Gender and Demand for Schooling:
Lessons from School Choice and Admission Outcomes in Ghana*

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Abstract

This paper examines the impact of a merit-based school choice system on gender disparities in schooling. In several countries, admission to secondary school is determined by students' performance on a national entrance exam and their ranking of a set of preferred choices. This admissions procedure may reinforce gender differences in academic performance for two main reasons: 1) male and female students may have gender-based preferences which lead them to choose different academic programs and schools of differing quality, and 2) male and female students may have different probabilities of being admitted to their preferred choices or to high performing schools. I use school choice data from Ghana's secondary education system to examine both of these issues. Estimates from a multinomial logit demand model suggest that female students are less likely to select technical programs and have a stronger preference for attending single-sex and public schools. However, demand for school quality and sensitivity to proximity appear to be more strongly correlated with academic ability than with gender. Finally, I find that female students are slightly less likely to be admitted to their first choice but are equally as likely to be admitted to a high-performing school. JEL Codes: I21, J16, J24.

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1 Introduction

Despite recent improvements in gender equality in education, female students still lag behind their male peers in school attendance and achievement in many low-income countries. Enrollment differences tend to increase at higher levels of schooling. In Ghana, for example, females constitute 48 percent of the student population in primary school but only 42 percent by senior secondary. Performance differences also increase with school attainment, particularly in the fields of science and mathematics. In 2004, 76.8 percent of male students and 72.4 percent of female students passed mathematics in the Basic Education Certification Exam (BECE) at the end of junior high school. However, 29 percent of male students and only 17 percent of female students passed mathematics when this same cohort of students took the Senior Secondary Certification Exam (SSCE) at the end of senior high school. (MOESS, 2008)

This paper considers the secondary school admissions process as a possible explanation for the increase in gender disparities. A vast majority of students transfer to a new school at the end of junior high school, through a merit-based system in which senior high school assignment is determined by a combination of students' choices as well as their performance on the BECE. Thus, students have differing (non-random) probabilities of being admitted to their first choice school. Given these conditions, I ask two central questions: 1) Do female students make less favorable choices? and 2) Are female students less likely to be admitted to a "good" school?[1]

I find that females have distinctive preferences for school characteristics and programs of study - they are less likely to select technical programs and have a higher valuation of public and single-sex schools than their male peers. However, academic ability plays a larger role than gender in explaining preferences for school quality and proximity - higher performing students of both sexes have a higher valuation of school quality and a weaker aversion to distance than lower performing students. Finally, female students are slightly less likely than males to be admitted to their first choice program but are admitted to schools with the same average quality of peers (as measured by the average BECE scores of incoming students). Altogether, these findings suggest that school choice and admission outcomes have limited implications for gender equality in secondary school.

The remainder of the paper is structured as follows: Section (2) reviews related literature and Section (3) provides some background information on secondary school admission in Ghana. Sections (4) and (5) describe the data and methodology. Section (6) presents the empirical results and the final section (7) concludes with a discussion of the main implications.

[1] Both objective and subjective valuations of school quality could be important. Objectively, if female students are less likely to be admitted to high performing schools, then they may receive a lower quality of education. However, students' subjective valuation of schools could also meaningful if students are likely to be motivated by being able to attend a school that they like. In essence, it could be equally as important to attend a first-choice school as a high performing one.

2 Literature Review

2.1 Gender and School Choice

Parents are usually the primary agents responsible for school choice. They may have different preferences for their sons' and daughters' education which they express through their choice of schools. These preferences may be consistent with human capital investment theory if differences in traditional occupations of men and women imply that certain types of education have differing returns for boys and girls.[2] Alternatively, choices may simply stem from sociological concepts of male and female identity and have little relation to education costs or expected returns (Akerlof and Kranton [2000] provide a theoretical foundation for this possibility).

In addition to parental influences, peer effects may be important to consider. Several studies have examined the impact of gender composition on students' academic performance (notably, Hoxby [2000] and Lavy and Schlosser [2008]), but there is less evidence on career choices. Using exogenous variation in the share of girls in a classroom, Schneeweis and Zweimüller (2009) find that exposure to a more female peer group decreases the likelihood that girls pursue a female-dominated academic track and increases their demand for technical education. In contrast, Bettinger and Long (2005) find that instructors' gender has mixed effects on students' course selection and choice of major.

In situations in which admission is restricted, students' program enrollment or school attendance may not reflect their preferences. An alternative approach is therefore to examine students' desired choices. Hastings, Kane and Staiger (2006, 2008) estimate parental preferences using data from a school choice program in the Charlotte-Mecklenburg Public School District in North Carolina. They find differences by socio-economic status (2008) as well as by race and gender (2006). However, students were not required to submit choices for subject-based academic tracks which is a central channel through which gender stereotyping may reinforce differences in academic achievement in secondary schools. Additionally, the school assignment mechanism may have provided incentives for parents to misrepresent their true preferences.[3]

One final limitation of existing studies of gender-based preferences is their tendency to view male and female students as two homogeneous groups, overlooking variation *within* gender groups. In particular, male and female students of similar academic ability or socio-economic status may have preferences which are more similar to one another than to those of other students of the same gender.

2.2 Influence of School Environment

The effect of school quality on student outcomes has been extensively documented. A set of recent studies using regression-discontinuity designs provide compelling evidence that attending a higher-performing school has a positive effect on student outcomes - Clark (2007), Pop-Eleches and Urquiola

[2] Munshi and Rosenzweig (2006) use this framework to explain differences in the take-up of English education in Bombay.

[3] See Abdulkadiroğlu, Pathak, Roth and Sönmez (2006) and Pathak and Sonmez (2008) for comprehensive discussions of strategic behavior under the *Boston mechanism*.

(2008), and Jackson (2009) examine returns to school quality in the UK, Romania, and Trinidad and Tobago. All three settings have admissions procedures which are quite similar to the one in Ghana. Additionally, Lai, Sadoulet and de Janvry (2009) find that parents' selection errors lowered the quality of schools attended and worsened academic outcomes for middle-school children in Beijing, establishing a causal link between school choice and student outcomes.

At the same time, there is a growing body of literature on school and neighborhood choice which suggests that girls may respond differently than boys to changes in their environments. Kling and Liebman (2005) conclude that random assignment to a lower-poverty neighborhood though the Moving to Opportunity program improved outcomes for girls but worsened outcomes for boys. Similarly, Anderson (2008) finds that early childhood programs had long-term effects for girls but not boys and Hastings, Kane and Staiger (2006) find significant improvements in academic performance for female students who were able to transfer to their first-choice school as a result of winning an assignment lottery but not for males.

