TÜSİAD-KOÇ UNIVERSITY ECONOMIC RESEARCH FORUM
WORKING PAPER SERIES

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Working Paper 0804
May 2008

TÜSİAD-KOÇ UNIVERSITY ECONOMIC RESEARCH FORUM
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Restriction on Stating Preferences in College Admissions in Turkey*

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May 29, 2008

JEL: I23, I28, C78

Abstract

A central authority designs and implements the college admissions process in Turkey. All applicants are required to take an SAT–like test and submit their preferences over the departments. Then, the central authority places the applicants in departments by considering the test scores and stated preferences of the applicants and the capacities of the departments. This procedure generates a fair placement if there are no restrictions on stating preferences. However, the applicants are restricted to state preferences over at most 24 departments out of 4022 available departments. In this paper, by using the college admissions data set of the year 2005, we estimate that the number of applicants who had an unfair placement due to this restriction is equivalent to 2.4 percent of the number of applicants who placed in a department.

*This paper is supported by The Scientific & Technological Research Council of Turkey (TUBITAK) via grant 106K081. We thank the Central College Admissions Authority in Turkey (ÖSYM) for providing us the data–set. We also thank the seminar participants at Ankara, Bogazici, Marmara, Sabanci Universities, 2007 AEFA annual meetings in Baltimore and the 5th International Conference on Logic, Game Theory and Social Choice in Bilbao.

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1 Introduction

A central authority designs and implements the college admissions process in Turkey. At the end of the process, the applicants are placed in departments. For instance, an applicant who is placed in "Ankara University – Economics" department studies economics at Ankara University. The placement is final and transfers are rare. Hence, the placement results are considered to be a matter of life and death by many applicants.

All applicants are required to take an SAT–like test. The central authority informs each applicant about his test score.[1] Then, the applicants state their preferences over the departments by ranking them from the most desired one to the least desired one. For instance, an applicant may choose "Ankara University – Economics" as his first choice, "Istanbul University – Chemistry" as his second choice, etc.

The central authority places the applicants in departments by considering the test scores and preferences of the applicants and the capacities of the departments.[2] Each department has a pre–announced limited capacity. Some departments have as low as one seat and some have more than four hundred seats. The number of the placed applicants cannot exceed the department's capacity. However, the demand for almost all departments exceed their capacities. The central authority uses a placement algorithm which gives a higher priority to the applicants with higher test scores while placing the applicants in departments.

Balinski and Sonmez (1999) show that the current placement is fair by implicitly assuming that there is no restriction on stating preferences. However, the applicants are not free to state all their preferences. They are restricted to state at most 24 departments out of 4022 available departments. Dogan (2005) shows that the placement is not fair if there is a restriction on stating preferences. This is because an applicant has imperfect information on the other applicants' preferences when stating his preferences. The preferences and test scores of the applicants and the capacities of the departments determine cut–off test scores of the departments. An applicant can be placed to a department only if his test score is higher than the cut–off test score of the department. The applicants know the test scores, the capacities of the departments and their own preferences but do not know the other applicants' preferences exactly. Consequently, when the applicants are

[1] The details about the test and computation of the scores are given in the appendix.

[2] The departments have no say in the admissions process.

stating the preferences, they are uncertain about the cut–off test scores and the departments they can be placed with their test scores. Therefore, the applicants have to choose the 24 departments strategically when stating the preferences. After the placement of the applicants to the departments, some applicants may have ex–post regret for their strategic decisions in stating the preferences. Those who have ex–post regret are the unfairly treated applicants.

By using the 2005 college admissions data set, we predict the number of the unfairly treated applicants. The data set contains the stated preferences and test scores of the applicants and the capacities of the departments. We only have the stated preferences of the applicants under the current restricted regime. In order to find the unfairly treated applicants, we also need to know the choices that the applicants could not state because of the restriction. For this purpose, we use a frequency methodology that exploits the statistical correlations between the preferences for different departments. For instance, we see that the applicants who stated economics departments were more likely to state business administration departments as well. After we estimate the choices that were left out, we predict that 4761 applicants were unfairly treated. This number is equivalent to 2.4 percent of the number of applicants who placed in a department.

