WORKING PAPERS

2025-22

05 Juin 2025

Efficiency and Application Fees in School Choice

Cyril Rouault

CEPS
Centre for Economics at Paris-Saclay

Efficiency and Application Fees in School Choice*

Cyril Rouault†

Abstract

This note investigates the impact of application fees on student strategies within the Deferred Acceptance mechanism (DA). We demonstrate that application fees reduce the set of Nash equilibria under DA. While this reduction may preserve the existence of Nash equilibria leading to assignments Pareto-dominating the student-optimal stable assignment, it may also preclude the existence of such equilibria. This occurs when application fees are positive for all students at a given school.

JEL Classification: C78, D47, D82.

Keywords: Matching; Application fees; Efficiency; Deferred acceptance; Nash Equilibrium

1 Introduction

Following Gale and Shapley's (1962) seminal paper, matching theory has influenced the design of college admission systems (Roth and Sotomayor 1990; Abdulkadiroğlu and Sönmez 2003). The *student-proposing deferred acceptance mechanism* (DA) is a widely used mechanism in this context. DA produces the student-optimal stable assignment and is strategy-proof for students (Roth 1982). However, schools must rank students by reviewing applications, which incurs costs. To offset these costs or limit the number of applicants, application fees are often introduced. This note investigates how such fees influence student strategies in a preference revelation game. We consider a setting in which students have lexicographic preferences over DA outcomes, prioritizing assignments first and application fees second. This assumption reflects the typically low magnitude of application fees, which makes them unlikely to influence students' preferences for more desirable assignments. Empirical evidence from He and Magnac (2022) supports this assumption.

Constraints on students' choices can affect their strategic behavior.[1] Even low application fees can limit the range of schools to which students choose to apply. We show that these fees reduce the set of Nash equilibria in DA (Theorem 1) and explore how this reduction impacts student welfare.

It is well known that certain Nash equilibria under DA can lead to assignments that Pareto-dominate the student-optimal stable assignment.[2] In our Example 1, we show that specific

*I am grateful to Olivier Bos, Vincent Iehlé, and Olivier Tercieux for their valuable comments.

†Université Paris-Saclay, ENS Paris-Saclay, CEPS. *E-mail address:* cyril.rouault@universite-paris-saclay.fr

[1] See Haeringer and Klijn (2009) for restrictions on the number of schools to which students can apply and Chade et al. (2014) for the role of application fees. While Haeringer and Klijn (2009) consider a constraint imposed on students, we examine the strategic response to the implementation of constraints such as application fees.

[2] Bando (2014), Dur and Morrill (2020), and Rouault (2023) explore Nash equilibria that yield such assignments in the absence of application fees.

profiles of application fees can result in such outcomes. However, these fees can also prevent the existence of such Nash equilibria. Our Theorem 2 establishes a sufficient condition on the application fee profile to prevent the existence of a Nash equilibrium that leads to certain assignments Pareto-dominating the student-optimal stable assignment. This condition holds when application fees are positive for all students applying to a given school. The main argument in the proof is that students do not apply to a school with a positive application fee unless they are assigned to it.

Furthermore, we show that when application fees are positive for all students at all schools, the outcomes of Nash equilibria coincide with stable assignments (Proposition 2). In the context of a large market, all equilibrium outcomes are stable (Artemov et al. 2023). Our results suggest that in a finite economy, equilibrium outcomes that are not stable are not robust to the implementation of application fees.

