In-State versus Out-of-State Students: The Divergence of Interest between Public Universities and State Governments*

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Abstract

This paper examines the divergence of interest between universities and state governments concerning standards for admitting in-state versus out-of-state students. We find that public universities set lower minimum admissions standards for in-state than out-of-state applicants, presumably in response to state pressure; while private universities treat both groups equally. However, we also find that favoring in-state applicants goes against states' long-term financial interest. This is because marginal out-of-state students pay higher tuition than marginal in-state students, pay more in future state taxes, and are equally influenced in whether they locate in the state after graduation by attending public university there.

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In-State versus Out-of-State Students:
The Divergence of Interest between Public Universities and State Governments[1]

Jeffrey A. Groen and Michelle J. White

States have an interest in using their public universities as tools to encourage economic development. University study increases students' human capital. Graduates with high levels of human capital contribute to their local economies by starting their own new businesses, attracting other businesses to the area, and raising wages generally. Attending a university in a particular state increases graduates' likelihood of locating in the state as adults because they develop local connections. If attending university has a different effect on in-state versus out-of-state students' probabilities of locating in that state, then states have an interest in favoring the particular group whose location decisions are most sensitive at the margin.

However universities' interests differ from those of their states. Both public and private universities have an interest in attracting high ability students, in maximizing revenue from tuition and donations, and/or in having graduates who are rich and famous, but they have little interest in where their students come from or where they go after graduation. Public universities in particular often have a financial incentive to favor out-of-state over in-state students, because out-of-state students pay higher tuition and universities may be able to keep the additional revenue for their own purposes. Private universities have no particular interest in encouraging economic development in their home regions, since economic development raises wages and land prices. These factors suggest that there is a divergence of interest between public and private universities and their state governments. Universities do not necessarily have an incentive to act in the best interests of their states.

In this paper, we explore the divergence of interest between public and private universities and their states. We focus on standards for admission of in-state versus out-of-state students and on whether universities act in their states' interest in setting these standards. After a brief literature review, section 2 develops several behavioral rules that represent states' interest and universities' interest in admitting in-state versus out-of-state students. These rules illustrate the divergence of interest between universities and their state governments. Section 3 tests the models using data from *College and Beyond* for public and private universities. We find that public universities set lower minimum admissions standards for in-state than out-of-state applicants, while private universities treat both groups equally. However, we also find that favoring in-state applicants goes against states' long-term financial interest. This is because marginal out-of-state students pay higher tuition than marginal in-state students, have higher future earnings, and, correcting for selection bias, are equally influenced in whether they locate in the state after graduation by attending public university there. As a result, states lose rather than gain financially when public universities favor in-state applicants for admission. Finally we examine whether states would benefit if public universities imposed maximum as well as minimum standards for admission.[2]

1. Literature Review

Goldin and Katz's (1998) study of the growth of public higher education from 1890 to 1940 supports the idea that state governments historically viewed public universities as tools for encouraging economic development. During this period, manufacturing, mining, and agriculture were all becoming more specialized and science-based. States that had substantial economic activity in particular fields often established specialized public universities to train workers in these fields and conduct research to advance the fields. Examples include tobacco farming in North Carolina, dairy farming in Wisconsin, mining in Colorado, and oil exploration in Texas. Since public universities provided training in fields that their states specialized in, graduates tended to remain in the state. This allowed states to capture the benefits of their investments.

College graduates create external benefits for other workers in the labor markets where they locate as adults, regardless of whether they work in the specific fields that the state's economy specializes in. Moretti (2002) finds that wages of both high school and college graduates are positively correlated with the share of college graduates in the local labor market. Also, college graduates earn more than other workers and therefore pay higher state taxes. College graduates are also more likely than other workers to start new businesses, which generate jobs for other workers and raise demand for labor (Fan and White, 2002).

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[2] For ease of exposition, we use the terms "university," "college," and "institution" interchangeably.

Since the period studied by Goldin and Katz, markets for college education and college-educated labor have become more spatially integrated. Hoxby (1997) argues that U.S. universities have been transformed from local autarkies into competitors, since students who previously attended universities close to home are now likely to attend universities that are further away. This means that universities are increasingly forced to compete for students on regional or national markets. As part of the same trend, demand for enrollment by out-of-state students has increased at the top public universities (Mixon and Hsing, 1994).

The fact that college graduates from one state may locate in other states after graduation affects states' incentives to invest in higher education. Strathman (1994) and Quigley and Rubinfeld (1993) show empirically that states with more mobile populations spend less on public higher education. Presumably these states expect to attract educated migrants from other states and/or expect local students to move elsewhere, so that they have less incentive to provide public universities to educate the local population. There may be a rationale for Federal intervention to subsidize provision of public universities in states that have high migration rates.

2. Theory

We first examine public and private universities' interest in admitting in-state versus out-of-state students and then turn to the state's interest. Our model focuses on selective universities because, among public universities, only those that are selective attract out-of-state applicants. Because the model is intended for empirical implementation, we intentionally keep it simple.