Altogether, these findings suggest that academic setting (and particularly the ability to study in a school of one's choice) may have a greater influence on the performance of female students than males. Combined with potential differences in preferences and admission prospects, therefore, merit-based school choice programs may provide an understudied explanation for the increasing gap between male and female performance in secondary school.

2.3 Contribution

This paper expands on existing literature in three main ways: 1) I examine program choice as well as demand for non-academic school characteristics, 2) I highlight heterogeneity by academic ability, and 3) I analyze both preferences and admission outcomes, using data generated by an assignment mechanism which encourages participants to provide a truthful ranking of choices.

3 Institutional Background

Ghana's public education system provides an ideal setting for this study. Pre-tertiary education in Ghana consists of six years of primary school, three years of Junior High School (JHS) and four years of Senior High School (SHS).[4] This paper focuses on the transition from JHS to SHS. Admission of JHS students into SHS is based on students' ranking of their top six program choices and their performance on the Basic Education Certificate Exam (BECE) which is a national exam administered by the West African Examinations Council (WAEC). There are over 9,000 JHSs in the country but only 700 SHSs with half the capacity of the JHSs, so spaces in senior high school are severely limited.

Over, 300,000 students sit the BECE exam each year. 60 percent of candidates receive a passing grade in the exam and less than half of all candidates move on to SHS. [5] In 2007 for example,

[4]Ghana adopted a 6-3-3 schooling system in 1987 after abandoning its pre-existent 6-4-5-2 system. In 2008, the government introduced the current 6-3-4 system with an additional year of senior high school.

[5]Students who pass the BECE may still be ineligible for secondary school placement. The passing grade is based

320,247 students sat the BECE exam, 196,240 passed, 167,279 were placed in a school, and only 153,402 were enrolled in Form One of SHS the following school year. Part of this attrition is due to the rigid qualification requirements for admission to senior high school and part is due to the increased school fees which prevent even some of the admitted students from attending. Thus, JHS is the end of formal education for many Ghanaian students and only a select group advances to SHS.

Nonetheless, virtually all BECE candidates submit a ranked list of six secondary school choices. Each choice consists of a school and an academic program within that school.[6] Secondary school admission is centrally coordinated through a Computerised School Selection and Placement System (CSSPS). (Figure 1 outlines the system) The CSSPS uses a *deferred-acceptance algorithm* for school placement (Gale and Shapley, 1962). Under this algorithm, students are placed in schools according to their preferences and priority is determined strictly by academic merit as follows:

Step 1: Each student proposes to his or her first choice school. Each school tentatively assigns its seats to proposers one at a time in order of students' academic performance (measured by aggregate BECE scores). Each school rejects any remaining proposers once all of its seats are tentatively assigned.

In general, at

Step k: Each student who was rejected in a previous round proposes to his or her kth choice school. Each school compares the set of students it has been holding with the set of new proposers. It tentatively assigns its seats to these students one at a time in order of students' academic performance and rejects remaining proposers once all of its seats are tentatively assigned.

The algorithm terminates when no spaces remain. Each student is then assigned to his or her final tentative assignment.

Unlike the *Boston mechanism*, this system does not provide incentives for students to misrepresent their rank ordering of submitted choices, which means that one can safely infer their preferences from their list of ranked choices. The fact that students are only allowed to submit a limited number of choices means that they may still be selective about the set of six schools that they choose to apply to; however, the optimal strategy is to report a truthful preference ordering over the list of six submitted choices. Thus, we cannot infer that the six selected choices are preferred to all other options, but we can infer that the first choice school is preferred to the remaining five choices. (See Appendix for a more detailed discussion of strategic behavior in the CSSPS context)

on the student's aggregate score in their six best subjects. However, placement eligibility is based on the student's performance in the four core subjects (Mathematics, English Language, Integrated Science and Social Studies) and in their two best remaining subjects.

[6]Secondary education is divided into two tracks - i) Senior High Schools follow an academic curriculum geared towards admission to university; and ii) Technical and Vocational Institutes provide more practical training and a track to a polytechnical degree. Most students exclusively apply to SHSs. Academic programs include Agriculture, Business, General Arts, General Science, Home Economics, Technical and Visual Arts. All students take the same four core subjects in SHS but their programs determine their choice of electives. Students can also state a preference for accommodation in boarding facilities.

4 Data

I use two main types of data in this study: 1) CSSPS administrative data on student background characteristics, BECE scores, choices, and placement outcomes, and 2) supplementary data on school characteristics, including a standardized measure of schools' academic performance. The sample covers the universe of 340,823 students who applied to senior secondary school in 2008. There are no default school assignments, so students are not guaranteed admission to any particular school if they leave their form blank or if they are not admitted to any of their listed choices. Thus, the consequences of school choice are salient and participation rates are high - 95 percent of students submitted a complete list of all six choices.[7]

4.1 Student Information

School selection forms collect information on each candidate's date of birth, sex and disabilities as well as the name, location, and deprivation score of the junior high school they attended.[8] The CSSPS data set also contains each student's ranked list of school and program choices. Finally, I observe the aggregate BECE score (a single number out of 600) for students admitted to a senior secondary school as well as the name and location of the school. (Table 2 presents descriptive statistics)

Forty-five percent of BECE candidates are female. At a first glance, there are some striking gender differences (Figures 2 and 3). Female students are less likely to pass the BECE and less likely to be placed in a school. They are also less likely to be placed in their first choice school (which could suggest that they have less realistic expectations about their exam performance or are less likely to take their admission probabilities into account when selecting schools). However, the distribution of BECE scores for the set of students who were admitted to secondary school is remarkably similar for boys and girls. Thus, any gender disparities in outcomes of admitted students cannot be attributed to differences their initial average performance.

4.2 School Characteristics

I combine the CSSPS student data with supplementary information on school characteristics. The Ministry of Education maintains a register of JHSs and SHSs which is updated each year to provide information on each school's location, JHS deprivation scores and to indicate whether a school is public or private, single sex or coeducational. The SHS register also provides information on whether schools are day or boarding, technical or academic, and lists the types of programs offered and number of vacancies in each program. (Table 3)

[7] This is a remarkably high participation rate compared to school choice programs in the US. For example, less than 50 percent of students in Boston Public Schools listed the full number of available choices in Abdulkadiroglu, Pathak, Roth and Sonmez's (2006) study and 40 to 60 percent did in Charlotte-Mecklenburg Public Schools (Hastings, Kane and Staiger, 2008).