2 Model

In a (school choice) *problem* with application fees, there is a finite set of *students*, I, and a finite set of *schools*, S. Each school $s \in S$ has a *capacity* q_s, and $q \equiv (q_s)_{s\in S}$ represents the *capacity vector*. Let $\emptyset$ denote the option of being unassigned, with $q_\emptyset = |I|$. Each student i has *strict preferences* P_i over $S \cup \{\emptyset\}$. Let $P \equiv (P_i)_{i\in I}$ be the *preference profile* of all students. Let $\mathcal{P}$ be the set of *all possible strict rankings* over $S \cup \{\emptyset\}$. Each school s has a *strict priority order* $\succ_s$ over I. Let $\succ \equiv (\succ_s)_{s\in S}$ be the *priority profile* of all schools. An *application fee profile* is a $|I| \times |S|$-dimensional matrix C, where each element $c_{i,s} \in \{0, 1\}$ represents the application fee of student i to school s: $c_{i,s} = 0$ means the application fee for student i to school s is zero, while $c_{i,s} = 1$ means the fee is positive. For each $i \in I$, we set $c_{i,\emptyset} = 0$. Let C_0 denote a *null application fee profile*, where for each $i \in I$ and $s \in S$, $c_{i,s} = 0$. Let $\mathcal{C}$ be the set of *all application fee profiles*. For notational convenience, we typically represent $(I, S, q, P, \succ, C)$ by (P, C).

An *assignment* is a correspondence $\mu : I \cup S \cup \{\emptyset\} \to I \cup S \cup \{\emptyset\}$ such that for each $i \in I, \mu(i) \in S \cup \{\emptyset\}$, for each $s \in S, \mu(s) \subseteq I$ with $|\mu(s)| \leq q_s$, and for each $i \in I, \mu(i) = s$ if and only if $i \in \mu(s)$. Student i's prefences P_i over schools implicitly define a preference relation R_i over assignments as follows: $\mu(i) R_i \hat{\mu}(i)$ if and only if $\mu(i) P_i \hat{\mu}(i)$ or $\mu(i) = \hat{\mu}(i)$.

An assignment μ is *stable* if:

- μ is *individually rational*, i.e., for each $i \in I$, $\mu(i) R_i \emptyset$,
- μ is *non-wasteful*, i.e., for each $i \in I$ and each $s \in S$, $s P_i \mu(i)$ implies $|\mu(s)| = q_s$,
- there is *no justified envy*, i.e., for each $i, j \in I$ with $\mu(j) = s$, $s P_i \mu(i)$ implies $j \succ_s i$.

Let $S(P, C)$ denote the *set of stable assignments* for problem (P, C). An assignment μ *Pareto-dominates* an assignment $\hat{\mu}$ if for each $i \in I, \mu(i) R_i \hat{\mu}(i)$ and there exists at least one i such that $\mu(i) P_i \hat{\mu}(i)$. An assignment is *(Pareto) efficient* if it is not Pareto-dominated by any other assignment. A stable assignment is the *student-optimal stable assignment* if it Pareto-dominates all other stable assignments. In this note, we denote it by μ_I.

A *mechanism* φ selects for each problem (P, C) an outcome $\varphi(P, C) = (\mu, c_P)$, where μ is an assignment and c_P is a vector $c_P \equiv (c_{P_i})_{i\in I}$. For each student $i \in I$, we denote the outcome of $\varphi(P, C)$ by $\varphi(P, C)(i) = (\mu(i), c_{P_i})$, where student i is assigned to $\mu(i) \in S \cup \{\emptyset\}$ and $c_{P_i} =$

$\sum_{s\in A(P_i)} c_{i,s}$.[3] Each problem (P,C) and mechanism φ induce a game where students are the *players*. We refer to the preference profile P as the students' true preferences. For each student, the *strategy space* is $\mathcal{P}$. Let $\tilde{P}_i \in \mathcal{P}$ denote the *strategy* of student i in the *strategy profile* $\tilde{P}$, and let $\mathcal{P}^{|I|}$ represent the set of *all possible strategy profiles*. A school s is *acceptable* to i under $\tilde{P}_i \in \mathcal{P}$ if $s\tilde{P}_i\emptyset$, and let $A(\tilde{P}_i) \equiv \{s \in S : s\tilde{P}_i\emptyset\}$ denote the *set of acceptable schools* to i under $\tilde{P}_i$. We consider the complete information environment such that preferences and priorities of all students are commonly known. We assume the *lexicographic preference* of students over outcomes, such that for each $i \in I$, $(\mu(i), c_{\tilde{P}_i}) \gtrdot_i (\hat{\mu}(i), \hat{c}_{\tilde{P}_i})$ if and only if $\mu(i)P_i\hat{\mu}(i)$ or $\mu(i) = \hat{\mu}(i)$ and $c_{\tilde{P}_i} < \hat{c}_{\tilde{P}_i}$.