2.1 *The university's interest*

The *"equal cutoff rule."* Consider first the interest of public and private universities in admitting in-state versus out-of-state students. Suppose the ability level of an in-state student *i* is denoted s_i and the ability level of an out-of-state student *o* is denoted s_o. The numbers of in-state and out-of-state students of ability level s_i and s_o who apply to the university and would attend if accepted are denoted $n_i(s_i)$ and $n_o(s_o)$ for in-state and out-of-state students, respectively.

Assume that universities select students by adopting minimum cutoff scores of $\bar{s}_i$ and $\bar{s}_o$ for in-state and out-of-state applicants, respectively. They reject all in-state applicants with $s_i < \bar{s}_i$ and accept all in-state applicants with $s_i \geq \bar{s}_i$, and similarly for out-of-state applicants.[3] Universities have binding capacity constraints (total class size) of $\overline{N}$. Universities' goal is to set the cutoff levels $\bar{s}_i$ and $\bar{s}_o$ so as to maximize students' average ability level:

$$(\frac{1}{\overline{N}})[\int_{\bar{s}_i}^{\infty} s_i n_i(s_i) ds_i + \int_{\bar{s}_o}^{\infty} s_o n_o(s_o) ds_o], \tag{1}$$

subject to the capacity constraint:

$$\overline{N} = \int_{\bar{s}_i}^{\infty} n_i(s_i) ds_i + \int_{\bar{s}_o}^{\infty} n_o(s_o) ds_o . \tag{2}$$

The first order condition is:

$$\bar{s}_i = \bar{s}_o . \tag{3}$$

We refer to this result as the "equal cutoff rule" – it says that the cutoff levels for admission of in-state and out-of-state students should be the same. It follows from the fact that universities are assumed to care only about the average ability of their students, not about where they come from. We test below whether public and private universities follow this rule. If private universities are found to set equal cutoffs for both types of students while public universities are found to set lower cutoffs for in-state students, then the result will provide support for the hypothesis that states require or pressure public universities to favor in-state over out-of-state applicants at the margin.

The *"equal marginal revenue rule."* Another formulation of universities' interest assumes that they maximize a hybrid of average student ability and total revenue. Suppose universities still admit students in declining order of ability until they reach the relevant cutoff, but they set the cutoff levels to maximize total revenue rather average student ability. Suppose T_i and T_o denote in-state and out-of-state tuition levels, respectively. Public universities always have higher tuition levels for out-of-state than in-state students, while private universities have a single tuition level for all students. Both types of universities may offer tuition discounts in the form of financial aid. Universities also collect revenue in the form of donations from graduates. Suppose $D_i(s_i)$ and $D_o(s_o)$ denote the expected present value of future donations from in-state and out-of-state students

[3] $n_i(s_i)$ equals the number of in-state applicants of ability level s_i times the proportion of in-state applicants of ability level s_i who would attend if accepted. The same applies to $n_o(s_o)$. The functions $n_i(s_i)$ and $n_o(s_o)$ are likely to differ because in-state applicants are more likely to attend university near their homes. We treat these functions as fixed because our dataset does not contain information on the full set of applicants to particular institutions.

of ability levels s_i and s_o, respectively. Future donations are assumed to depend on student ability, because ability is positively related to earnings. Assume now that universities set the cutoff levels $\bar{s}_i'$ and $\bar{s}_o'$ so as to maximize the sum of tuition plus donations from in-state and out-of-state students, or:

$$\frac{1}{\overline{N}}\left[\int_{\bar{s}'_i}^{\infty}(D_i(s_i)+T_i)n_i(s_i)ds_i+\int_{\bar{s}'_o}^{\infty}(D_o(s_o)+T_o)n_o(s_o)ds_o\right], \tag{4}$$

subject to the capacity constraint, eq. (2).

The first order condition is:

$$D_i(\bar{s}_i')+T_i=D_o(\bar{s}_o')+T_o. \tag{5}$$

This rule – the "equal marginal revenue rule" – says that universities set the cutoff levels such that they collect the same amount of revenue from marginal in-state and marginal out-of-state students.

The "equal marginal revenue rule" suggests reasons why both private and public universities might have an incentive to set different cutoff levels for in-state students (i.e., students who live nearby) versus for out-of-state (i.e., distant) students. One reason is that in-state students are more likely to locate close to the university as adults and this may cause them to donate more on average than out-of-state students having the same ability levels. Another reason is that universities have spatial monopoly power over in-state students, because some of them wish to attend college near their homes. Private universities can take advantage of this monopoly power by giving less financial aid to nearby students, but public universities probably cannot. (See Epple et al., 1999, for discussion.)