The college admissions system in the United States has a similar feature. The applicants do not apply to all the colleges that they potentially wish to enroll in since there is an additional cost (i.e., application fees) for applying to each additional college. Because of the application costs, each applicant may apply to a restricted number of colleges depending on his budget. After the placement of the applicants, an applicant may have ex–post regret for not applying to some colleges.

In the United States college admission system, the application costs – the source of having the restriction – are justified because the colleges need to spend money to assess the applicants and information processing is costly. However, in the Turkish college admission system, the existence of restriction on stating preferences is not justified. College admission system is centralized and no additional cost is incurred to the central authority if the applicants state preferences over more departments. The applicants are stating their preferences by using a web interface, and the restriction can be removed without any significant cost.

The outline of the paper is as follows. In section 2, we explain how the existence of restriction on stating preferences leads to an unfair placement. In section 3, we introduce the data set. In section 4, we discuss the methodology used in predicting the choices that the applicants left out because

of the restriction on stating preferences. We lay out the results in Section 5 and give concluding remarks in Section 6.

2 Fairness

The central authority places the applicants in departments by considering the preferences and test scores of the applicants and the capacities of the departments. At the end of the placement process, each applicant knows his own test score and preferences, the department that he is placed and the cut–off test scores of all the departments. The cut–off test score of a department refers to the test score of the applicant who is placed to that department with the least test score. The cut–off test scores are affected by the preferences and test scores of the applicants and the capacities of the departments.

A placement is fair if each student is placed to his favorite department among which with a lower cut–off test score than his test score. In a placement, if a student has a higher test score than the cut–off test score of a department and prefers this department to the department that he is placed, then this student is unfairly treated in that placement. A placement mechanism is fair if it always generates a fair placement.

A placement generated by Turkish placement mechanism has the following property. An applicant's test score must be lower than the cut–off test scores of a department which hold these two conditions: i) The applicant prefers it to the department that he is placed in. ii) The applicant states a preference over that department. For instance, if an applicant is placed in his third choice, then his test score should be lower than the cut–off test scores of his top two choices.

Balinski and Sonmez (1999) show that Turkish placement mechanism is fair by implicitly assuming that there does not exist a restriction on stating preferences. When the non–existence of a restriction on stating preferences is assumed, the second condition above is removed and they show that this property satisfies the fairness of the placement.

Dogan (2005) shows that the fairness result no longer holds when there is a restriction on stating preferences. The applicants are restricted to state only 24 departments out of 4022 available departments. The applicants do not know the cut–off test scores when they are stating the preferences. However, they form expectations mainly by using the cut–off test scores of the previous years. Of course, the applicants may not be able to guess the cut–off test scores accurately. Then,

they may leave out departments that are preferred to their current placement and which have lower cut–off test scores than their test scores. In other words, the applicants may not be placed in some departments that they prefer to their current placement, although their test scores are higher than the cut–off test scores of these departments. As a consequence, they are not given priority for their higher test scores and they are unfairly treated.

Let's demonstrate how the existence of restriction on stating preferences violates fairness with a simple example.[3] Assume that there are five applicants (1 through 5) and two departments (A and B) with a capacity of two each. Let the preferences and the test scores of the applicants be as shown in Table 1.

Table 1: Preferences and Test Scores of the Applicants

Applicant #	First Choice	Second Choice	Test Score
1	Department A	Department B	100
2	Department A	Department B	90
3	Department A	Department B	80
4	Department B	Department A	70
5	Department B	Department A	60

First, we deal with the case where there is no restriction on stating preferences. That is, the applicants can state preferences over both departments.[4] Applicants 1 and 2, who have the highest two test scores, are placed in department A which is their most favorite department. Since, the capacity of department A is two, applicant 3 cannot be placed in department A. The placement results are given in Table 2.[5]

Table 2: Placement Results When There is No Restriction

	Cut–off Test Scores	Placement Result
Department A	90	Applicant 1, Applicant 2
Department B	70	Applicant 3, Applicant 4
No Placement		Applicant 5

[3] A similar example is given in Dogan (2005).

