

Comparative Study of University Admission Systems: A Market Design Perspective

Zixin Xu

School of International Economics and Trade, Shanghai University of International Business and Economics, Shanghai 201103, China

Abstract: As we all know, the university entrance examination system will distribute the limited educational resources. Many countries around the world have set up various institutions to connect students with universities, each aiming to achieve fairness, efficiency and merit-based selection in different ways. In recent years, economists have paid more attention to the design of markets and matching theory in their studies of admission systems. Deferred Acceptance algorithm and other mechanisms have been employed to improve the stability and reduce the strategic behaviour of allocation. This paper studies university admission systems in the United States, the United Kingdom and China. This paper studies how these systems allocate university seats and assesses their efficiency in terms of market-equilibrium theory. Based on the previous studies and policies, this paper examines the effect of these admission rules on behaviour and allocation outcomes. Different modes of admission have been shown to have various trade-offs among fairness, efficiency and strategic depth. Centralised Matching Systems reduce manipulation and improve stability, but decentralised Systems offer more flexibility at the cost of efficiency.

Keywords: university admissions; matching market design; deferred acceptance algorithm; higher education policy; allocation mechanisms

1. Introduction

Higher education can be used to develop people's all-round abilities and boost the economy. Each year, the universities have to allocate a small number of seats for a large number of applicants with various academic results and aspirations. Thus, the construction of an effective university entrance examination system has not yet been achieved.

Different countries have established different institutions to manage the distribution of university places. For example, some countries have a centralised admission system that organises students' ranked preferences and, at the same time, allocates them to universities centrally. Other countries use a decentralised system for the universities to independently evaluate and admit applicants. The above are differences in educational traditions, policy objectives and institutional environments.

Recently, economists have been studying the system of college admissions through the lens of matching market design. Several countries' university entrance examination and other admission systems will be compared here. Investigate how institutional rules affect allocation results and other problems in the system for

students. By comparing the strengths and weaknesses of centralised and decentralised admission mechanisms, this paper will investigate how market design theory can be employed to improve the higher education admission system [1].

2. University Admission Systems and Institutional Comparisons

2.1. Market Design and the Concept of Matching Markets

Matching markets are economic environments that require people on both sides of the market to be connected according to their individual needs rather than through a price system [1]. Prices of some old markets are set by supply and demand. Prices cannot determine the allocation results for education admissions, medical residency placement, organ donation, etc., in the market. Institutions should design rules based on matching theory to guide the matching process instead [2].

Matching theory is a set of ideas on how institutions can organise resources in the absence of prices as coordination signals. David Gale and Lloyd S. Shapley's Deferred Acceptance algorithm was the first such algorithm. Shapley, and later extended by Alvin E. Roth has developed a device to construct a reasonable and stable division method of the education market [2].

Generally speaking, people have different preferences for the other side in a matching market. Students prefer different universities because of their ranks, fame, locations and other study areas. The other reasons for not getting admitted by the school include bad grades or low test scores. A matching mechanism seeks to match students with suitable universities based on their preferences, and at the same time, aims to maintain stability and efficiency; thus far, many areas of institutional design in various parts of the education system have been applied for this purpose [3,4].

2.2. The United States: Decentralized Admissions System

The United States has a large-scale decentralized university admissions system. Each university independently sets the requirements for admission and evaluates the applicants. Students generally apply to many universities at the same time, and each university will independently decide whether to accept them based on its own standards.

The other is an all-encompassing assessment system in the United States. Universities consider a large number of factors in their evaluations, such as students' extracurricular activities, internships, personal statements, letters of recommendation, and so on; they do not focus solely on grades and test scores. Thus, the university will be able to select students of various talents and backgrounds for its student body.

A Decentralised System also has some problems. The applicants need to prepare and submit many applications at the same time, so it is both costly and time-consuming. In addition, the absence of coordination among the universities may cause uncertainty for the students, and thus they apply to a large number of universities because they cannot know whether they will be accepted.

Another problem is that the system is not strategy-proof; therefore, students may select a university based on the perceived probability of admission rather than their actual desires [5]. The cause will be a poor-allocation process.

2.3. The United Kingdom: Centralized UCAS System

The UK has established a centralised system for university and college admissions under the Universities and Colleges Admissions Service (UCAS) to some extent [6]. UCAS is a single application platform that can be used to apply to several universities for students.

The UCAS system will be used to upload students' school records, life experiences and references online. The university will evaluate the applicant and offer conditional admission based on the student's grades in the final exams. Release of examination results, and then the eligible students will be admitted.

UCAS will reduce the application workload and coordinate more effectively with universities and students. Centralised application: Students can manage their applications more conveniently and learn about the admission time through this system.

UCAS is the centralised application platform, but the universities are still responsible for judging the applicants independently. Therefore, the system uses central coordination and distributed decision-making simultaneously.