A strategy profile $\tilde{P}$ is a *Nash equilibrium* under φ if for each $i \in I$, there is no strategy $\hat{P}_i$ such that $\hat{P}_i \neq \tilde{P}_i$, and $\varphi((\hat{P}_i, \tilde{P}_{-i}), C)(i) \gtrdot_i \varphi(\tilde{P}, C)(i)$, where $\tilde{P}_{-i} \equiv (\tilde{P}_j)_{j\in I\setminus\{i\}}$. For problem (P,C), let $DA(\tilde{P}, C)$ denote the outcome of *the deferred acceptance mechanism* (DA) with strategy profile $\tilde{P}$, and $NE(DA(P,C))$ the *set of strategy profiles* $\tilde{P}$ *that are Nash equilibria* under DA for problem (P,C).

We now introduce an example to illustrate our model and results.

Example 1. Consider a problem $(I, S, P, \succ, q, C_0)$ such that $I = \{i_1, i_2, i_3\}$, $S = \{s_1, s_2, s_3\}$, for each $s \in S, q_s = 1$. Preferences and priorities are given in the following tables, and $(\cdot)$ indicates that priorities are irrelevant to the problem:

$\succ_{s_1}$	$\succ_{s_2}$	$\succ_{s_3}$
i_3	i_1	$\cdot$
i_1	i_2	$\cdot$
i_2	i_3	$\cdot$

P_{i_1}	P_{i_2}	P_{i_3}
s_1^*	s_1	s_2^*
$\underline{s_2}$	s_2	$\underline{s_1}$
s_3	$\underline{s_3^*}$	s_3
$\emptyset$	$\emptyset$	$\emptyset$

μ_I is underlined in students' preferences and μ^* is denoted by a star (*). It is clear that μ^* is the only assignment that Pareto-dominates μ_I, and μ^* is efficient. From the literature, we know that $P \in NE(DA(P, C_0))$ (Gale and Shapley 1962). Now, suppose we introduce an application fee profile C, where $c_{i_2,s_2} = 1$ and 0 for all other entries of C. With this application fee profile and given the strategies of the other students, P_{-i_2}, there exists a profitable deviation for i_2: namely, not applying to s_2. There exists a strategy profile $\tilde{P}_{i_2} : s_1, s_3, \emptyset$ such that $DA((\tilde{P}_{i_2}, P_{-i_2}), C)(i_2) \gtrdot_{i_2} DA(P,C)(i_2)$ and $P \notin NE(DA(P,C))$. This illustrates that the set of Nash equilibria is reduced by implementing application fees. Following i_2's deviation, for each $i \in I, DA((\tilde{P}_{i_2}, P_{-i_2}), C)(i) = (\mu^*(i), 0)$. Furthermore, $(\tilde{P}_{i_2}, P_{-i_2}) \in NE(DA(P,C))$. Therefore, there exist application fee profiles that lead to a Pareto improvement while maintaining the existence of a Nash equilibrium that results in an assignment Pareto-dominating the student-optimal stable assignment.

[3]In our model, c_{P_i} represents the number of schools with applications fees acceptable to student i with preferences P_i. We implicitly assume that the application fees of all schools are similar, and consider only the sum of these schools rather than the sum of the fees.

3 Results

3.1 Impact of Application Fees on the Set of Nash Equilibria

In this section, we show that application fees reduce the set of Nash equilibria.

Theorem 1. For any application fee profile $C \in \mathcal{C}$, $NE(DA(P,C)) \subseteq NE(DA(P,C_0))$.