[8] Schools are assessed on their availability of resources and assigned a deprivation score ranging from 0 (non-deprived) to 9 (highly deprived). These scores are used to scale up test-scores for students from low-resource schools in an effort to compensate them for any test-taking disadvantages resulting from attending a deprived school.

Finally, I obtained school-level distributions of grades in the Secondary School Certificate Examination (SSCE) for each of the four core subjects (English, Mathematics, Social Studies and Integrated Science). The SSCE is taken at the end of secondary school and used for admission to university. It is also centrally administered by WAEC so exam scores are therefore comparable across schools. Students must receive a grade of A to F in each of the four core subjects in order to pass the exam. I use the average percentage of students receiving a grade of A to C in each subject as an index of academic performance. There is substantial variation in school quality with some schools having a close to a 100 percent pass rate and others producing not a single successful candidate. (Figure 6)

5 Econometric Model of Demand for Schools

5.1 Discrete Choice Specification

I estimate a discrete choice demand model using students' rankings of their top program choices to examine the extent to which preferences vary according to observable student characteristics (primarily gender and academic ability). To begin, I assume that each individual i's expected utility (U) from attending a given school s is a linear function of student-specific school characteristics (X_{is}):[9]

$$U_{is} = \beta X_{is} + \upsilon_{is}$$

Each student i selects a first choice school s from the set of all available schools (S), such that:

$$y_{is} = \begin{cases} 1 & iff\, U_{is} > U_{it}\ \forall\ t\,\epsilon\, S \\ 0 & otherwise \end{cases}$$

Thus, a student lists a school as his or her first choice if the student expects to derive greater satisfaction from attending this school than from attending any other school. If we assume that the error term υ_{is} is independently and identically distributed (i.i.d.) extreme value, then the probability that student i chooses school s as a first choice can be written as:

$$P_i(s) = Pr\left(U_{is} > U_{it}\ \forall\ t\,\epsilon\, S\right) \tag{1}$$

$$= \frac{e^{X_{is}\beta}}{\sum_{t\epsilon S} e^{X_{it}\beta}} \tag{2}$$

This yields the log-likelihood function:

$$LL(X,\beta) = \sum_{i=1}^{N}\sum_{s=1}^{S} y_{is} ln \frac{e^{X_{is}\beta}}{\sum_{t\epsilon S} e^{X_{it}\beta}} \tag{3}$$

[9] Here the subscript "is" indicates that these characteristics result from an interaction between school attributes and student characteristics. For example, proximity to a given school varies across students.

5.1.1 Ranked Ordering

We can generalize this basic discrete choice model to the case of choosing a set of six schools, such that the probability that individual i chooses schools $\left(s^1, s^2, s^3, s^4, s^5, s^6\right)$ can be written as:

$$P_i\left(s^1, s^2, s^3, s^4, s^5, s^6\right) = Pr\left\{\left(U_{is^1} > U_{it} \forall t \, \epsilon \, S_i^1\right) \cap \left(U_{is^2} > U_{it} \forall t \, \epsilon \, S_i^2\right) \cap \ldots \cap \left(U_{is^6} > U_{it} \forall t \, \epsilon \, S_i^6\right)\right\} \tag{4}$$

$$= \int \prod_{c=1}^{6} \frac{e^{X_{is^c}\beta}}{\sum_{t \epsilon S_i^c} e^{X_{it}\beta}} f\left(\beta \mid \mu, \theta\right) d\beta \tag{5}$$

Where each subsequent choice set excludes the previously chosen school. This yields the log-likelihood function:

$$LL\left(X, \mu, \theta\right) = \sum_{i=1}^{N} \sum_{s=1}^{S^1} \sum_{t=1}^{S^2} \sum_{u=1}^{S^3} \sum_{v=1}^{S^4} \sum_{w=1}^{S^5} \sum_{z=1}^{S^6} y_{is}^1 y_{it}^2 y_{iu}^3 y_{iv}^4 y_{iw}^5 y_{iz}^6 ln\left(P_i\left(s, t, u, v, w, z\right)\right) \tag{6}$$

This expanded specification provides a more efficient estimate of preferences as I am able to use information from five separate choices (each ranking decision creates a pseudo-observation of a student's preferences).

5.1.2 Strategic Behavior

Because students may be strategic in their choice of what set of schools to apply to, their preferences are only reliably revealed over the set of six submitted choices. I therefore restrict the choice set for each student to the list of six choices and estimate the probability that they pick their first choice from the initial set of six schools, that they pick their second choice from the set of remaining five, ... , and their fifth choice from the last remaining two. Focus on this subset of six choices still yields a valid estimate due to the independence from irrelevant alternatives (IIA) property of the multinomial logit. (See Train, 2007 as a reference.)

5.2 Geographic Location

Unlike in contexts with residence-based assignment, there is little reason to be concerned about the potential endogeneity of school distance. We might wrongly estimate the importance of school proximity if students were already geographically sorted according to their preferences. For example, if parents with a strong value for academic performance had moved to live next to high performing schools then we would underestimate their true willingness to trade off distance for school quality. However, school priority is not determined by residence in Ghana so selective sorting is less likely to be a factor than in the US and there is substantial variation in the location of high quality JHS and SHS schools. Moreover, 65 percent of students attend a boarding school for senior high so they do not live at home.

I do not have geographic information on students' residences or the specific locations of schools so I use the distance between the district of a student's junior high school and district of senior high schools as a measure of distance. I also experiment with using dummy indicators for whether a school is in the same region or district as a student's junior high school. (There are 170 districts and 10 regions in Ghana.)

5.3 School Quality

I do not include any indicators of academic performance in my baseline specification because these could be endogenous. For example, if high performing students have historically picked certain types of schools, then the average performance of students in these schools could be high as a result of this positive selection. Any observed correlation between students' ability and the academic performance of schools they select could merely reflect historical preferences instead of a demand for academic quality. To address this inference problem, I use a reputation measure rather than an index of academic performance. In particular, I include an indicator for schools that were created before Ghana's independence in 1957. These 34 schools have a historical prestige similar to that of Ivy-League institutions in the US. They have superior academic performance and higher selectivity (as indicated by a higher average BECE score for admitted students). They also have better resources according to a categorization system introduced by the Ministry of Education in 2009 which divided public senior high schools into four categories based on their "available facilities". 59 percent of the pre-independence schools were placed in the first category compared to only 10 percent of the remaining schools. (Table 1)

Table 1: School Age and School Quality

	School Age		
School Quality	Pre-Independence	Post-Independence	All
Available Facilities			
Category A	20	45	65
Category B	11	61	72
Category C	2	176	178
Category C	1	177	178
Academic Performance			
SSCE Index (%)[a]	65.80	31.74	34.66
Selectivity			
Average BECE score[b]	362.87	273.26	280.67
Total	34	459	493

Note: [a]Average percentage of SSCE candidates who scored between A and C in the each of the four core subjects.[b]Average BECE score of students admitted to the school in 2007.