2.2 *The state's interest*

The *"equal additional tax payments rule."* Now consider the interests of an arbitrary state, which we refer to as state *X*. In line with the view that states view universities as tools of state economic development, we assume that state *X*'s goal is to maximize the present value of future state tax revenues. Most states collect the bulk of their tax revenue from income and sales taxes. Because these taxes are roughly proportional to income, high ability individuals pay higher taxes because they earn more. (High income individuals tend to pay higher amounts of other state taxes, such as property taxes and business taxes, as well.) Therefore state *X* has an interest both in retaining high ability in-state students and attracting high ability out-of-state students. Both in-state and out-of-state students are assumed to choose between attending college in state *X* or in some other state. If students attend college in state *X* rather than another state, we assume that their probability of locating in state *X* as adults rises, regardless of where they are from.[4]

Suppose p_{kj} denotes students' probabilities of locating in state *X* as adults. The subscript *k* denotes home state and it equals *y* if the student's home state is state *X* and *n* otherwise. The subscript *j* denotes college state and it equals *y* if the student attends college in state *X* and *n* otherwise. Thus p_{yy} is the probability of students locating in their home states as adults if they attend college there, p_{yn} is the probability of students locating in their home states as adults if they attend college out-of-state, and $\Delta p_i = p_{yy} - p_{yn}$ denotes the increase in the probability of in-state students locating in their home states if they attend college there rather than elsewhere. Similarly, p_{ny} is the probability of out-of-state students locating in the state where they attend college as adults, p_{nn} is the probability of students locating in a particular state as adults if they are neither from the state nor attend college there, and $\Delta p_o = p_{ny} - p_{nn}$ denotes the increase in the probability of out-of-state students locating in a particular state if they attend college there rather than elsewhere. We assume that all of these terms vary with students' ability levels. We further assume that both $\Delta p_i(s_i)$ and $\Delta p_o(s_o)$ are positive, but do not make any assumptions concerning their relative magnitude. (We estimate these terms in the next section.)

Suppose $\tau_i(s_i)$ and $\tau_o(s_o)$ denote the average present value of future state tax payments by in-state graduates having ability level s_i and out-of-state graduates having ability level s_o, respectively. The present value of future state tax revenues is assumed to increase with ability for both types of students, but the relationship is assumed to differ for in-state versus out-of-state students. The present value of future state tax revenues also varies across states because state tax rates differ.[5]

[4] For some in-state students, the best alternative to attending the most selective public university in state *X* is to attend a less selective public university in state *X*, rather than a university in some other state. In this case students' probability of locating in state *X* as adults is likely to be unaffected by which public university in state *X* they attend, so that – according to our model – state *X* does not benefit when they are admitted to the most selective public university. Because our dataset includes only public universities that are the most selective in their states, we ignore this possibility.

[5] The functions $\tau_i(s_i)$ and $\tau_o(s_o)$ may differ because the relationship between ability and future earnings/future state tax payments may differ for in-state versus out-of-state students. Note that students' future earnings could also depend

The state's goal is for the public university to set cutoff levels $\tilde{s}_i$ and $\tilde{s}_o$ so as to maximize the increase in expected future tax payments that results from in-state and out-of-state students, respectively, attending public university in state *X* rather than elsewhere, or:

$$[\int_{\tilde{s}_i}^{\infty} \Delta p_i(s_i)\tau_i(s_i)n_i(s_i)ds_i + \int_{\tilde{s}_o}^{\infty} \Delta p_o(s_o)\tau_o(s_o)n_o(s_o)ds_o], \quad (6)$$

subject to the same capacity constraint, eq. (2). The first order condition is:

$$\Delta p_o(\tilde{s}_o)\tau_o(\tilde{s}_o) = \Delta p_i(\tilde{s}_i)\tau_i(\tilde{s}_i). \quad (7)$$

Eq. (7) says that the state wants the public university to set cutoff levels such that the additional expected future state tax revenue collected from the marginal student admitted is the same for in-state versus out-of-state students. We call this the "equal additional tax payments rule." If the functions $\Delta p_o(s_o)$ and $\Delta p_i(s_i)$ are identical in the region of the cutoff levels and the functions $\tau_i(s_i)$ and $\tau_o(s_o)$ are also identical in the region of the cutoff levels, then the minimum cutoff levels $\tilde{s}_i$ and $\tilde{s}_o$ for in-state and out-of-state students should be the same. But if $\Delta p_i(s) > \Delta p_o(s)$ and/or $\tau_i(s_i) > \tau_o(s_o)$ in the region of the cutoff levels, then the state will tend to favor a lower cutoff level for in-state students, and vice versa.