Proof. Assume by contradiction that there exists $\tilde{P}$ such that $\tilde{P} \in NE(DA(P,C))$ and $\tilde{P} \notin NE(DA(P,C_0))$. This implies that there exist $i \in I$ and $\hat{P}_i \neq \tilde{P}_i$ such that $DA((\hat{P}_i, \tilde{P}_{-i}), C_0)(i) \succ_i DA(\tilde{P}, C_0)(i)$. This means that for $DA((\hat{P}_i, \tilde{P}_{-i}), C_0)(i) = (\hat{\mu}(i), c_{\hat{P}_i})$ and $DA(\tilde{P}, C_0)(i) = (\tilde{\mu}(i), c_{\tilde{P}_i})$, either $\hat{\mu}(i) P_i \tilde{\mu}(i)$ or $\hat{\mu}(i) = \tilde{\mu}(i)$ and $c_{\hat{P}_i} < c_{\tilde{P}_i}$. Since C_0 is the null application fee profile, we know that $c_{\hat{P}_i} = c_{\tilde{P}_i} = 0$, and thus, $\hat{\mu}(i) P_i \tilde{\mu}(i)$. Consider $\tilde{P}_{-i}, C$, and $P_i^* : \hat{\mu}(i), \emptyset$. We have to show that $DA((P_i^*, \tilde{P}_{-i}), C)(i) \succ_i DA(\tilde{P}, C)(i)$.

Lemma 1. Let $DA(\tilde{P}, C)(i) = (\tilde{\mu}(i), c_{\tilde{P}_i})$ and $P_i^* : \tilde{\mu}(i), \emptyset$ such that $DA((P_i^*, \tilde{P}_{-i}), C)(i) = (\mu^*(i), c_{P_i^*})$. Then, $\tilde{\mu}(i) = \mu^*(i)$.

Proof. Suppose that $\tilde{\mu}(i) \neq \mu^*(i)$. There exists $s \in A(\tilde{P}_i)$ such that $s \neq \tilde{\mu}(i)$ and $s \neq \mu^*(i)$. However, i has been rejected from s in $DA(\tilde{P}, C)$, and by the construction of DA, this leads to a contradiction.[4] ■

From Lemma 1 we know that if i applies only to $\hat{\mu}(i)$ in $DA(\tilde{P}, C)$, using strategy P_i^*, then i is assigned to $\hat{\mu}(i)$, and $\hat{\mu}(i) P_i \tilde{\mu}(i)$. Therefore, $DA((P_i^*, \tilde{P}_{-i}), C)(i) \succ_i DA(\tilde{P}, C)(i)$, meaning that $\tilde{P}$ is not a Nash equilibrium, which contradicts that $\tilde{P} \in NE(DA(P,C))$. ■

Theorem 1 establishes that implementing application fees reduces the set of Nash equilibria. The consequence is that all strategy profiles that are Nash equilibria with the application fee profile are also Nash equilibria without fees.

3.2 Application Fees and Nash Equilibria Leading to Pareto Improvements

In this section, we identify a condition on the application fee profile that prevents the existence of Nash equilibria leading to an assignment μ that Pareto-dominates the student-optimal stable assignment.

Proposition 1. For any problem (P, C), if $\tilde{P} \in NE(DA(P,C))$, with $DA(\tilde{P}, C) = (\mu, c_{\tilde{P}})$, then for each $i \in I, c_{\tilde{P}_i} = c_{i,\mu(i)}$.