6 Results

To examine heterogeneity in preferences, I split the sample by gender and academic ability (see Table 4 for summary statistics). I define students of "higher ability" as those who perform well enough on the BECE exam to be admitted to a secondary school program and students of "lower ability" as those who do not. Table 5 and 6 report estimates from the 2008 sample. I estimate the demand for school characteristics and program choice separately and cluster standard errors at the junior high school level.

6.1 Demand for School Quality

There are no significant gender differences in demand for high quality schools. However, higher ability students of both sexes have a stronger preference for attending one of the pre-independence schools.

6.2 Demand for Non-Academic Factors

Female students prefer public schools to private ones but males have the opposite preferences. Males also have a preference for attending technical institutes, but high ability females have a significant distaste for technical training. Higher ability students are more likely to apply to single sex schools than mixed ones and female students have a stronger preference for single sex schools than male students do on average. All students prefer to choose schools with boarding facilities but higher ability students have a particularly strong valuation of boarding accommodation. Higher ability students have a weaker aversion to distance and so appear to be more willing to travel in order to attend a high quality school. On the whole, male students have a lower demand for proximity than female students do. Finally, all students prefer schools with a larger variety of program offerings and male students have a stronger preference for attending large schools.

6.3 Program Choice

The most notable differences in program choice are that male students prefer Technical and Visual Arts programs more than female students do, while females have a stronger preference for Home Economics particularly if they are of lower ability. Academic ability (rather than gender) appears to be the more important factor behind preferences for Business and General Science programs.

On the whole therefore, gender and academic ability both appear to have strong influences on program choice. This may have significant implications for labor market outcomes if programs are linked to future occupations. At the very least, program choice affects the options of courses available to students in university because students must again apply to specific programs and these require that they have taken a particular set of courses in senior high school.

6.4 Admission Outcomes

The share of female classmates increases for female students admitted to senior high school (Figures 7 and 8). Thus, there is no compelling evidence of changes in gender composition as an explanation for worsened performance.

7 Robustness Checks

7.1 Academic Quality

As explained earlier, I do not include any purely academic variables in my baseline specification due to potential endogeneity problems. However, I examine differences in the average standardized score between a student's first choice and the JHS they attended as a descriptive exercise (with the caveat that test scores are left-censored because I do not observe scores for students who did not perform well enough to be placed in a school). I also construct some value-added measures of school quality by comparing the average quality of incoming students to their SSCE performance. This provides additional suggestive evidence that students have a high demand for academic quality.

7.2 School Distance

As an alternative distance measure, I use dummy variables to indicate whether a school in the same region or district a student's junior high school. This is because ethnic differences may create stronger preferences for attending a school within the same region even if it is a further distance away.

8 Conclusions

Altogether, this study suggests that there is substantial heterogeneity in student demand for schooling. Lower ability students appear to have an insignificant or negative valuation of school quality and a weaker preference for attending highly selective schools. Female students have particularly strong preferences for single sex schools which could justify the increased establishment of girls' schools (particularly ones with boarding facilities), given that currently less than 4 percent of schools are reserved for female students exclusively. Finally, there is some evidence of gender-based selection into program tracks which may lead to differences in future academic opportunities and later career choices.

The implications of these findings for gender equality in the long-run are unclear. Given that less than 15 percent of jobs are concentrated in the formal private sector and civil service, practical training arguably provides a more useful foundation for future income-generation than a purely academic education does. Male students who are more likely to pursue practical training by selecting applied programs (such as the Technical Track or Agriculture) or by choosing to attend technical or vocational institutes may therefore be better positioned for labor market entry. However, there

is limited evidence on the effectiveness of technical training and an academic education may still yield higher returns for workers even in the informal sector.

Differences in school environments may be a more relevant factor for performance disparities. Male students' lesser aversion to attending coeducational schools means that their demands more closely match the realities of school supply. Many of the pre-independence schools were single-sex and boarding; however, the more recent waves of public school expansion have favored the construction of coeducational day schools. One possible interpretation of this study is therefore that female students are less able to satisfy their preferences given the set of available institutions and have less favorable outcomes as a result. Nonetheless, additional research is needed to establish a more definitive link between gender-based preferences and differences in future academic performance.

References

[1] Abdulkadiroğlu, Atila, Parag Pathak, Alvin Roth and Tayfun Sönmez (2006). "Changing the Boston Mechanism: Strategyproofness as Equal Access," Unpublished mimeo, Harvard University.

[2] Abdulkadiroğlu, Atila and Tayfun Sonmez (2003). "School Choice: A Mechanism Design Approach." *American Economic Review*, 93(3): 729-747.

[3] Anderson, Michael (2008). "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects," Journal of the American Statistical Association. 103(484): 1481-1495.

[4] Bettinger, Eric P. and Bridget Terry Long (2005). "Do Faculty Serve as Role Models? The Impact of Instructor Gender on Female Students" *American Economic Review*, 95(2):152-157.

[5] Clark, Damon (2007). "Elite Schools and Academic Performance" Institute for the Study of Labor (IZA) Discussion Paper 3182.

[6] Gale, David and Lloyd S. Shapley (1962) "College Admissions and the Stability of Marriage." The American Mathematical Monthly, 69(1): 9-15.

[7] Haeringer, Guillaume and Flip Klijn (2009), "Constrained School Choice", Journal of Economic Theory, 144(5): 1921-1947.

[8] Hastings, Justine, Thomas Kane and Douglas Staiger (2006). "Gender and Performance: Evidence from School Assignment by Randomized Lottery." *American Economics Association Papers and Proceedings*, 96(2): pp. 232 - 236.

[9] Hastings, Justine, Thomas Kane and Douglas Staiger (2008). "Heterogeneous Preferences and the Efficacy of Public School Choice." *National Bureau of Economic Research Paper Working Papers* No. 12145 and No. 11805 combined.

[10] Hoxby, Caroline M. (2000). "Peer Effects in the Classroom: Learning from Gender and Race Variation," National Bureau of Economic Research Working Paper No. 7867.

[11] Jackson, C. Kirabo (2009). "Ability-Grouping and Academic Inequality: Evidence from Rule-Based Student Assignments" Working Paper.