2.4. China: Gaokao-Based Centralized Allocation

China's university admission system is relatively centralized and heavily based on the National College Entrance Examination (Gaokao) [7]. The Gaokao is a typical national examination in China that serves to select students for universities.

Students take the final exam at the end of high school and are given a numerical score. Based on the above scores, the students submit ranked choices of universities and academic programs. Then, a single Allocation mechanism will assign the students to universities based on their scores and wishes [8].

The first is that the system is relatively simple in terms of understanding and operation. Since the foundation of admission is generally a uniform test score, it will be more rational and predictable.

However, the Gaokao has also been criticised for being too high-pressure for students. As one general test is the main determinant of higher education admission, students have long prepared for it. A focus on scores fails to cultivate students' other forms of learning behaviours, such as originality and initiative.

3. Comparative Analysis of Admission Mechanisms

The above three typical university admission systems will be compared in this chapter by examining the design of the matching market, focusing on the core institutional differences among centralised and decentralised systems, the impact of various mechanisms on students' strategic behaviour and preference expression, and the trade-off between allocation efficiency and fairness in these systems. First, the institutional features and operating effects of centralized and decentralized admission systems will be compared in the following section; second, the reasons and impacts of strategic behaviour in the two systems will be analysed; finally, how these different admission mechanisms perform in terms of allocation efficiency and social equity will be explored. This analysis will provide a foundation for the following study on admission system reform based on market design theory.

3.1. Centralized vs Decentralized Admission Systems

A Comparison of the Centralised and Decentralised Admission Systems. The Centralised system can coordinate the applicants and universities more effectively. Reduce information asymmetry and simplify the application process for students.

The University will choose its students independently in a decentralized system. Flexibility is used by the school to set different educational goals for different students. However, without a joint distribution plan, the decentralized model will also suffer from a loss of economy [5].

The American admission system shows the advantages of institutional flexibility, and the British and Chinese systems are typical cases of centralised coordination [6]. These differences reflect the trade-offs in the Design of Admission Institutions.

3.2. Strategic Behavior and Student Preferences

Many admission systems have had a problem of strategic behaviour. When students believe that some strategies will help them get into college, they may choose to falsely report their interests or apply to specific schools in an organised manner.

Applicants may apply to universities that are more convenient to enter, but are not the ones they wish to attend. Therefore, the behaviour may deviate from the distribution results and reduce the overall economy of the system.

Matching mechanisms to promote truthful reporting of preferences can solve the above problems. The Deferred Acceptance algorithm is indeed known to be strategy-proof for students; that is to say, they will reach the best outcome by revealing their true preferences [2].

3.3. *Efficiency and Fairness in Allocation Outcomes*

The Objectives of Efficiency and Fairness in Admission System Design. Rational allocation will make good use of the university's seats by allocating them to students who need them more, and fairness will give all applicants with the same qualifications the same opportunity.

Centralised systems generally promote fairness by using the same distribution rules for all applicants [7]. However, they may be too dependent on standardised factors, such as examination scores [8].

A decentralized system can be used to consider all kinds of talents by various indicators in the university's admissions. At the same time, differences in evaluation methods may result in inequality of opportunity for higher education.

4. **Market Design Perspective on Admission Reform**

4.1. *Application of Matching Algorithms in Education*

Matching markets are economic environments that match participants on both sides according to preferences rather than prices [1]. Prices in the old market regulate supply and demand; however, for areas such as education admissions, medical residencies and organ donation, this has not been the case. Instead, the institutions will create rules for the matching process [3]. Therefore, at present, students prefer universities with high rankings, good reputations, convenient locations, excellent programs, etc., and colleges have been selecting students based on exam results and academic backgrounds. Thus, a good-designed matching mechanism will aim to distribute resources in accordance with the above demands and guarantee stability and efficiency.

David Gale and Lloyd S. founded the theoretical basis of matching markets. Shapley proposed the concept of stable matching and put forward the Deferred Acceptance algorithm [2]. The workers have achieved stable results through the introduction of a good allocation mechanism. Since then, matching algorithms have been used to design educational allocation, and one of the more famous is the Deferred Acceptance mechanism [4].

The algorithm will be applied to proposal and rejection steps iteratively. Students first apply to their most desired universities, and these universities tentatively accept the applications based on the students' pre-set priorities for others. The rejected students then apply for the next-best-fit institutions. The loop has been broken, and a stable match has been obtained. The above mechanisms ensure the stability of the final allocation; that is to say, no student-university pair will be willing to leave their matched outcomes, thus promoting the reliability and fairness of the admission system.