Proof. By contradiction, suppose there exists $\tilde{P} \in NE(DA(P,C))$ such that there exists $i \in I$, with $DA(\tilde{P}, C)(i) = (\mu(i), c_{\tilde{P}_i})$ and $c_{\tilde{P}_i} \neq c_{i,\mu(i)}$. Since $DA(\tilde{P}, C)(i) = (\mu(i), c_{\tilde{P}_i})$, it follows that $\mu(i) \in A(\tilde{P}_i)$, and thus $c_{\tilde{P}_i} > c_{i,\mu(i)}$. Consider $\hat{P}_i : \mu(i), \emptyset$, such that $DA((\hat{P}_i, \tilde{P}_{-i}), C)(i) = (\hat{\mu}(i), c_{\hat{P}_i})$. We know that $c_{\hat{P}_i} = c_{i,\mu(i)}$. We need to show that $(\hat{\mu}(i), c_{\hat{P}_i}) \succ_i (\mu(i), c_{\tilde{P}_i})$. Suppose $(\mu(i), c_{\tilde{P}_i}) \succ_i (\hat{\mu}(i), c_{\hat{P}_i})$. This implies either $\mu(i) P_i \hat{\mu}(i)$ or $\mu(i) = \hat{\mu}(i)$ and $c_{\tilde{P}_i} < c_{\hat{P}_i}$. It is straightforward that $c_{\tilde{P}_i} > c_{\hat{P}_i}$. From Lemma 1, we have $\mu(i) = \hat{\mu}(i)$, which contradicts $\tilde{P} \in NE(DA(P,C))$. ■

[4] McVitie and Wilson (1970) show that DA can be decomposed by considering an order of application among the students rather than simultaneous applications. Lemma 1 follows as a direct consequence of their Theorem 1.

The intuition behind Proposition 1 is that, when the strategies of other students are fixed, no student will apply to a school with a positive application fee unless they are assigned to it. Proposition 1 therefore implies that, in any Nash equilibrium, students apply to such schools only if they are assigned to them. From this reasoning, we derive our second main result. Theorem 2 identifies a sufficient condition on application fee profiles such that for an assignment μ that Pareto-dominates the student-optimal stable assignment, no Nash equilibrium exists that leads to μ with DA.

Theorem 2. Consider a problem (P, C), and an assignment μ that Pareto-dominates μ_I. Let i^*, j be students such that $\mu(i^*)P_{i^*}\mu_I(i^*)$ and $\mu(i^*)P_j\mu(j)$, with $j \succ_{\mu(i^*)} i^*$. If for each $i \in I$ such that $i \succ_{\mu(i^*)} j$ and $\mu(i) \neq \mu(i^*)$, we have $c_{i,\mu(i^*)} = 1$, then there does not exist $\tilde{P} \in NE(DA(P, C))$ such that $DA(\tilde{P}, C) = (\mu, c_{\tilde{P}})$.