[4] The applicants do not gain by misrepresenting their preferences in this example. See Dogan (2005) for a proof.

[5] Details about the placement algoritm are given in the appendix.

Applicants 1, 2 and 4 are placed in their most preferred departments. Applicant 3 cannot be placed in his most preferred department because this department's capacity is already filled with applicants with higher test scores. This means that the priority for department A is given to the applicants with higher test scores. The same reasoning explains why applicant 5 cannot be placed in any of the departments.

Now, let's suppose that the applicants are restricted to state preference over only one department. Along with the test scores, the applicants also receive their ranks among all applicants. For instance, applicant 2 knows that he has the second highest test score among all the applicants. After the applicants receive their test scores and their ranks among all the applicants, they need to state their preferences. This imposes no difficulty for applicant 1 or 2. Since the capacity of each department is two, applicant 1 and 2 know that they will be placed in the department that they state. Therefore, they both state department A under the restriction.

Unfortunately, applicant 3 does not have an easy choice. This is because he has imperfect information about the preferences of the other applicants. If he had known their preferences, then he could have easily stated department B as his choice. Let's assume that applicant 3 has a prior belief that both applicant 1 and applicant 2 prefer department A to department B with probability 1/2. The possible placement results and their probabilities are given in Table 3.

Table 3: Placement Results for Applicant 3 under Restriction

Probability Assigned By Applicant 3	Applicant 1 states:	Applicant 2 states:	Placement if Applicant 3 states Department A	Placement if Applicant 3 states Department B
1/4	Department A	Department A	No Placement	Department B
1/4	Department A	Department B	Department A	Department B
1/4	Department B	Department A	Department A	Department B
1/4	Department B	Department B	Department A	No Placement

Applicant 3 will be placed in department A (department B) with probability 3/4 and he will not be placed in any of the departments with probability 1/4 if he states department A (department B). Then, we can easily say that applicant 3 states the department A given this prior belief and his actual preferences appearing in Table 1. Let's suppose that applicant 4 has the same prior belief

about the preferences of applicants 1 and 2, and he believes that applicant 3 prefers department A to department B with probability 1/2. Then, a similar calculation reveals that he should state the department B. Likewise, applicant 5 should state department B if he believes that all applicants prefer department A to department B with probability 1/2. The placement results in this case are given in Table 4.

Table 4: Placement Results under Restriction

	Cut–off Test Scores	Placement Results
Department A	90	Applicant 1, Applicant 2
Department B	60	Applicant 4, Applicant 5
No Placement		Applicant 3

This placement is not fair. Applicant 3 prefers department B rather than his existing no placement result. He also has a higher test score than the cut–off test score of department B. Therefore, he is not given priority for his higher test score and he is unfairly treated. Note that, removing the restriction does not cause a Pareto improvement. Applicant 3 cannot be placed to department B due to the restriction. However, applicant 5 is placed in department B and he gains from the restriction.

In this example, the prior belief of the applicant 3 implies that the distributions of the cut–off test scores of department A and department B for the previous years are same. In this case, applicant 3 states his most preferred department as his only choice. Alternatively suppose that, applicant 3 holds a prior belief such that department A has a higher expected cut–off test score than department B. Now, he faces the following trade–off. Stating the department A, rather than department B, decreases the probability of being placed in a department, but increases the payoff he gets if he places to a department. Depending on the probabilities and payoffs, applicant 3 can leave out his first choice (department A) or his second choice (department B) under the restriction.

As the example above demonstrates, in order to find the unfairly treated applicants, we need to know the departments that the applicants leave out because of the restriction on stating preferences. By using a simple frequency methodology, we predict the departments that are left out. This methodology is described in the next two sections.

3 Data

We use the college admissions data set of the year 2005 in our analysis. There are three types of higher education institutions in Turkey. These are colleges which offer four year undergraduate programs, open education institutions, and vocational colleges which offer two year programs. The open education institutions do not have any capacity constraints. In the placement of the applicants to the vocational colleges, the test scores of the applicants have no importance.[6] Therefore, we want to focus our attention to the colleges since they have capacity constraints and give priority to the applicants with higher test scores. Hence, we exclude the preferences for the open education institutions and vocational colleges from our analysis. In 2005, there were 4022 departments with a total capacity of 198,204 in the colleges.