The *"tuition offset rule."* States in fact receive revenue from students in two forms: tuition payments from current students and future state tax payments from graduates who locate in the state as adults. Therefore another formulation of the state's objective is for public universities to determine the cutoff levels for in-state versus out-of-state students by maximizing the sum of tuition revenues plus the increase in expected future tax revenues from both types of students, subject to the same capacity constraint. The first order condition implies that:

$$T_o - T_i = \Delta p_i(\tilde{s}_i')\tau_i(\tilde{s}_i') - \Delta p_o(\tilde{s}_o')\tau_o(\tilde{s}_o'). \quad (8)$$

This is the "tuition offset rule," which says that the extra tuition paid by marginal out-of-state students should just offset the extra future state tax payments paid by marginal in-state students admitted to the public university. If this condition holds, then public universities are acting according to the state's interest. But if the left hand side of condition (8) is less than the right hand side, then it would be in the state's interest for public universities to set a lower cutoff for in-state relative to out-of-state students, and vice versa. We test this rule below.

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on the type of university they attend, but we ignore this possibility. See Dale and Kreuger (2002) for discussion of whether graduates of selective universities earn more.

Maximum cutoffs. So far we have assumed that it is in states' interest for universities to admit students in declining order of ability and to set only minimum cutoff levels for admission of in-state and out-of-state students. However states may not have lexicographical preferences for higher over lower ability students and may in fact prefer that universities set multiple cutoffs for one or both groups of students. In particular, we investigate the possibility that states might have an interest in universities rejecting the highest ability applicants from in-state or out-of-state, because these students' location choices are unlikely to be affected by where they attend college. This possibility is of interest because state legislators often seem reluctant to support public universities at the expenditure levels required to attract high ability students.

Suppose $\tau_o(s_o)$ and $\tau_i(s_i)$ increase monotonically with ability (since earnings are positively related to ability), while $\Delta p_i(s_i)$ and/or $\Delta p_o(s_o)$ may not be monotonically related to ability. One possibility is that $\Delta p_i(s_i)\tau_i(s_i)$ and $\Delta p_o(s_o)\tau_o(s_o)$ have the shapes shown in figure 1. Assuming that the "equal additional tax payments rule" is followed, the minimum cutoff levels are set at $s_i^{\min}$ and $s_o^{\min}$, where the two curves intersect on the left hand side of the figure. As s_i increases, $\Delta p_i(s_i)\tau_i(s_i)$ increases monotonically, so that states do not want their universities to set maximum cutoff levels for in-state students. But as s_o rises, $\Delta p_o(s_o)\tau_o(s_o)$ rises to a maximum and then falls sharply. At the point where $\Delta p_o(s_o)\tau_o(s_o) < \Delta p_o(s_o^{\min})\tau_o(s_o^{\min})$, states want universities to set a maximum cutoff for out-of-state students. If the curve for in-state students also turned downward at high ability levels, then states might want universities to set maximum cutoff levels for in-state students as well. We test the model below.

These arguments suggest that states may have an interest in their public universities having an intermediate quality level: not too high because the highest ability students are unlikely to be influenced in their location decisions by whether they attend college in the state, but not too low because then relatively high ability in-state students would attend college elsewhere and be less likely to settle in the state as adults.[6]

2.3 *Summary*

[6] Our model neglects various other reasons why states may favor admitting in-state students or high ability students to public universities, including peer effects (Rothschild and White, 1995) or state legislators' desire to appeal to voters who want their children to be admitted to the most selective public university.

The theory suggests several testable hypotheses. First, if universities' goal is to maximize average student ability and they are free to follow their own interests, then they are predicted to follow the "equal cutoff rule" or the "equal marginal revenue rule." Second, states prefer that universities follow the "equal additional tax payments rule" or the "tuition offset rule," under which states gain equal additional revenue when a marginal out-of-state or in-state student is admitted to a public university. Third, states may have an interest in public universities' setting maximum as well as minimum cutoffs for in-state and/or out-of-state students, depending on how the highest ability students are influenced in their adult location decisions by attending the state university.

In testing these hypotheses, we use data for both public and private universities. This is because private universities are less likely to be influenced by their states' preferences, so that their behavior follows the model of university behavior just discussed. In contrast, public universities are likely to follow a path that is intermediate between their states' preferences and private universities' preferences.

3. Empirical Work

Our primary data source is the Mellon Foundation's *College and Beyond (C&B)*. This dataset includes information from students at 27 selective to highly selective colleges and universities who entered college in 1976 or 1989. The 1976 cohort includes 32,000 students and the 1989 cohort includes 36,000 students.[7] For both cohorts, we have information from college records. For the 1976 cohort, we also have information from a survey of graduates conducted in 1996 that asked questions concerning current state of residence and current income. There were 23,500 responses to the survey.

The *C&B* dataset fits our model well in that all of the institutions are selective and all enroll substantial numbers of both in-state and out-of-state students. But two drawbacks of the dataset are that the participating universities were not randomly selected (selection in part was based on willingness to participate) and only four public universities – University of Michigan, Ann Arbor; University of North Carolina, Chapel Hill; Miami University (Ohio); and Penn State University – are included. The *C&B* private institutions are generally representative of selective private colleges

[7] See Bowen and Bok (1998) for discussion of the *C&B* data. For the private institutions, all students in the entering class were included in the dataset. For the public universities, a sample of 2,000 students from each entering class was selected. We use institutional sample weights to account for the probability of being sampled. A list of institutions is in Appendix Table 1.

and universities and the *C&B* public institutions are all flagship universities that compete regionally and nationally with private universities for academically talented students and enroll substantial numbers of out-of-state students. We address the question of whether the *C&B* sample is representative of selective colleges/universities generally by repeating some of our calculations using a different dataset that covers more institutions (see below).