[12] Kling, Jeffrey R. and Jeffrey B. Liebman (2004) "Experimental Analysis of Neighborhood Effects on Youth," Princeton University, Industrial Relations Section Working Paper, 483.

[13] Lavy, Victor and Analia Schlosser (2007). "Mechanisms and Impacts of Gender Peer Effects at School," National Bureau of Economic Research Working Paper, 13292.

[14] Ministry of Education, Sports and Science (2005). "Computerised School Selection and Placement System (CSSPS) Guidelines for Selection and Admission into Senior Secondary Schools and Technical/Vocational Institutes".

[15] Ministry of Education, Sports and Science (2008). *2007/2008 Education Profiles*. EMIS Project. Accra, Ghana.

[16] Munshi, Kaivan and Mark Rosenzweig (2006). "Traditional Institutions Meet the Modern World: Caste, Gender and Schooling Choice in a Globalizing Economy." *American Economic Review*, 96(4): 1225-1252.

[17] Pathak, Parag and Tayfun Sonmez (2008). "Leveling the Playing Field: Sincere and Sophisticated Players in the Boston Mechanism," American Economic Review, 98(4): 1636-1652.

[18] Pop-Eleches, Christian and Miguel Urquiola (2008). "The Consequences of Going to a Better School", Working Paper.

[19] Schneeweis, Nicole and Martina Zweimüller (2009). "Girls, Girls, Girls: Gender Composition and Female School Choice," NRN working papers 2009-05, The Austrian Center for Labor Economics and the Analysis of the Welfare State, Johannes Kepler University Linz, Austria.

[20] Train, Kenneth (2003). *Discrete Choice Methods with Simulation*. Cambridge, United Kingdom: Cambridge University Press.

Figure 1: Timeline for School Selection and Placement in Ghana (2005-2008)

- **October**: West Africa Exam Council (WAEC)
  - Registers BECE students and collects students' lists of program choices
  - Provides CSSPS Secretariat with data on student backgrounds and choices
- **January**: Ministry of Education supplies CSSPS Secretariat with
  - register of all JHSs
  - register of all SHSs (with numbers of program vacancies)
- **April**: Students take the BECE exams
- **July/August**: WAEC sends scores to CSSPS Secretariat which then
  - Assigns each student an aggregate score based on performance in 4 core and 2 best subjects
  - Places qualified students in schools according to ranked choices, with priority determined by aggregate BECE scores
- **A few weeks** after CSSPS Secretariat receives BECE results:
  - Placement results released and displayed in junior and senior high schools or retrieved by text messaging candidate IDs to the CSSPS Secretariat
- **September**: Schools reopen
  - Students have 30 days to enroll at placement schools
  - SHSs requested to report any unfilled places so that new students can be placed in remaining vacancies

Table 2: CSSPS Summary Statistics (2005-2008)

	2005	2006	2007	2008
Student Characteristics				
Age[a]	17.0136	17.1003	17.1678	17.1330
(Standard deviation)	(1.8557)	(1.8309)	(1.9132)	(1.8562)
Male	0.5540	0.5480	0.5462	0.5490
Disability	0.0034	0.0002	0.0000	0.0006
Student Choices				
Listed maximum number of choices	0.9834	0.9879	0.9991	0.9480
Listed senior high schools only	0.8337	0.8540	0.8264	0.7493
Listed same program for all choices	0.2176	0.2255	0.1853	0.0953
Listed same school for all choices	0.0353	0.0137	0.0073	0.0006
School Placement				
Placed in a school	0.5549	0.3818	0.5197	0.4722
(Total number)	(162,077)	(118,336)	(167,279)	(160,936)
Placed in a school chosen by the student	0.4371	0.3589	0.4338	0.4543
Choice for which student listed placement school[b]	2.1470	1.9002	2.4305	2.9505
Placed in first choice	0.1363	0.1468	0.1181	0.1057
Placed in second choice	0.1002	0.1011	0.1103	0.0954
Placed in third choice	0.2006	0.1110	0.1060	0.0880
Placed in fourth choice			0.0994	0.0925
Placed in fifth choice				0.0264
Placed in sixth choice				0.0463
Placed in JHS district	0.2285	0.1586	0.2043	0.1746
Placed in JHS region	0.4225	0.2928	0.3974	0.3572
Placed in boarding school	0.3125	0.2684	0.3490	0.3103
Observations	292,070	309,911	321,891	340,823

Notes: [a]Mean age with standard deviation reported below in brackets. Observations with date of birth before 1900 or after 2000 are dropped (N = 287,207 (2005), 309,840 (2006), 321,811 (2007) 340,173 (2008)). [b]For students placed in one of their chosen schools only (N = 127,665 (2005), 111,232 (2006), 139,629 (2007), 154,845 (2008)).

Figure 2: Distribution of BECE Scores for Admitted Students

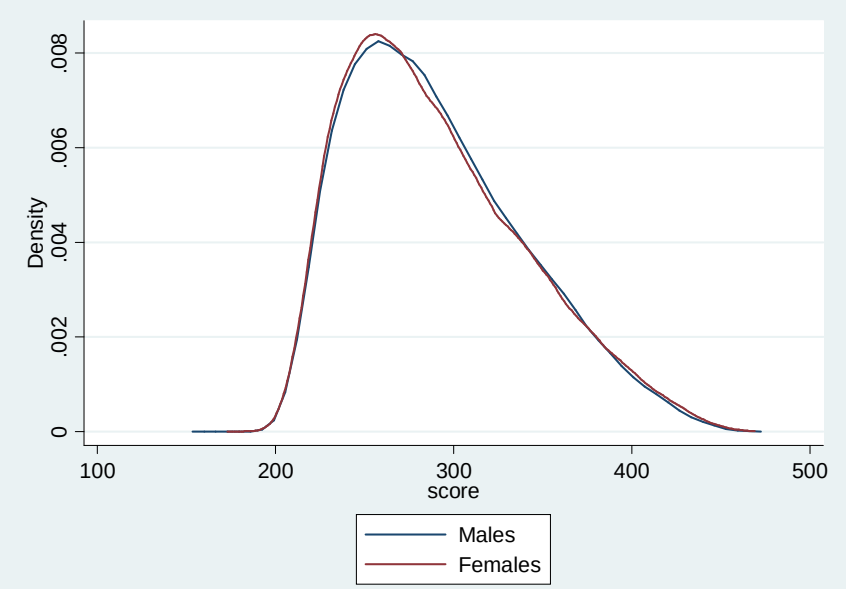
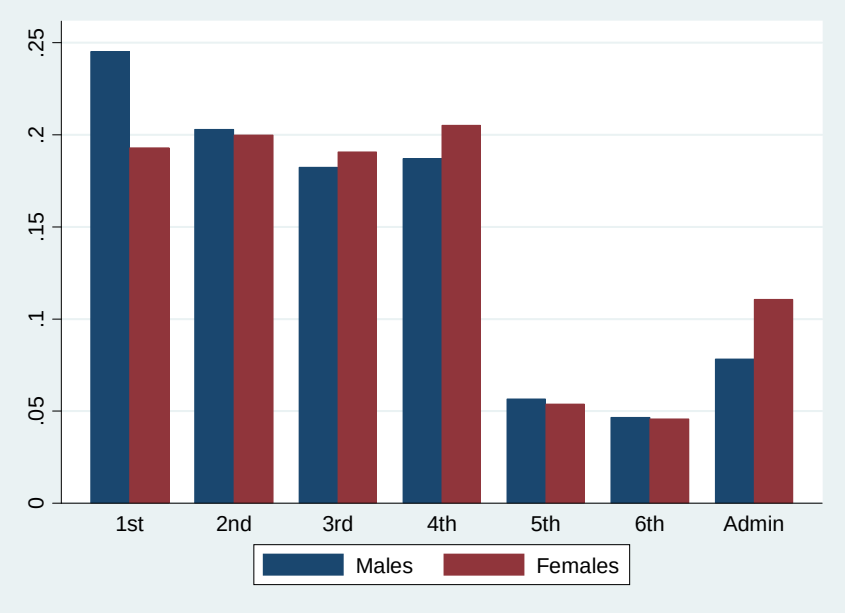