There were 1,614,984 applicants who took the college admissions test in 2005. There is a threshold test score for the applicants to reach in order to state preferences for the departments in the colleges. There were 988,471 applicants who exceeded this threshold. Among those, 394,893 applicants stated preferences over at least one department from the colleges.[7]

In table 5, we see the distribution of applicants in terms of the number of choices that they made. Note that, the number of applicants who stated 1 through 23 departments does not exceed 18,000 but the number of applicants who stated 24 departments is 72,217. Given this information, we predict that many applicants would have stated more than 24 departments if they had not been restricted to state preferences.

[6] We provide more information on the placement to the vocational colleges and open education institutions in the appendix.

[7] The applicants, who reached the threshold test score but do not state any preference over departments from the colleges, either submit preferences only over open education institutions and vocational colleges or do not submit any preferences with the consideration of their test scores are not good enough for placement to the departments they prefer. In general, the applicants who do not submit any preferences hope to take a higher test score and be placed in a department one year later.

Table 5: The Distribution of the Departments Stated			
# of Departments Stated	# of Applicants	# of Departments Stated	# of Applicants
1	17652	13	12343
2	15944	14	12978
3	14967	15	12704
4	15829	16	12259
5	15384	17	12138
6	16109	18	17581
7	14711	19	10231
8	14957	20	11402
9	14130	21	10480
10	14932	22	11381
11	13680	23	16438
12	14446	24	72217

The main challenge in this paper is to predict the departments that the applicants would have stated if there had been no restriction on stating preferences. In order to achieve this, we use a simple frequency methodology. The details of the methodology are given in the next section. For now, we present some helpful statistics to answer the following two questions.

1. How many departments would each applicant have stated if there had been no restriction on stating preferences?

2. Which additional departments would have been chosen by the applicants if they had been allowed to state preferences over more departments?

Some statistics about the applicants who stated 24 departments is given in Table 6. We see that 18 percent of the all applicants stated 24 departments. This ratio is higher among the applicants who stated at least one economics department but lower among the applicants who stated at least one Arabic language department. This difference may be caused by many factors. For instance, there are more economics departments than Arabic language departments in Turkish colleges. Moreover, departments such as business administration have close resemblance to economics departments.

Therefore, an applicant who wants to be placed in an economics department has a lot of other suitable departments to state preferences.

Table 6: Some Statistics about the Applicants Who Stated 24 Departments	
	% of applicants who stated 24 departments
All Applicants	18
Among those who stated at least one of the following departments:	
Economics	32
Mathematics	40
Medical Science (*)	33
History	38
Electric–Electronic Engineering	30
High School Geography Teaching	43
Law School (*)	19
Marketing	6
Arabic Language and Literature	8
Among those who were:	
Boy	20
From a Major City	15
High School Senior	16
Placed to a Department	26
Graduated from Vocational High School	8
(*): Both medical science and law are undergraduate degrees in Turkey	

Table 6 also shows that the percentage of the applicants who stated 24 departments differs by the applicant characteristics. For instance, the applicants who were ultimately placed in departments were more likely to state 24 departments. The applicants who were applying for the first time (high school seniors) were less likely to state 24 departments. Boys were more likely to state 24 departments than girls.

Such correlations given in Table 6 help us to answer the first question above. We assume that an applicant who stated the popular departments for the applicants who stated 24 departments, is more likely to be constrained by the restriction on stating preferences. For instance, an applicant

who prefers an Arabic language department is assumed to be less likely to be constrained than an applicant who prefers an economics department. Hence, the former applicant would have stated fewer departments than the latter applicant if they had not been restricted to state preferences.