4.2. *Advantages of Market Design Approaches*

Several Strengths of Market Design Approaches for Admission System Reform. Firstly, the algorithm will help distribute resources more evenly and reasonably [4]. Standardise the procedures for organising applications and entrance examinations, remove ambiguity, eliminate the discretion of staff in grading, and prevent the waste of educational resources due to arbitrary allocation.

Second, they reduce the motivation for strategic behaviour. A strategy-proof mechanism, such as deferred acceptance, can be used by the system to have students truthfully disclose their actual preferences and avoid excessive applications; thus, it lowers the application costs for students and the screening workload of universities [2].

Thirdly, centralised matching can consider policy goals such as regional quotas and diversity requirements to some extent [6]. Thus, the government can reduce regional differences in education and allow more students to choose schools across the country freely.

Fourth, Market Design approaches are very flexible and scalable. They can be adjusted according to the national situation and educational objectives, and in conjunction with digital technology, the admission system will continue to be optimised.

4.3. *Policy Implications for Future Admission Systems*

Future reforms of university admissions will likely be hybrid models that integrate centralised coordination

and institutional autonomy. A central matching platform will be set up by the government, but universities can still judge the applicants independently. The above way will standardize the application process, reduce information asymmetry and application costs, maintain the autonomy of institutional selection in talent, and prevent excessive uniformity in admissions.

Improve the Admission System through Technological Advancement. Digital platforms and data systems promote the open-book policy of transparency for students and administrators in resource allocation. Intelligent information services reduce application blindness, and big data and AI optimiser matching algorithms for refined resource allocation. Digital Tools are employed to improve the supervision of admissions and promote transparency and fairness.

Reform Paths should be consistent with national institutional conditions. Decentralized systems in the United States should strengthen coordination and unified information sharing in reforms, but still maintain an all-encompassing evaluation system [5]. Reforms for the UK's mixed system may focus on improving coordination between the central platform and universities, as well as standardising the basic level [6]. To decentralise the high-stakes Gaokao in China, multi-dimensional evaluations of students will be introduced in addition to test scores to improve fairness and diversity [7,8].

Finally, the application of market design needs to be publicly accepted and institutionally flexible. Policy-makers should enhance the spread of information about the new mechanism among the public and organise pilot projects in certain areas before nationwide implementation to make appropriate modifications according to local conditions and ensure the smooth progress of reforms.

4.4. Challenges and Countermeasures in the Practice of Market Design Reform

Market design offers an ideal system for the reform of university admissions, but it has many problems in practice.

First, the supporting data and information systems are lacking. Algorithmic matching needs high-quality, standardised data on students and universities, and many countries have problems such as fragmented data, inconsistent indicators, and low sharing efficiency. Build a single national admission data platform to standardise data collection, remove institutional barriers, and ensure the accuracy of data for algorithm operation.

Second, the professional skills of the practitioners are lacking. Good algorithm design and operation require knowledge of economics, computer science and education management; many admission officials do not have this. Targeted Training and Recruitment of Specialised Talents can Strengthen the Professional Team Responsible for Mechanism Design and Operation.

Third, the conflict between algorithmic rationality and humanitarianism is also not easy to solve. Algos can do so reasonably, but they may not be aware of people's special circumstances, such as disabilities or family problems. A supplemental humanistic review channel will offer some flexibility for special circumstances and balance technical efficiency with fairness.

Fourthly, there are problems of algorithmic bias and information security risks. An algorithm error or biased data will result in incorrect allocation results, and at the same time, data leakage may occur at a single platform. Strengthen the audit of the algorithm and multi-party supervision to reduce bias; enhance encryption, access control and security management to protect personal and institutional data.

5. Conclusions

University admission systems are the necessary institutions that distribute limited educational opportunities. Several countries' admission systems have been studied and analysed using the theory of market design in this paper [1]. According to the above research, the structure of admission systems varies greatly; some are decentralized university-led systems, while others are highly centralised national allocation systems.

The two are not the same. A decentralised system in the United States can also be used to select students and set evaluation standards freely for different schools [5]. However, such systems are relatively complicated and have high resource demands for applicants. On the other hand, the centralisation model in the UK and China simplifies the application procedures and reduces the uncertainty of allocation results [6,7].

The design of the market is likely to be relatively efficient and less prone to strategic behaviour in a

centralised matching model [4]. Algorithms such as the Deferred Acceptance mechanism can achieve a stable outcome and motivate truthful preference revelation [2]. Other reasons for not doing so in practice include issues of social equity, regional policies and institutional autonomy, etc.

However, there are still flaws in the university admission system. Unfair distribution of resources and information asymmetry are still problems affecting the allocation results. Future reforms can use the matching market theory as a reference and adjust the mechanism according to the institutional environment in different countries [3].

Generally speaking, this study has shown that applying market design ideas to college admissions can offer some ideas for policies aimed at enhancing fairness, openness and efficiency in the distribution of educational resources.

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