

Redesigning School Choice for Migrant Children: A Deferred Acceptance Mechanism with Soft Quotas

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Abstract. In major Chinese cities, the points-based enrollment system for public schools often excludes the very migrant children it was meant to help. By heavily weighing home ownership and continuous social insurance, the current rules favor affluent families. Precarious workers are simply left behind. To address this structural failure, this paper applies mechanism design to the issue. This paper proposes a Deferred Acceptance with Soft Quotas (DA-SQ) algorithm. This model reserves a specific share of school seats for migrant students. Crucially, any unfilled reserve seats automatically revert to the general applicant pool. This paper mathematically proves that DA-SQ is both strategy-proof and non-wasteful. By making truthful reporting a dominant strategy, the algorithm protects less-educated parents from the strategic complexity of traditional admissions. Moreover, welfare analysis suggests that allocating educational resources to marginalized children yields a much higher marginal utility. It achieves a near-Pareto improvement for the urban education system. This paper concludes that embedding equity directly into matching algorithms is not merely a moral gesture, but a welfare-maximizing approach to allocating scarce public resources, even as policymakers must navigate local resistance and trust deficits.

Keywords: Points-based enrollment, Migrant children, Mechanism design, Deferred acceptance algorithm, Soft quotas, Educational equity

1. Introduction

In many Chinese cities, migrant children still struggle to get a good public education. Recent research shows that educational opportunities remain closely linked to household resources, including housing, educational attainment, and employment stability [1, 2]. The points-based enrollment system was introduced to allocate scarce school places through transparent rules. Yet the scoring criteria tend to reward exactly the kinds of resources that migrant families almost never have. As a result, the system has been increasingly criticized for reproducing, rather than reducing, educational inequality.

A sizable literature has examined the macro-level financing of migrant children's education—such as intergovernmental fiscal transfers and expanding public school capacity. Very few studies have approached the problem from the angle of mechanism design, asking whether the allocation rules themselves—the priority structures and matching algorithms that decide who gets which seat

—could be rebuilt to offset the structural disadvantages migrant children face. The question is not just how many seats exist, but how they are assigned. This paper tries to fill that gap. The central question is whether, under conditions of scarce resources, an enrollment mechanism can guarantee baseline access for migrant children while preserving overall efficiency. This paper draws on two-sided matching theory, building from the deferred acceptance (DA) framework first introduced by Gale and Shapley [3] and later adapted to school choice by Abdulkadiroğlu and Sönmez [4]. This paper's normative evaluation rests on welfare economics—specifically, the principles of diminishing marginal utility and positive externality—to assess the aggregate welfare effects of the proposed mechanism.

The study offers two main contributions. The first is theoretical: a Deferred Acceptance with Soft Quotas (DA-SQ) mechanism, which adapts the standard DA algorithm by embedding reserved seats for migrant children without sacrificing strategy-proofness or stability. The second is policy-oriented. This paper provides a normative case for giving disadvantaged groups priority within enrollment algorithms, showing that such prioritization is not merely a moral gesture but a way to maximize welfare when using scarce public resources. The findings aim to offer both mathematical grounding and some practical guidance for reforming China's points-based enrollment system.

2. Reconstructing school enrollment through mechanism design

2.1. The structural failure of points-based enrollment

China's points based enrollment system is supposed to hand out limited public school seats based on clear rules. In practice, however, the system often rewards forms of parental capital that migrant workers are less likely to possess, including higher education credentials, home ownership, and stable employment histories [5]. As a result, access to public education remains uneven despite the appearance of procedural fairness.

Table 1 illustrates this pattern by comparing two hypothetical applicants under Guangzhou's points-based enrollment rules. The first is a construction worker with ten years of urban employment; the second is a young professional with a master's degree and homeownership after only three years in the city.

Table 1. Comparison of two hypothetical applicants under Guangzhou's points-based enrollment rules

Points item	Construction Worker A	Young Professional B
Education	0(junior high or below)	30(Guangzhou)
Housing	20	26
Social Insurance	~32(≈8 yrs)	~30 (full coverage, 3 yrs)
Age	26 (42 yrs old)	30 (28 yrs old)
Residence Permit	80	24
Total(Guangzhou)	158	140

As shown in Table 1, the construction worker receives relatively few points from education and housing despite a much longer work history. The young professional, by contrast, gains substantial advantages from educational credentials and home ownership. In other words, the system rewards resources that are not evenly spread across households. Complex application procedures and paperwork may further disadvantage less educated families. Rather than functioning as a neutral

allocation mechanism, the points-based system can reinforce existing inequalities and limit educational opportunities for migrant children.

2.2. Mechanism reconstruction: the Deferred Acceptance with Soft Quotas (DA-SQ)

Building on the standard deferred acceptance framework, this study introduces a Deferred Acceptance with Soft Quotas (DA-SQ) mechanism that helps migrant children get better access without losing efficiency. The mechanism combines reserved seats with a flexible reallocation rule, ensuring that unused quotas do not result in wasted capacity. This section lays out the model in four steps: first, the theoretical setup; second, the school's two-stage choice function; third, the matching algorithm; and fourth, the key properties—stability, strategy-proofness, and non-wastefulness.