Figure 3: Admission Outcomes for Admitted Students



Note: Students who are not admitted to one of their chosen schools receive an administrative placement and are assigned to the closest school with vacancies in one of the student's selected program tracks.

Figure 4: Average BECE score in JHS Attended

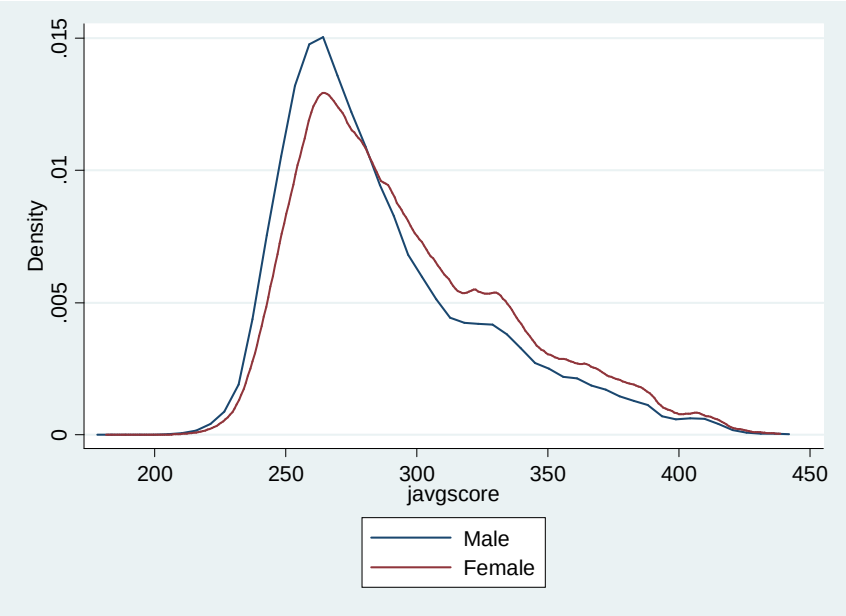


Figure 5: Average BECE score in Incoming SHS Cohort

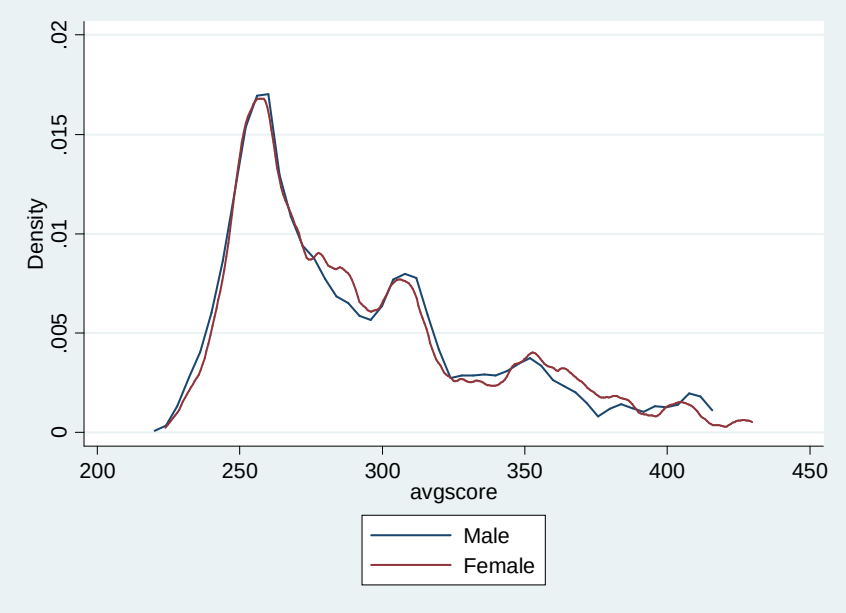


Figure 6: Variation in SSCE Performance

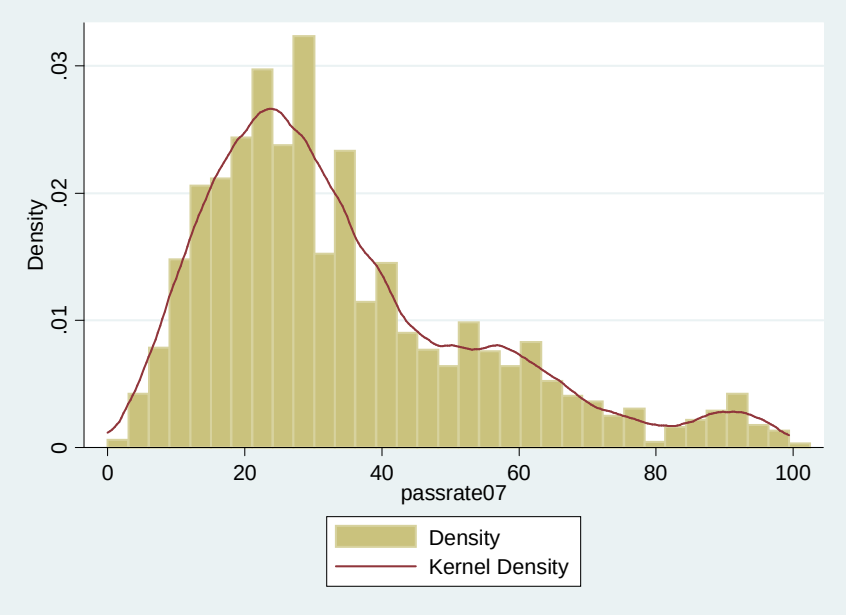


Table 3: SHS Summary Statistics (2005-2008)