In table 7, we see that 81,744 applicants stated preferences over the economics departments and 35,757 applicants stated preferences over the medical science departments. Those who preferred at least one economics department had 27 percent of their choices in economics, 18 percent of their choices in business, 8 percent of their choices in public governance, etc. The composition of choices is quite different for the applicants who stated preferences over medical science departments. More than half of their choices were in health related departments.[8]

Table7: Composition of Choices

Applicants Who Stated At Least One Economics Department	% of choices	Applicants Who Stated At Least One Medical Science Department	% of choices
Economics	27	Medical Science	40
Business	18	Pharmacy	12
Public Governance	8	Dentistry	8
Public Finance	7	Computer Engineering	6
Turkish Literature	3	Electric–Electronic Engineering	5
Number of Applicants:	81744	Number of Applicants:	35757

The composition of choices helps us to answer the second question. For example, as given in Table 7, the applicants who stated preferences over economics departments would have been more likely to add another economics, business or public governance department if they had been allowed to state more departments. Likewise, the applicants who stated preferences over health related departments would have been more likely to add another health related department if they had been allowed to state more departments.

[8] There are two possible reasons why an applicant who wants to be an MD does not state preferences over economics departments that often. First, it may be related with the preferences of the applicant. An applicant who wants to be in a health related profession might not want to be an economist. Second, these departments belong to different test score categories. More details on the second reason is provided in the appendix.

4 Methodology

An applicant who has more than 24 departments to state should give a tough strategic decision when stating his preferences. For example, he may state his most favorite 24 departments. However, in that case, he may not be placed to any of these. Alternatively, he may state the 24 departments that have the lowest expected cut–off test scores. In that case, he maximizes the probability of being placed, however he misses the chance of being placed in a more favorite department. The applicants will choose a path between these two extreme cases. They will pick the 24 departments which maximize their expected payoff by considering the payoffs and the probabilities of being placed in them.

Even though the modeling the strategic behaviour of the candidates is possible, predicting the left out choices from this model by using the available data is not possible. Instead, we use a methodology to predict the left out choices based on the frequencies of departments stated as preferences of the applicants. Here, we describe the methodology in four steps.

Step 1: What is the total number of departments stated as each choice of the applicants?

The number of departments that an applicant states depends on his preferences and test score. In 2005, more than half of the applicants decided not to state any departments. Among the applicants who stated at least one department, the ratio of applicants who stated 24 departments is only 18 percent. The reason for the many of the applicants to state less than 24 departments is as follows. These applicants think that their chance for being placed to some departments is practically zero because the expected cut–off test scores of these departments are much higher than their test scores. They state preferences over departments which they want to enroll in and also they have a positive probability for being placed. For these applicants, the number of departments which they want to enroll in and have a positive probability for being placed, is less than 24.

Would there have been any applicants who would have stated 100 departments if they had been allowed to? With the data at our hands, it is not possible to give a good answer. We make the following assumption for total number of departments stated as each choice of the applicants. The last two columns of table 5 gives the number of applicants who made 11 to 23 choices. These numbers average 12928 with a low variance of 2166. We assume that the number of applicants who would have made 24 and more choices is equal to this average if there had been no restriction on stating preferences. Table 8 gives this distribution of choices under the unrestricted regime.

Table 8: The Number of Departments Stated in the Absence of Restriction	
Number of Departments Stated	Number of Applicants
1 through 23	Same as in Table 5
24	12036
25	12036
26	12036
27	12036
28	12036
29	12037
Total	394893

Step 2: How many departments would each applicant have stated if there had been no restriction on stating preferences?

We assume that the applicants who stated at most 23 departments would have made the same choices if they had not been restricted to state preferences. For the applicants who stated 24 departments, we look at their choices. If they stated departments that were popular among the applicants who stated 24 departments, then we assume that they were more restricted. In this way, we assume that the applicants who stated 24 choices were restricted to some degree and the departments that they stated reflects this degree of restriction. For instance, we know that the economics departments were popular among the applicants who stated 24 departments. An applicant who stated preferences over economics departments is assumed to be more restricted. A more restricted applicant is assumed to leave out more choices because of the restriction.