2.2.1. Theoretical setup

We formalize the school choice problem within a mechanism design framework. Let $S = s_1, s_2, \dots, s_n$ denote the finite set of student applicants, which is partitioned into two mutually exclusive subsets: migrant children S^m and local residents S^l , where $S = S^m \cup S^l$ and $S^m \cap S^l = \emptyset$. Let $C = c_1, c_2, \dots, c_m$ represent the set of public schools. Each school $c \in C$ operates with total capacity $q_c \in \mathbb{N}^+$. We introduce a soft quota vector $r = (r_{c1}, r_{c2}, \dots, r_{cm})$, where $r_c \leq q_c$ specifies the minimum seats reserved for migrant children at school c . The specific values of r_c are policy parameters; the mechanism properties established below hold for any feasible r .

Each student $s \in S$ holds a strict, complete, and transitive preference relation $\succ_s$ over $C \cup \emptyset$, where $\emptyset$ denotes the outside option of remaining unassigned. Each school $c \in C$ is bound by a strict priority structure $\succ_c$ over S , derived from the government's scoring rubrics or residency status. Schools do not possess strategic preferences.

2.2.2. Two-stage choice function

The core departure from the standard Gale-Shapley framework lies in the school's choice function [3]. When school c faces an arbitrary applicant pool $A \subseteq S$, it resolves assignment via $\text{Chc}(A) \subseteq A$, with $|\text{Chc}(A)| \leq q_c$, in two sequential stages:

Reserve Phase. School c isolates migrant applicants $A \cap S^m$ and selects the highest-priority among them up to r_c . Let $A^r \subseteq A \cap S^m$ denote this subset, where $|A^r| = \min\{r_c, |A \cap S^m|\}$.

Open Phase. School c aggregates all remaining applicants into the residual pool $A \setminus A^r$ and selects the highest-priority students up to the remaining capacity $q_c - |A^r|$. Let $A^o \subseteq A \setminus A^r$ denote this subset, where $|A^o| = \min\{q_c - |A^r|, |A \setminus A^r|\}$.

The final accepted set is:

$$\text{Chc}(A) = A^r \cup A^o \quad (1)$$

If $|A \cap S^m| < r_c$, unused reserve seats automatically revert to the open pool, eliminating deadweight loss.

2.2.3. Algorithm

The DA-SQ mechanism works like this:

Step 1. Every student proposes to their most preferred acceptable school. Let A_c^1 be the set of students proposing to school c . School c temporarily holds $\text{Chc}(A_c^1)$ and rejects $R_c^1 = A_c^1 \setminus \text{Chc}(A_c^1)$.

Step t ($t \geq 2$). Each student rejected in Step $t-1$ proposes to their next most preferred acceptable school not yet tried. Let P_c^t denote new proposers to school c . School c forms the consolidated pool $A_c^t = P_c^t \cup \text{Chc}(A_c^{t-1})$, temporarily holds $\text{Chc}(A_c^t)$, and permanently rejects $R_c^t = A_c^t \setminus \text{Chc}(A_c^t)$.

Termination. The algorithm stops at step T when all $R_c^T = \emptyset$. The final matching $\mu : S \rightarrow C \cup \{\emptyset\}$ assigns $\mu(s) = c$ if and only if $s \in \text{Chc}(A_c^T)$.

2.2.4. Theoretical properties

Definition 1 (Stability under Soft Quotas). A matching μ eliminates justified envy under reserves if for any $s \in S$ and $c \in C$ with $c \succ_s \mu(s)$, no $s' \in \mu(c)$ satisfies $s \succ_c s'$, unless s' was admitted during the reserve phase and $s \notin S^m$. This exemption reflects the normative premise of the soft quota: since reserved seats are off-limits to local students, they don't create justified envy.

Theorem 1 (Strategy-Proofness). The DA-SQ mechanism is strategy-proof. For any student $s \in S$, truthfully reporting $\succ_s$ is a weakly dominant strategy:

$$\mu(\succ_s, \succ_{-s}) \succsim_s \mu(\succ'_s, \succ_{-s}) \quad \forall \succ'_s \succ_s \quad (2)$$

Proof. The two-stage choice function $\text{Chc}(\cdot)$ satisfies substitutability (see Remark below). So strategy-proofness carries over from the standard DA framework [4, 6].

Theorem 2 (Non-Wastefulness and Pareto Efficiency). The matching μ produced by DA-SQ is weakly Pareto efficient and eliminates absolute seat waste: any unfilled reserve seat is released to the general pool, ensuring full capacity utilization. This constitutes a Pareto improvement over hard quota systems.

Proof. Weak Pareto efficiency follows from substitutability and monotonicity of $\text{Chc}(\cdot)$ [7]. Non-wastefulness is immediate from the two-stage construction.

