overline{W}^B_S$	$\overline{W}^B_{S\{G,S\}}$	Δ%	$\overline{W}^B_{S\{H,S\}}$	Δ%	$\overline{W}^B_{S\{G,H,S\}}$	Δ%
2006	Arts	Estimates	5801.70	5026.34	-13.364%	6099.39	5.131%	5365.07	-7.526%
		Std.	–	2.90	0.050%	2.51	0.043%	4.22	0.073%
	Science	Estimates	41577.92	42563.21	2.370%	47470.81	14.173%	47673.96	14.662%
		Std.	–	7.74	0.019%	9.02	0.022%	11.31	0.027%
2007	Arts	Estimates	5801.70	5025.10	-13.386%	6097.03	5.090%	5368.42	-7.468%
		Std.	–	3.30	0.057%	2.69	0.046%	3.75	0.065%
	Science	Estimates	45807.87	48283.09	5.403%	51427.92	12.269%	52753.40	15.162%
		Std.	–	8.40	0.018%	11.44	0.025%	13.83	0.030%

Panel B: Provincial Welfare Change after Pooling Quotas under Deferred Acceptance Mechanism

Year	Major		$\overline{W}^D_G$	$\overline{W}^D_{G\{G,H\}}$	Δ%	$\overline{W}^D_{G\{G,S\}}$	Δ%	$\overline{W}^D_{G\{G,H,S\}}$	Δ%
2006	Arts	Estimates	4416.74	5704.73	29.161%	5728.79	29.706%	6458.96	46.238%
		Std.	–	4.49	0.102%	3.15	0.071%	5.49	0.124%
	Science	Estimates	13838.78	16766.83	21.158%	13857.88	0.138%	15103.63	9.140%
		Std.	–	4.33	0.031%	4.82	0.035%	6.00	0.043%
2007	Arts	Estimates	4218.70	4734.70	12.231%	4559.83	8.086%	4919.03	16.601%
		Std.	–	1.74	0.041%	1.44	0.034%	2.27	0.054%
	Science	Estimates	14026.28	15151.81	8.024%	13273.25	-5.369%	14073.86	0.339%
		Std.	–	4.84	0.034%	4.46	0.032%	5.67	0.040%

Year	Major		$\overline{W}^D_H$	$\overline{W}^D_{H\{G,H\}}$	Δ%	$\overline{W}^D_{H\{H,S\}}$	Δ%	$\overline{W}^D_{H\{G,H,S\}}$	Δ%
2006	Arts	Estimates	2769.67	2232.84	-19.383%	2649.67	-4.333%	2337.44	-15.606%
		Std.	–	2.06	0.075%	1.96	0.071%	2.39	0.086%
	Science	Estimates	13063.57	11380.43	-12.884%	10359.48	-20.700%	10111.30	-22.599%
		Std.	–	3.90	0.030%	4.13	0.032%	4.61	0.035%
2007	Arts	Estimates	2511.96	2175.57	-13.391%	2225.15	-11.418%	1983.02	-21.057%
		Std.	–	1.99	0.079%	1.65	0.066%	2.59	0.103%
	Science	Estimates	14944.07	14668.85	-1.842%	11880.90	-20.498%	12159.96	-18.630%
		Std.	–	5.18	0.035%	5.98	0.040%	6.75	0.045%

Year	Major		$\overline{W}^D_S$	$\overline{W}^D_{S\{G,S\}}$	Δ%	$\overline{W}^D_{S\{H,S\}}$	Δ%	$\overline{W}^D_{S\{G,H,S\}}$	Δ%
2006	Arts	Estimates	5578.75	4789.12	-14.154%	5908.25	5.906%	5167.18	-7.378%
		Std.	–	2.43	0.044%	2.06	0.037%	2.77	0.050%
	Science	Estimates	40184.56	41528.39	3.344%	46573.85	15.900%	46862.53	16.618%
		Std.	–	5.86	0.015%	6.18	0.015%	8.37	0.021%
2007	Arts	Estimates	6285.91	6195.85	-1.433%	6923.36	10.141%	6753.42	7.437%
		Std.	–	1.65	0.026%	2.30	0.037%	2.70	0.043%
	Science	Estimates	44201.94	47297.46	7.003%	50419.15	14.065%	52037.14	17.726%
		Std.	–	6.11	0.014%	9.08	0.021%	9.43	0.021%

[a] Student i will be randomly assigned a rank $\tilde{i}$ in the super province $\tilde{p}$ after pooling the quotas, which contributes the randomness to the total welfare ($W^{\bullet}_{\bullet}$). I report the mean ($\overline{W}^{\bullet}_{\bullet}$) and its standard error of the total welfares from 114 (BM) or 224 (DA) repetitions.

[b] $W^{\bullet}_{p^{\tilde{p}}}$ represents the total welfare of students in province p after pooling the quotas and forming a super province $\tilde{p}$.

5. Conclusions

In this paper, I use the data from three Chinese provinces for two years to analyze the effects of sharing admission quotas among provinces. The results yield three conclusions. First, pooling the quotas improves the welfare of students, and pooling the quotas of more provinces further improves welfare. Second, the performances of BM and DA become more similar after pooling the quotas. Finally, the model can quantify unfairness for students in different provinces.

This paper suggests that the government should switch the province-specific quota system to the pooling quota system as, after pooling, the welfare of the students increases. Additionally, DA is largely implemented in China, but it encounters a welfare loss compared to BM. After pooling, the performances of the two mechanisms become more similar and the welfare loss decreases. Furthermore, the province-specific quota system introduces unfairness among provinces, which the pooling quota system can eliminate.

However, this paper only studies three provinces for two years. The effect of pooling the quotas of all 31 provinces in the Chinese mainland is still a mystery. Future studies may want to use data from more provinces for a more comprehensive study.

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