Table 1 shows that the average proportion of in-state students in the 1976 cohort was .83 at the public universities and .29 at the private universities, but in the 1989 cohort, these figures dropped to .76 and .23, respectively. The increase in out-of-state students over the period reflects the increasing regional and national competition for students over the period.

3.1 *Do universities follow the "equal cutoff rule?"*

Turn first to the question of whether universities follow the "equal cutoff rule." We treat SAT scores as our measure of student ability. Because it is impossible to identify a single student as *the* marginal in-state or out-of-state student, we treat all in-state students in the lowest decile of the in-state distribution at each university as marginal in-state students and we follow the same procedure for out-of-state students. However because athletes and minority students are heavily represented in the marginal group and they are likely to be admitted on different admissions criteria, we omit these students before constructing the sets of marginal in-state and out-of-state students. (If athletes and minorities were left in, we would primarily be testing institutions' cutoffs for these groups rather than for in-state versus out-of-state students.)[8] For each institution, we construct the average SAT score for in-state and out-of-state students in the lowest decile. We treat these values as the cutoffs, $\bar{s}_i$ and $\bar{s}_o$. We then compute the value of $(\bar{s}_o - \bar{s}_i)$ for each institution and we report $(\bar{s}_o - \bar{s}_i)$ averaged over the groups of public and private universities.

The results are given in the middle panel of table 1. For the 1976 cohort at public universities, the average value of $(\bar{s}_o - \bar{s}_i)$ is 51 points and the minimum and maximum values are 8 and 77, respectively. The value of $(\bar{s}_o - \bar{s}_i)$ is significantly different from zero for three of the four institutions, using a one-tailed test. Thus our data suggest that public universities set higher

[8] Since no information was available concerning athletic scholarships, we defined athletes as anyone who played an intercollegiate sport during college. Minorities include African-Americans, Hispanics, and Native Americans. For public university students in the 1976 cohort, 40% of in-state students and 53% of out-of-state students in the lowest decile were athletes or minorities. For private university students in the same cohort, the figures were 55% and 47%, respectively. For the 1989 cohort, the figures were 44%, 58%, 69%, and 57%, respectively.

minimum cutoff levels for out-of-state students. Now turn to private universities. The average value of $(\bar{s}_o - \bar{s}_i)$ is 10 points, with a minimum of -122 and a maximum of 81. Thus, on average, private universities treat in-state and out-of-state students equally, but there is a wide range of behavior. To gauge the importance of the admissions advantage given to in-state students, we calculate the share of the overall student distribution that is between the two cutoffs. For 1976, this figure is 5 percent at public universities, compared to less than 1 percent at private universities. Thus the in-state advantage at public universities is significant but not large, while in-state and out-of-state students are treated equally at private universities.[9]

We repeat the analysis using the 1989 cohort and the results are shown on the right-hand side of table 1. The results show that public universities gave in-state students a larger advantage in 1989 than in 1976 – 84 points versus 51, while private universities' behavior again treated both groups of students equally, but with wide variation in their behavior. Overall the results suggest that public universities consistently favor in-state students by a small margin, while private universities on average treat in-state and out-of-state students the same.[10]

In order to check on the representativeness of the *C&B* sample, we would like to replicate the analysis of the "equal cutoff rule" with a dataset that contains more institutions. However we found only one dataset that both contains more institutions and also has a large sample of students at each institution. The Higher Education Research Institute (HERI) at UCLA annually surveys college freshmen at a nationally representative sample of 4-year colleges and universities. Unfortunately HERI only began to collect data on students' state of residence starting in 2001, so that our replication is for a later time period.

We constructed two samples of institutions from the HERI data. The first includes 10 public and 39 private institutions that are as selective as those in the *C&B* dataset. The second adds 5 additional public and 46 additional private institutions, all taken from the next-most-selective category. All institutions in both samples have at least 10% out-of-state students.[11] We followed

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[9] For the private institutions in 1976, the value of $(\bar{s}_o - \bar{s}_i)$ is significantly different from zero for only 6 of 22 institutions, using a two-tailed test.

[10] The value of $(\bar{s}_o - \bar{s}_i)$ is significantly different from zero for all of the four public institutions in 1989, using a one-tailed test. We also repeated the analysis using the lowest 20% of SAT scores, rather than the lowest 10%, and the results were similar.