	2005	2006	2007	2008
Vacancies reported				
Vacancies per programme[a]	69.7914	68.3958	78.7437	66.4281
Vacancies per school	304.3920	300.5553	373.4186	315.3660
Programs per school	4.3347	4.3174	4.7894	4.8535
Total number of vacancies	160,590	159,157	204,340	176,566
School characteristics				
Public	95.88	91.09	89.32	88.00
Mixed	91.64	90.96	91.14	87.48
Males only	1.70	1.68	1.56	1.40
Females only	3.65	3.83	3.84	3.68
Programme type[b]				
Agriculture	14.26	14.25	14.22	13.74
Business	17.13	17.42	18.08	18.50
General Arts	21.39	21.40	21.37	21.83
General Science	11.53	11.59	11.45	11.42
Home Economics	17.50	17.32	17.11	16.81
Technical	6.57	6.55	6.45	6.24
Visual Arts	11.62	11.46	11.32	11.46
Observations	2,357	2,379	2,630	2,716

Notes: Unit of observation is a specific program within a school (e.g. Agriculture in Accra Academy). [a]Some observations are excluded due to missing values: N = 2,301 (2005), 2,327 (2006), 2,595 (2007), 2,658 (2008). [b]Some observations are excluded due to missing values: N= 2,160 (2005), 2,182 (2006) 2,279 (2007), 2,373 (2008).

Table 4: Discrete Choice Model: Summary Statistics (2008)

	Male		Female	
	Admitted	Not Admitted	Admitted	Not Admitted
Student characteristics				
Background information				
Age	16.90	17.85	16.32	17.20
Disability	0.04	0.06	0.06	0.05
Attended a public JHS	76.41	91.65	71.59	90.00
Attended a JHS that was not deprived	89.86	86.16	91.29	87.68
BECE score	291.22		290.89	
Choice behavior				
Listed maximum number of choices	94.51	94.98	94.26	95.51
Listed SHSs only	73.20	57.71	91.13	88.48
Same program type for all choices	10.74	5.53	15.22	8.85
Same school for all choices	0.04	0.08	0.04	0.05
Characteristics of first choice program and school				
Academic performance				
SSCE Index	54.18	37.47	53.15	37.42
Average BECE score of admits (2007)	435.28	360.24	403.21	347.31
Pre-Independence	25.53	8.51	24.00	8.51
Other school characteristics				
Public	100	100	99.98	99.90
Mixed sex	90.23	97.91	74.56	92.73
Males only	9.19	1.67	0.06	0.12
Females only	0.00	0.00	24.60	6.02
Technical or Vocational Institute	0.00	0.00	0.00	0.00
Has boarding facilities	86.85	71.00	87.55	73.00
Located in student's JHS district	36.24	48.62	34.65	50.70
Located in student's JHS region	75.00	86.44	70.38	86.43
Distance from student's JHS district	0.4938	0.3443	0.4969	0.3211
Number of programs offered	5.0424	4.9647	5.2141	4.9961
Number of vacancies	438.41	410.32	410.70	398.97
Program choice				
General Arts	36.26	35.22	47.24	35.01
Admissions Outcomes				
Placed in one of six choices	92.07		88.80	
Placed in first choice school	24.01		19.09	
Placed in JHS district	38.19		35.39	
Placed in JHS region	77.44		72.61	
Placed in boarding school	65.68		65.85	
Number of students	90,358	86,385	64,596	83,251

Table 5: Discrete Choice Model (School Characteristics)

	Male		Female	
	Higher Ability	Lower Ability	Higher Ability	Lower Ability
School Quality				
Pre-Independence	1.0763	0.6783	1.0679	0.6418
	(0.0275)	(0.0258)	(0.0260)	(0.0247)
Other school characteristics				
Public	-1.1289	*-0.7255*	0.4319	0.3557
	(0.3047)	*(0.2422)*	(0.0953)	(0.0628)
Males only	0.8959	0.2740		
	(0.0292)	(0.0409)		
Females only			2.4524	1.5659
			(0.0250)	(0.0271)
Technical or Vocational Institute	0.5873	0.6195	-0.3665	*0.0671*
	(0.0322)	(0.0267)	(0.0919)	*(0.0491)*
Has boarding facilities	0.6823	0.4260	0.6596	0.4281
	(0.0100)	(0.0092)	(0.0123)	(0.0098)
Distance from student's JHS	-0.0988	-0.3336	-0.1786	-0.4351
	(0.0139)	(0.0166)	(0.0172)	(0.0183)
Number of vacancies (2007)	0.0010	0.0011	0.0002	0.0007
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Number of programs offered	0.0723	0.0758	0.1769	0.1159
	(0.0040)	(0.0035)	(0.0054)	(0.0043)
Log-likelihood	-553733.55	-568076.63	-378164.66	-526374.38
Number of students	93,734	93,367	67,202	86,520
Number of observations	1,803,727	1,791,725	1,293,080	1,665,317

Notes: Standard errors clustered at JHS, reported in parentheses. All estimates are significant at the 0.1% level except for those in italics. Dependent variable is a dummy variable indicating which program the student ranked highest out of the set of remaining choices. Explanatory variables are characteristics of programs in the student's choice set.