Proof. By contradiction, suppose there exists $\tilde{P} \in NE(DA(P, C))$ such that $DA(\tilde{P}, C) = (\mu, c_{\tilde{P}})$ and μ Pareto-dominates μ_I. First, let us show that such students i^* and j exist and that $\mu(i^*) \in S$. By the definition of stability and the Pareto-domination of the student-optimal stable assignment μ_I (Gale and Shapley 1962), we know that there exists $i^*, j \in I$ such that $\mu(i^*)P_{i^*}\mu_I(i^*)$ and $\mu(i^*)P_j\mu(j)$, with $j \succ_{\mu(i^*)} i^*$. Since μ Pareto-dominates μ_I, we know that $\mu(i^*) \neq \emptyset$ because $\mu_I(i^*)$ is individually rational and $\mu(i^*)P_{i^*}\mu_I(i^*)R_{i^*}\emptyset$.
Second, we now show that j has a profitable deviation and can be assigned to $\mu(i^*)$. By applying to $\mu(i^*)$, (i) a student will be rejected, and (ii) no student whose application could lead to the rejection of j will apply to $\mu(i^*)$.
(i) Since μ_I is stable, there is no justified envy. Therefore, for each $i \in I$ such that $\mu_I(i) = \mu(i^*)$, it holds that $i \succ_{\mu(i^*)} i^*$. Additionally, since μ_I is non-wasteful, it follows that $|\mu_I(\mu(i^*))| = q_{\mu(i^*)}$. Since μ Pareto-dominates μ_I, we know that $|\mu(\mu(i^*))| = q_{\mu(i^*)}$ (i.e. $\mu(i^*)$ has reached its maximum capacity under assignment μ). Thus, if j applies to $\mu(i^*)$, we know that a student will be rejected because $j \succ_{\mu(i^*)} i^*$.
(ii) Let us now consider the strategy of other students. By Proposition 1, if the application fee for a school is positive for a student and the student is not assigned to that school, then at a Nash equilibrium, the student does not apply to it. Since for each $i \in I$ such that $i \succ_{\mu(i^*)} j$ and $\mu(i) \neq \mu(i^*)$, we have $c_{i,\mu(i^*)} = 1$, it follows that $\mu(i^*) \notin A(\tilde{P}_i)$. Thus, in the strategy profile $\tilde{P}$, at most $q_{\mu(i^*)} - 1$ students with a higher priority than j at $\mu(i^*)$ apply to $\mu(i^*)$ (since i^* is assigned to $\mu(i^*)$ under $DA(\tilde{P}, C)$).
Now, let us consider a strategy for j, denoted $\hat{P}_j : \mu(i^*), \emptyset$. Given that $DA(\tilde{P}, C) = (\mu, c_{\tilde{P}})$, with i^* assigned to $\mu(i^*)$ and $j \succ_{\mu(i^*)} i^*$, we know that in $DA((\hat{P}_j, \tilde{P}_{-j}), C)$, j applies to $\mu(i^*)$ and a student will be rejected from $\mu(i^*)$ since $\mu(i^*)$ has reached its maximum capacity. Student j cannot be rejected from $\mu(i^*)$, because at most $q_{\mu(i^*)} - 1$ students with a higher priority than j apply to $\mu(i^*)$ in $\tilde{P}_{-j}$. Therefore, $DA((\hat{P}_j, \tilde{P}_{-j}), C)(j) = (\mu(i^*), c_{j,\mu(i^*)})$ and $(\mu(i^*), c_{j,\mu(i^*)}) \succ_j (\mu(j), c_{\tilde{P}_j})$ as $\mu(i^*)P_j\mu(j)$, which contradicts that $\tilde{P} \in NE(DA(P, C))$. ■

Theorem 2 can be illustrated with Example 1. Consider $\tilde{P}$ such that $\tilde{P}_{i_1} = P_{i_1}$, $\tilde{P}_{i_2} : s_1, s_3, \emptyset$ and $\tilde{P}_{i_3} = P_{i_3}$. Under the assignment μ^*, the student i_1, who has a higher priority than i_2 at school s_2, is not assigned to s_2. If an application fee profile C is introduced such that $c_{i_1,s_2} = 1$, then i_1 does not apply to s_2 (Proposition 1). For instance, the strategy of i_1 could be $\hat{P}_{i_1} : s_1, s_3, \emptyset$. The strategy profile $(\hat{P}_{i_1}, \tilde{P}_{-i_1})$ is not a Nash equilibrium, as the student i_2 has a profitable deviation, for example, by using the strategy $\hat{P}_{i_2} : s_2, \emptyset$. We have $DA((\tilde{P}_{i_3}, \hat{P}_{-i_3}), C)(i_2) = (s_2, c_{i_2,s_2})$ and $s_2 P_{i_2} \mu^*(i_2)$.

In practice, application fees are often uniform across all students at a given school. This aspect is discussed in the next section. Thus, the condition identified in Theorem 2 is satisfied if, for all students, the application fee for $\mu(i^*)$ is positive. Application fees can hinder Pareto improvements for certain students. Proposition 2 completes Theorem 2 by establishing that when all schools impose positive application fees on all students, only stable assignments can be obtained at Nash equilibrium. Therefore, the best assignment students can expect in a Nash equilibrium of DA is the student-optimal stable assignment.

Proposition 2. Consider a problem (P, C). If for each $i \in I, s \in S, c_{i,s} = 1$, then for each $\tilde{P} \in NE(DA(P, C))$ with $DA(\tilde{P}, C) = (\mu, c_{\tilde{P}})$, we have $\mu \in S(P, C)$.