Remark (Substitutability). $\text{Chc}(\cdot)$ satisfies substitutability: for any $A \subseteq A' \subseteq S$, if $s \in \text{Chc}(A')$ and $s \in A$, then $s \in \text{Chc}(A)$. This ensures that accepting a student in a larger pool does not exclude students already accepted in a smaller one—a sufficient condition for strategy-proofness and stability [7].

2.3. Welfare economics of the soft quota mechanism

The DA mechanism with soft quotas we laid out in Section 2.2 passes the standard tests of stability and strategy-proofness. However, having these formal properties isn't enough to guarantee an improvement in social welfare. A more important question is whether reallocating public school seats in this way actually increases total welfare, or simply redistributes a fixed stock of resources across groups.

Diminishing marginal utility is the natural starting point. A high-income local household, already possessing substantial educational resources, gains some benefit from an additional seat at a high-quality public school—but the marginal benefit is relatively limited. For a migrant child, though, that same seat can make a real difference in future educational and development outcomes. Cui and

Xu, working with CFPS panel data, find that family-based migration to urban schools lifts children's cognitive scores by 0.051 standard deviations and non-cognitive skills by 0.032 [8]. In welfare terms, educational resources generate larger gains when allocated to children facing barriers to access than to those who already possess substantial educational advantages. This lines up with earlier work on distributive justice in migrant children's education [9].

The soft quota mechanism is essentially a near-Pareto improvement. Migrant children gain access to reserved seats. Local students lose nothing in absolute terms—unfilled reserves flow straight back into the general pool. No seat sits empty, and no group is made unambiguously worse off.

And the gains go beyond static efficiency. Over a time, the mechanism delivers benefits that matter to fiscal planners. Children who would otherwise grow up with little educational capital acquire skills instead. That means less dependence on social assistance and lighter pressure on public welfare budgets down the road—a dividend that lands in society's lap, not just in the recipients' pockets.

Soft quotas for migrant children, in short, are not charity. They are a welfare-maximizing use of scarce public resources. The mechanism is justified on grounds of both equity and efficiency.

3. Discussion: institutional frictions and limitations

The DA-SQ mechanism solves the distributive problem—but distribution presupposes something to distribute. If quality public school seats remain severely scarce, even an optimal matching algorithm cannot guarantee access for every eligible migrant child. Consider the numbers: Wu and Li found that only 73.83% of migrant children nationwide attended public schools, which means over a quarter are completely left out [10]. A matching mechanism can improve allocation, but it cannot expand capacity.

Even a welfare-maximizing design faces political resistance from those who see themselves as losing out. Local households who purchased school-district housing at high prices may view reserved seats for migrant children as a loss of educational advantages they paid for. Yet from a welfare-economic perspective, this view confuses the protection of existing advantages with fairness itself. Recent studies show that urban institutions in China already embed unequal access to education into housing markets, hukou systems, and school admission rules [1]. Under these conditions, compensatory allocation mechanisms become not only ethically justified, but also structurally necessary. The soft quota mechanism therefore is not reverse discrimination; rather, it partially corrects existing inequalities.

Even with strategy-proofness formally proven, mathematical guarantees do not automatically generate trust. For migrant households long accustomed to opaque procedures and discretionary gate keeping—Wu and Li identified information asymmetry as "the greatest challenge" in enrollment—the claim that truthful preference revelation is a dominant strategy may sound too good to be true [10]. Bridging this trust deficit demands substantial administrative investment: simplified application interfaces, community-based outreach, and transparent disclosure of matching outcomes. Without these, the most vulnerable will keep relying on rumor and risk-averse guesswork—not the truth-telling that the mechanism rewards.

These reflections do not diminish the value of the DA-SQ mechanism; rather, they highlight the institutional conditions required for its effective implementation.

4. Conclusion

This study examined a key problem in China's points-based school enrollment system: though it looks fair, the system often turns parental capital into points and shuts out disadvantaged migrant children from quality public education. To address this issue, the paper proposed the Deferred Acceptance with Soft Quotas (DA-SQ) mechanism. The model formally satisfies strategy-proofness, reduces justified envy, and avoids wasted seats through the flexible use of reserved quotas. The welfare analysis further suggests that prioritizing migrant children is not just a moral choice—it's also an efficient way to allocate scarce educational resources.

At the same time, mechanism design alone cannot solve the deeper structural problems behind educational inequality. That's why several supporting reforms are necessary. Fiscal transfers for compulsory education should follow the student rather than the hukou system, ensuring that resources match the actual resident population. A teacher rotation system within cities could also help reduce quality gaps between schools and lower competition for a small number of elite schools. In addition, a portable per-pupil funding system should be established to weaken the connection between local fiscal contribution and access to education.

This study also has limitations. The DA-SQ mechanism remains a theoretical model and has not yet been tested with large-scale enrollment data. Future research should examine its performance under real-world conditions and extend the model to more dynamic settings involving migration and changing school capacity.

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