Let's take an applicant, say Ali, who stated 24 departments and compute his degree of restriction. Let d_k $(k = 1, ..., 24)$ denote the choices that Ali made under restriction where d_1 is the highest ranked department and d_{24} is the lowest ranked department. Let's define R_{d_k} be the number of applicants who stated department d_k and state 24 departments and define U_{d_k} be the number of applicants who stated department d_k but stated fewer than 24 departments. Then the

degree of restriction (DR) for Ali is computed as follows:

$$DR(Ali) = \frac{\sum_{k=1}^{24} R_{d_k}}{\sum_{k=1}^{24} (R_{d_k} + U_{d_k})}$$

Then, we suppose that the applicants with the highest degree of restriction would have made 29 choices if they had not been restricted. The applicants who had the least degree of restriction would have stated 24 choices even if they had been allowed to state more choices.

Step 3: What are the additional departments that the applicant would have stated if there had been no restriction on stating preferences?

In section 3 we describe that the applicants who stated at least one medical science department had more than half of their choices in health related departments. If such an applicant had been allowed to state preference over one more department, he would have been more likely to state preference over another health related department. We use such correlations between the preferences for different departments when we predict the departments that were left out because of the restriction.

Let's say that in step 2, we find that Ali made 27 choices. Then, we need to find three new choices for him that he would have stated in the absence of the restriction. He did not state preferences over 3998 $(= 4022 - 24)$ departments. Let x_j $(j = 1, ..., 3998)$ denote those departments. Let $f(x_j, d_k)$ be the frequency of the applicants who stated preferences over both x_j and d_k. Then, the degree of likelihood (DL) of department x_j for Ali is computed as follows.

$$DL(x_j, Ali) = \sum_{k=1}^{24} f(x_j, d_k)$$

We choose three departments with the highest DL values to be Ali's new choices.

Step 4: How would the applicants have ranked their new choices?

As we discussed in section 2, the applicants can leave out any of their choices when they are restricted. They would even leave out their most favorite department if they believe that the chances of being placed to that department is slim. After finding the left out choices in step 3, we rank those with the original choices.

We assume that the order in the original preferences is preserved. For instance, if "Istanbul

University–Economics" was ranked above "Istanbul University–Chemistry" when there is restriction on stating preferences, we assume that they would have been ordered same way in the absence of the restriction, too. We find the ranking of the new choices by using the frequencies. Suppose that "Ankara University–Political Science" is a new choice for Ali. If this department was ranked above "Istanbul University–Chemistry" by more than half of the applicants who had stated preferences over both departments, then we assume that if there had been no restriction on stating preferences, then Ali would rank "Ankara University–Political Science" in higher order than "Istanbul University–Chemistry."

Let a_1, a_2 and a_3 be Ali's new choices where a_1 has the highest DL value and a_3 has the lowest. We incorporate these new choices to the existing choices one by one. We first take a_1 and compare to d_{24}. If more applicants ranked d_{24} in higher order, then a_1 becomes Ali's 25. choice. Otherwise we make the same comparison with a_1 and d_{23}. Say, by doing this comparison, we find that a_1 is more favorite than d_k but less favorite than d_{k-1}. Then, department a_1 becomes Ali's k'th choice. We repeat the same procedure for other new choices.

5 Results

We have the stated preferences and test scores of the applicants and the capacities of the departments in our data set. We predict the departments that the applicants would have stated if there had been no restriction on stating preferences by using the methodology described in the previous section. Then, by using the multi–category placement algorithm[9], we determine the departments that the applicants place in when there is no restriction on stating preferences. Consequently, we determine the unfairly treated applicants and the applicants placing in a different department.

We predict that there were 60,181 applicants who had at least one left out choice due to the restriction on stating preferences. Among them, 4,761 applicants had ex–post regret. In other words, each of these applicants had at least one left out choice which is preferred to his current placement and also has a lower cut–off test score than the applicant's test score. Therefore, these applicants were not given priority for their high scores and they were unfairly treated. The number of unfairly treated applicants is equivalent to 2.4 percent of the number of applicants who placed in a department.

[9] Details of the multi–category placemet algorithm is given in the appendix.