Proof. From Proposition 1, we know that for each $\tilde{P} \in NE(DA(P, C))$, for each $i \in I$, we have $DA(\tilde{P}, C)(i) = (\mu(i), c_{\tilde{P}_i})$, with $c_{\tilde{P}_i} = c_{i,\mu(i)}$, therefore, $|A(\tilde{P}_i)| \leq 1$. Then, by Theorem 5.3 of Haeringer and Klijn (2009), it directly follows that only stable assignments can be obtained at Nash equilibrium when students apply to at most one school. ■

4 Discussion

In this note, we demonstrate that application fees reduce the set of Nash equilibria under DA. Furthermore, we identify a sufficient condition in the application fee profile that prevents the existence of Nash equilibria leading to an assignment that Pareto-dominates the student-optimal stable assignment. This condition holds when fees are positive for all students at a given school. In some centralized admission mechanisms, students are required to pay application fees to apply to various programs. For instance, in the United States, the *Common App* enables students to apply to multiple universities, some of which charge application fees for all applicants.[5] Similarly, in France, the *Parcoursup* platform includes business schools that impose application fees.[6] Our results suggest that these costs prevent Pareto improvements for students.

One potential solution would be to allow students to apply free of charge to certain schools. Various criteria could be considered for waiving the fees, such as the student's background in a disadvantaged socio-economic context, or demonstrating a particular interest in the program. For example, at *Penn State DuBois*, application fees are waived if a student has visited the campus.[7]

This note emphasizes the importance of carefully designing application fee profiles in college admission mechanisms. A natural follow-up research would be to investigate mechanisms that allow for fee waivers for certain applicants, which could potentially improve student assignments.

[5] The description is available at https://www.commonapp.org/apply (last accessed on 12/17/2024).

[6] The description is available at https://www.parcoursup.gouv.fr/trouver-une-formation/quelles-formations-sont-accessibles-sur-parcoursup-1318 (last accessed on 12/17/2024).

[7] The description is available at https://dubois.psu.edu/visit-campus-waive-your-application-fee (last accessed on 12/17/2024).

Furthermore, laboratory experiments could complement our theoretical analysis by providing insights into the impact of application fees on student behavior and outcomes.

References

Abdulkadiroğlu, A. and Sönmez, T. (2003). School choice: A mechanism design approach. *American economic review*, 93(3):729–747.

Artemov, G., Che, Y.-K., and He, Y. (2023). Stable matching with mistaken agents. *Journal of Political Economy Microeconomics*, 1(2):270–320.

Bando, K. (2014). On the existence of a strictly strong nash equilibrium under the student-optimal deferred acceptance algorithm. *Games and Economic Behavior*, 87:269–287.

Chade, H., Lewis, G., and Smith, L. (2014). Student portfolios and the college admissions problem. *Review of Economic Studies*, 81(3):971–1002.

Dur, U. M. and Morrill, T. (2020). What you don't know can help you in school assignment. *Games and Economic Behavior*, 120:246–256.

Gale, D. and Shapley, L. S. (1962). College admissions and the stability of marriage. *The American Mathematical Monthly*, 69(1):9–15.

Haeringer, G. and Klijn, F. (2009). Constrained school choice. *Journal of Economic theory*, 144(5):1921–1947.

He, Y. and Magnac, T. (2022). Application costs and congestion in matching markets. *The Economic Journal*, 132(648):2918–2950.

McVitie, D. G. and Wilson, L. B. (1970). Stable marriage assignment for unequal sets. *BIT Numerical Mathematics*, 10(3):295–309.

Roth, A. E. (1982). The economics of matching: Stability and incentives. *Mathematics of operations research*, 7(4):617–628.

Roth, A. E. and Sotomayor, M. (1990). Two-sided matching. *Handbook of game theory with economic applications*, 1:485–541.

Rouault, C. (2023). Efficiency and stability trade-offs in school choice: Implementing and characterizing nash equilibria. *hal-04238849v2*.