Table 6: Discrete Choice Model (Program Choice)

	Male		Female	
	Higher Ability	Lower Ability	Higher Ability	Lower Ability
Program type				
Agriculture	-0.0914	-0.0950	-0.1265	-0.1293
	(0.0097)	(0.0097)	(0.0149)	(0.0122)
Business	0.1206	0.0678	0.0900	0.0467
	(0.0079)	(0.0091)	(0.0101)	(0.0100)
General Science	0.4321	0.2920	0.4311	0.2943
	(0.0122)	(0.0150)	(0.0173)	(0.0199)
Home Economics	-0.2541	-0.1692	*0.0248*	*0.0238*
	(0.0189)	(0.0155)	*(0.0103)*	*(0.0083)*
Technical	*-0.0273*	-0.0962	-0.3368	-0.2848
	(0.0142)	(0.0125)	(0.0522)	(0.0298)
Visual Arts	0.0711	0.0801	*0.0029*	*-0.0316*
	(0.0119)	(0.0117)	*(0.0162)*	*(0.0139)*
Log-likelihood	-579208.01	-559883.41	-424454.26	-543653.85
Number of students	90,358	86,385	64,596	83,251
Number of observations	1,761,184	1,694,860	1,289,764	1,649,148

Notes: Sample restricted to students who only chose senior high schools. Omitted program is General Arts. Standard errors reported in parentheses. All estimates are significant at the 0.1% level except for those in italics.

Figure 7: Share of Male Students in JHS Peer Group

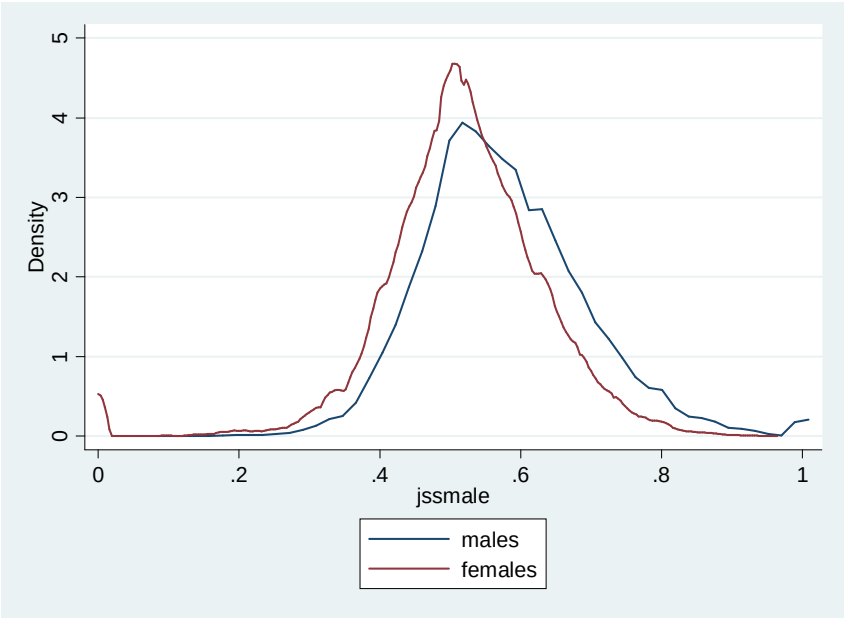
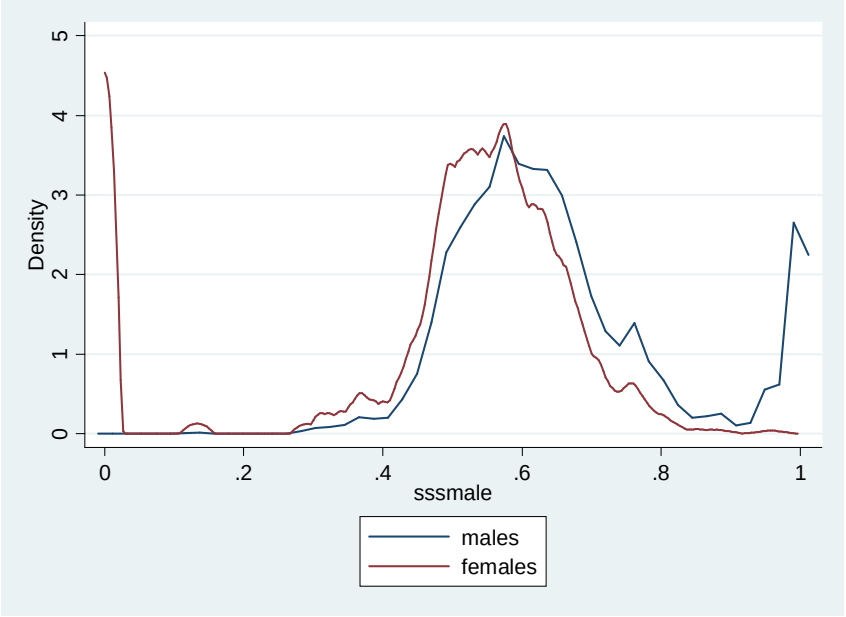


Figure 8: Share of Male Students in SHS Peer Group



Appendix

A.1: Strategic Behavior

Note that academic performance is the ultimate determinant of school assignment and no preferential treatment is given to students for listing a school as a first choice. Thus, there is no penalty for ranking schools in true preference order within the set of listed choices. This contrasts with the *Boston mechanism* (formerly used by Boston public schools and several other school districts in the United States) which assigns students based on their first choices in the same way but then keeps these initial assignments for all subsequent rounds and does not allow higher priority students to displace students already assigned to a school in a preceding round. There are clear incentives for making a strategic first choice under the *Boston mechanism* which do not apply under the *deferred-acceptance algorithm*. The CSSPS technical working committee produced a handbook outlining a set of "Guidelines for Selection and Admission into Senior Secondary Schools and Technical/Vocational Institutes" (MOESS, 2005). The publication highlights the issue of "Displacement of 1st choice candidates and 2nd choice candidates as a matter of merit or better performance" and emphasizes the notion that placement priority is based on "merit not choice". (p.4)

The *deferred-acceptance algorithm* has several desirable properties when students are allowed to rank all schools - it is student optimal, strategy proof and eliminates "justified envy"[10] (Gale and Shapley, 1962; and Abdulkadiroğlu and Sonmez, 2003). The attractiveness of this mechanism decreases only slightly when students are forced to make a constrained choice with an opportunity to rank only a limited number of schools (Abdulkadiroğlu, Pathak and Roth, forthcoming). However, the CSSPS's rationing of spaces and merit-based priority ordering may create incentives for students to misrepresent their true preferences. Advantages to sophistication arise because students are only allowed to list a limited number of choices and are not guaranteed a default placement (see Haeringer and Klijn, 2009 for a detailed theoretical discussion of constrained school choice). Qualified students who are not placed in any of their chosen schools are administratively placed in an available space in their district or region wherever possible (with limited regard for stated preferences). Thus, there may be low incentives for students to be strategic about the *ranking* of selected programs, but certain students could still benefit from choosing their *set* of selected programs strategically.

[10] This requires that there should be no unmatched student-school pair (i, s) where student i prefers school s to her final assignment and has higher priority than another student who is assigned to school s.