[11] All private institutions had at least an 85% participation rate by students in the HERI survey and all public institutions had a 75% participation rate. Institutions were also required to have data on students' home states and SAT/ACT scores for at least 75% of their students. There are 47,863 and 90,208 students in the two samples. See Sax et al. (2001) for a discussion of the HERI survey.

the same procedure as above to calculate average values of $(\bar{s}_o - \bar{s}_i)$. The bottom panel of table 1 gives the results. Examine the more selective sample first. For the public universities, the average value of $(\bar{s}_o - \bar{s}_i)$ is 49 points and the share of the overall distribution between the two cutoffs is 4 percent. For the 39 private institutions, the average value of $(\bar{s}_o - \bar{s}_i)$ is 33 points, but the range is large. The average share of the overall distribution between the cutoffs is 2 percent. Thus the results are similar to those using the *C&B*, even though the time period is later. Now examine the results for the less selective sample. Both public and private institutions on average give a smaller preference to in-state students. For publics, the share of the overall distribution between the two cutoffs is only 3 percent, while for the privates, it is 1 percent. These results again suggest that selective public universities give in-state students a small advantage in admission, while private universities tend to treat students equally.

3.2 *Do universities follow the "equal marginal revenue rule"?*

In the theoretical discussion, we argued that universities follow the "equal marginal revenue rule," i.e., they set minimum cutoffs such that revenue from tuition plus donations is the same for marginal in-state versus marginal out-of-state students, or $D_i(\bar{s}_i') + T_i = D_o(\bar{s}_o') + T_o$. The *C&B* dataset includes information concerning donations, but only for graduates of private institutions. It does not include information concerning individual student tuition levels (financial aid). We therefore ignore differences in tuition levels across in-state versus out-of-state students – which in any case are likely to be small for students at private institutions. The "equal marginal revenue rule" then simplifies to a rule of equal donations by marginal in-state versus out-of-state students, or $D_i(\bar{s}_i') = D_o(\bar{s}_o')$. Although we only have data for graduates of private universities, we analyze them on the grounds that the results are also suggestive for public universities' behavior, assuming that donations behavior by public versus private university graduates is similar. (Actually, most public universities did not regularly solicit donations from graduates as of the mid-1990's, but they appear to be moving in that direction.)

We have data on donations between 1991 and 1996 by graduates in the 1976 cohort. The data cover 18 of the private institutions in our dataset and are taken from the institutions' records. To determine $(D_o(\bar{s}_o') - D_i(\bar{s}_i'))$ for each institution, we constructed distributions of donations by the marginal groups of in-state and out-of-state students at each institution (again excluding athletes and minorities). We focus on the 75th percentile value in each distribution, because average donations are heavily affected by large gifts and the median donation is usually zero. We found the difference between the 75th percentile donation by marginal out-of-state versus marginal in-state students at each of the 18 institutions and then calculated the average value. The results are that the average value of $(D_o(\bar{s}_o') - D_i(\bar{s}_i'))$ is \$17 per year and the range is from -\$58 to \$117 per year. Out-of-state students give more than in-state students at 14 of the 18 institutions and the average difference in donations is \$17 per year. But the difference in donations is significantly different from zero at only one of the 14 institutions. Thus the results do not support the idea that universities give in-state students an advantage in admissions because they donate more. On the contrary, they suggest that private institutions, at least, have an interest in treating in-state and out-of-state students equally.[12]

3.3 *The effect of attending college in a state on adult location choice*

In order to test the "equal additional tax payments rule," we must estimate the increase in marginal in-state versus out-of-state students' probabilities of locating in a particular state as adults when they attend college there. These effects are denoted $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$ for marginal in-state and out-of-state students, respectively. Our sample consists of students in the 1976 cohort who responded to the 1996 survey, so that we observe students' locations 16 years after graduation from college. We drop students who are from outside the U.S. or lived outside the U.S. at the time of the survey. Also for reasons discussed below, we drop students if they did not answer survey questions that asked which universities they applied to.

We use a conditional logit model. Because students can locate in any of the 50 states plus the District of Columbia, students each choose their state of residence from among 51 alternatives.[13] The dependent variable equals one for the state where the student lived at the time of the survey and zero for all other states. Pre-college and college locations are represented by three dummy variables: *home* equals one for the student's home state and zero otherwise, *college* equals one for the state in which the student attended college and zero otherwise, and *home*×*college* is an

[12] The same result also emerges if we examine donation behavior only by students who donate positive amounts or if we run a regression explaining donations as a function of in-state versus out-of-state status, SAT score, and income at the time of the survey. The average donation in the marginal group of students is \$66/year.
[13] The conditional logit model is intended for situations in which individuals choose from among more than two mutually exclusive categories. See Greene (2000, Section 19.7).

interaction between the *home* and *college* variables.[14] The omitted category is states that are neither the student's home state nor his/her college state. We represent students' ability level with three dummy variables: low SAT equals one if the student is in the lowest quintile of the SAT distribution for in-state or out-of-state students (whichever is relevant), middle SAT equals one if the student is in any of the three middle quintiles, and high SAT equals one if the student is in the highest quintile. Also we define a dummy variable for whether students attended public versus private universities. In order to estimate $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$ for the marginal groups of students at public and private universities, we interact the three location variables with three SAT variables and interact the resulting variables with the public versus private variable. We also include state fixed effects.[15]