Note that all the unfairly treated applicants would not have gained by placing in a more favorite department if the central authority had removed the restriction on stating preferences. The number of unfairly treated applicants is computed by considering their left out choices and the cut–off test scores under the current restricted regime. If the central authority switches to the unrestricted regime, then the cut–off test scores of the departments would change. Consequently, some of the unfairly treated applicants might be worse off. Moreover, some of the applicants who were not counted as unfairly treated might benefit from this policy change.

We compute that 12,763 applicants would have been placed in a different department if the central authority had removed the restriction. 10,333 applicants would have benefited whereas 2,450 applicants would have lost from this change. The removal of the restriction clearly does not create a Pareto improvement. Some applicants suffer and cannot be placed in their more favorite departments due to the restriction. These slots might be filled by some other applicants who gain from the restriction. The applicants cannot know whether they benefit or lose from the existence of restriction because they do not know the cut–off test scores that form in the absence of the restriction.

6 Concluding Remarks

We can certainly say that the number of applicants, who were unfairly treated because of the restriction on stating preferences, is significant. Moreover, removing this restriction almost has no cost. Then, why the central authority keeps this restriction? We come up with two sets of answers when we discuss it with the bureaucrats from central authority, our colleagues and the students. The first set of answers relies on the historical facts and the second set of answers relies on a logic in which fairness has no importance.

The restriction saved costs in the past. The centralization of the college admissions system took place in 1970's. At that time, the applicants were filling paper forms to state their preferences and the placement algorithm was run through the computers which were relatively much slower than today's computers. Hence, additional choices would mean extra papers and extra processing time. Today, none of these reasons are valid. The applicants are stating their preferences by using a web interface and the placement algorithm can be run by an ordinary computer in less than two hours.

The people who gave the second set of answers believe that the priority of the placed department

in the stated preferences is important for the quality of the college education. For instance, they believe that the teachers in high schools have low ability because they are placed in education departments as their tenth choice on average. If there are no restriction on stating preferences, then the applicants will be placed in teaching colleges as their twentieth choice on average and this policy change will even lower the ability of teachers. However, this reasoning is not valid. Assume that the central authority restricts applicants to state only one choice. In that case, education departments will be the first and only choice of the applicants who will be placed in them. However, the applicants will not naively state their most favorite choice as their only choice. An applicant would pick the department which maximizes his expected payoff by considering the payoff and the probabilities of being placed in the departments.

In sum, we believe that the cost of removing the restriction is insignificant in the Turkish college admissions, and the restriction on stating preferences should be removed. For the case of the decentralized systems, such as the college admission system of the U.S, the costs are significant. In the decentralized systems, cooperation among the colleges might decrease these costs. For instance, a centralized placement system may be established for the state colleges and the applicants apply to the state colleges by applying to this system rather than filling out applications separately. As the costs of application decrease, the applicants apply to more colleges. Application to more colleges will decrease the number of ex–post regrets felt by the applicants.

7 References

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8 Appendix

8.1 Open Education Institutions and Two Year Vocational Colleges

In 2005, there were six departments in open education institutions in Turkey which have no capacity constraint. There was a threshold test score that was required to be placed in a department in open education institutions. If an applicant scores more than this threshold, he is able to place in a department in open education institutions. 1,298,752 applicants (80 percent of all applicants)

scored above this threshold test score and 143,181 of those placed in departments in open education institutions.

In 2005, there were 4,161 departments in vocational colleges which offer two year programs. These departments have capacity constraints. However, in the placement to the vocational colleges, the test scores of the students have no importance. The central authority places the students to these colleges by considering their high school type and high school GPA. 265,981 applicants placed in the departments in vocational colleges.

The applicants can state preferences over 24 departments from any of colleges, vocational colleges or open education institutions. In this paper, we focus our attention to the preferences over colleges by excluding the preferences over vocational colleges and open education institutions. Suppose that an applicant states 23 departments from the colleges and one department from a vocational college. In our analysis, we assume that this applicant states only 23 departments. The reason for this exclusion is to preserve simplicity and focus our attention to the placement to the colleges which is more competitive than the placement to open education institutions and vocational colleges. If we include the preferences over vocational colleges and open education institutions, then there will be more applicants who states preferences over 24 departments. Therefore, our analysis provides a lower bound for the effect of restriction on stating preferences.