The results of the regression are given in Appendix table 2. The results are used to predict p_{yy}, p_{yn}, Δp_i, p_{ny}, p_{nn}, and Δp_o for in-state versus out-of-state students in the lowest quintile of the SAT distribution at public and private universities. The results are shown in table 2, columns (1) and (2). Because state fixed effects are included in the regression, the estimates differ across states and we show the results for a representative state.[16] The probability of marginal in-state students locating in their home states as adults if they attend college there (p_{yy}) is .55 for public university students and .51 for private university students. These figures suggest that home state is an important factor in determining graduates' post-college location choices. If students instead attend college outside their home states, the probability of locating in their home states after college (p_{yn}) falls to .32 for both public and private university students.[17] Thus the increase in the probability of in-state students locating in their home states if they attend college there is $\Delta p_i(\bar{s}_i)$ = .55 - .32 = .23 for public university students, compared to .19 for private university students. For marginal out-of-state students, the probabilities of locating in the state where they attend college (p_{ny}) are

[14] Students' home states are the states where the high schools from which they graduated are located.
[15] We use the lowest quintile rather than the lowest decile of the relevant distributions as our marginal groups, because some of the data come from the post-college survey, which has fewer observations than the college records used in the previous section. State fixed effects are included to capture relative sizes of states, climate, and other factors that vary across states but not across individuals.
[16] We do not identify the representative state, because the confidentiality rules for the *C&B* dataset preclude reporting results for particular institutions and most states contain only one institution.
[17] This figure is calculated assuming that students from a particular state who attend an out-of-state institution rather than an in-state public university may attend either a public or a private institution. We make this assumption because

.15 and .07 if they attend public or private universities, respectively, and the probability of locating in a particular state if they are neither from the state nor attended college there (p_{nn}) is .01 for both types of universities. Thus the increase in the probability that marginal out-of-state students locate in a particular state if they attend college there ($\Delta p_o(\bar{s}_o)$) is .14 for public university students and .06 for private university students.

An implication of these results is that attending a public university has a much larger effect on students' post-college location choices than attending a private university. This may be because, when students attend public universities, they meet many more in-state students than they would if they attended a private university in the same state. But another possibility, which we now consider, is that there may be selection bias arising from students' choice of where to attend college. In particular, whether students attend college in a particular state may be correlated with whether they would like to live in that state after graduation.

For example, students from Ohio who want to remain close to their families are likely both to attend college in Ohio and to locate in Ohio after graduation. But students from Ohio who want to live in warm climates are likely both to attend college in Arizona and to locate in Arizona (or another warm state) after graduation. Ignoring this factor causes our estimates to overstate the effect of going to college in a state on the probability of locating in that state after graduation. Our estimate of p_{yy} is based on natives of a representative state who attend college in their home state. This group, on average, is predisposed to their home state as a post-college location. But our estimate of p_{yn} is based on natives of the same state who go to college outside their home state and therefore tend to be predisposed against their home state as a post-college location. These effects cause our estimates of p_{yy} to be biased upward and p_{yn} to be biased downward, so that our estimate of Δp_i is biased upward. Similarly, our estimate of p_{ny} is based on non-natives of the representative state who attend college in the state and are predisposed to the state as a post-college location; while our estimate of p_{nn} is based on non-natives of the state who don't attend college there and are pre-disposed against locating there. These effects cause our estimate of Δp_o to be

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the number of students in our sample who attended an out-of-state public university is fairly small. As a result, the value of p_{yn} is the same for both public and private universities. A similar point applies to the calculations of p_{nn}.

biased upward. In both cases, the treatment group is composed of students who are predisposed to the state and the control group is composed of students who are predisposed against the state.

To address this problem, we use information concerning the set of institutions that students applied to but did not attend. We have information on up to four such institutions. Since location preferences are a factor in college choice, students reveal information about their location preferences by the locations of the colleges they apply to. We re-estimate the model of adult location choice but with two changes. First, we restrict the sample to students who applied to colleges in more than one state, since this group of students does not have strong preferences to locate in a particular state. Second, we define a new dummy variable *apply* that equals one if a student applied to at least one institution in a state and zero otherwise. We interact *apply* with all of the variables involving *home* and we also introduce a new set of variables that interact *apply* with the dummy variables for the low, middle, and high SAT score regions and with the dummy variable for public versus private institution. Adding the latter group of variables allows us to use the information concerning students' applications to colleges in states other than their home or college states, where these states are the omitted category for the *home* and *college* variables.[18]