8.2 Computation of the Test Scores

The college admissions test has five components: Mathematics, Science, Social Sciences, Turkish and Foreign Languages. The central authority computes four categories of test scores by giving different weights to these components. These weights are given in table A1.

Table A1: Weights for different categories of test scores

	Math	Science	Turkish	Social Sciences	Foreign Languages
Quantitative	1.1	0.7	0.3	0.1	–
Verbal	0.3	0.1	1.1	0.7	–
Equally Weighted	1.0	0.1	0.8	0.3	–
Foreign Languages	–	–	0.7	0.1	1.4

The central authority takes one of these categories into account while placing the applicants in the departments. For instance, the central authority takes verbal test score into account while

placing an applicant in a Turkish literature department, whereas the quantitative test score is taken into account while placing the applicant in an engineering department.

In footnote 8, we explain why the composition of the applicants who stated economics and medical science departments differs. One reason is that applicants are evaluated in terms of different test score categories for these departments. The equally weighted test score is considered when the applicant is placed in an economics department, whereas a the quantitative test score is considered for a medical science department. Then, an applicant who wants to be placed in a medical science department would allocate more time to science test rather than the social science test during the test preparation and solving the test. Hence, it is disadvantageous to state departments in different test score categories.

Another step in computation of the test score is to add a component reflecting the high school performance. This component is affected by three factors. First, higher points are given to applicants who have higher GPA. Second, higher points are given to applicants who graduate from high schools which perform well in the test. Third, applicants who graduate from certain high schools are rewarded or punished when they state preferences over certain types of departments. For instance, an applicant who graduates from a vocational high school gets a higher point when he is evaluated for a department of his specialty in high school, whereas he is penalized if he is evaluated for a department of a different specialty.

8.3 Placement Algorithm

A multi–category placement algorithm is used by the central authority to place the applicant to the departments. In this algorithm, the departments are separated into four categories in terms of the test score category that is used in placing the applicants in them. The departments are also divided to many categories in terms of the rewards and punishments that are given to applicants from certain types of high schools. We simplify and aggregate the categories for this latter group into seven categories. In sum, we divide the departments into 7*4=28 categories. First, we explain the placement algorithm by assuming the existence of single category. Then, we will explain the multi–category placement algorithm.

8.3.1 Single Category Placement Algorithm

First, the applicants are sorted in terms of their test scores computed in the single category. Starting from the highest scoring applicant, the applicants are placed in their most preferred department among the set of departments that did not fill its capacity yet. For instance, take the 1000th applicant. If his first choice is not filled, then we place him to his first choice. However, if his first choice is filled by the 999 applicants who score above him, then we look at his second choice and use the same procedure.[10] After placing all the applicants, we look at the lowest scoring applicant placed to each department in order to get the cut–off test scores.

8.3.2 Multi–Category Placement Algorithm

First Step: The applicants are sorted in terms of the test scores computed in the first category. By ignoring the preferences for the departments that do not belong to the first category, the applicants are placed in departments by the single–category algorithm described above. Then, we use the same procedure for all the other categories. Note that, the applicant can be placed in more than one department. For instance, the applicant may be placed in a department from the third category and another department from the eleventh category. If there is such an applicant, we move to step 2. Otherwise, the algorithm stops.

Second Step: If an applicant is placed in more than one department, we find his most preferred department among the departments he placed in and delete their choices ranked below this department. For instance, if this most preferred department is a third choice for an applicant, then we would re–form his preferences such that he has only the first three choices. We apply this procedure for all the applicants placed in more than one department.

After forming the new preferences in the second step, we repeat the first step. We continue this procedure until all the applicants are placed in at most one department. Then, we look at the lowest scoring applicant placed in each department in order to get the cut–off test scores.

[10] This is the only fair placement algoritm. For a formal proof, see Dogan (2005).