The results of the model are given in Appendix table 3. We use them to re-do our predictions of p_{yy}, p_{yn}, etc., for marginal students at public and private institutions, using the same representative state as before. The results are shown are in columns (3) and (4) of table 2. Comparing the adjusted and unadjusted results for public university students, we find that p_{yy} falls from .55 to .45 and p_{yn} rises from .32 to .34. Both of these changes are in the predicted direction. This causes our estimate of $\Delta p_i(\bar{s}_i)$ for marginal in-state public university students to fall from .23 to .11. Similarly p_{ny} falls from .15 to .14 and p_{nn} rises from .01 to .04, so that $\Delta p_o(\bar{s}_o)$ for marginal out-of-state public university students falls from .14 to .10. For private universities, the changes are similar: $\Delta p_i(\bar{s}_i)$ falls from .19 to .08 and $\Delta p_o(\bar{s}_o)$ falls from .06 to .02. Thus adjusting for bias in the estimation of $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$ sharply reduces the predicted effect of attending college in a state on the probability of graduates' locating in that state. For in-state students, the adjusted results show that attending a public university has only a slightly larger effect

[18] 40% of marginal in-state students and 80% of marginal out-of-state students applied to colleges in more than one state. There are no interactions between *college* and *apply,* since students must have applied to a college in the state

on post-college location choice than attending a private university does, although the difference remains large for out-of-state students. But the most surprising result of the adjustments is that attending a public university has nearly the same effect on whether marginal in-state versus out-of-state students locate in the state after graduation (.11 versus .10). This differs from the unadjusted results, where the in-state student effect was considerably larger.

3.4 *Do universities follow the "equal additional tax payments rule?"*

Now consider the "equal additional tax payments rule," eq. (7). This says that states would like public and private universities within their boundaries to set cutoff levels such that the increase in expected future state tax payments when a marginal student is admitted is the same for students from in-state versus out-of-state. This requires that the difference between expected additional state tax payments from marginal in-state versus out-of-state students, $\Delta p_i(\bar{s}_i)\tau_i(\bar{s}_i) - \Delta p_o(\bar{s}_o)\tau_o(\bar{s}_o)$, equals zero. We refer to this term as *Difference*.

We estimated $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$ in the previous section. Now turn to expected future state tax payments by marginal students, $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$. Our only observation of graduates' incomes comes from their answers to the 1996 survey, which asked about income during the previous year. However, graduates earn income and pay taxes to the state every year. We therefore convert reported income in 1995 for each graduate in the sample into an estimate of lifetime income, expressed in 1995 dollars. We use age-earnings data for college graduates from Murphy and Welch (1990) and standard mortality tables.[19] We estimate that lifetime income is 38 times the value of income in 1995. We then convert graduates' lifetime incomes into lifetime state tax payments by multiplying lifetime incomes by the sum of the income and sales tax rates in 1995 in

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where they attended college. See Groen (2003) for further discussion of the specification and estimation results using a different dataset. The results are similar to those reported here.

[19] Murphy and Welch (1990, table 9) report that earnings of college graduates increase by 74.3% during the first 10 years of labor market experience, increase by 29.3% during the next 15 years of experience, and decline by 9.8% during the next 15 years of experience. Our figure for earned income is assumed to be for the 16th year of labor market experience. We discount income over 10-year age ranges by the probability of death in that range, using mortality data for 1998 from Murphy (2000), table 23, p. 80. We do not apply a discount rate, since the figures for earnings growth are in real terms. The resulting figures underestimate true lifetime state tax payments because they neglect earnings from wealth and pensions, but they overestimate true lifetime state tax payments by assuming that all graduates work for 40 years and that all income is subject to taxes.

the state where the graduate attended college. For all of the states represented in our sample, the average combined tax rate is 9.8 percent.[20]

We then compute average lifetime state tax payments for in-state and out-of-state students in the lowest quintile of the relevant distribution for each institution in our sample. These are denoted $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$, respectively. Because our estimates of average income are affected by students' location preferences, we compute $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$ both with and without adjustments for location preferences. The unadjusted values of $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$ are based on all students in the relevant marginal group, while the adjusted values of $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$ are based on students in the marginal group who applied to colleges in more than one state.[21]

The middle rows of table 3 report the results for $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$, averaged over the groups of public versus private universities. The unadjusted estimates are shown in the left panel. At public universities, lifetime state tax payments by marginal out-of-state students are 25 percent higher than those by marginal in-state students ($225,000 versus $177,000, respectively). This difference could be due to strong location preferences by in-state students, who may pass up lucrative opportunities in order to remain near home. In addition, the difference could be explained by the lower average ability of marginal in-state students at public universities, since these students were subject to a lower minimum cutoff level for admission. Marginal private university students have higher lifetime state tax payments than marginal public university students, regardless of whether they are from in-state or out-of-state. This could reflect weaker preferences to remain near home or higher minimum cutoffs at private universities, or both. When the results are adjusted, as shown on the right side of table 3, the differential between out-of-state versus in-state students at public universities falls ($227,000 versus $185,000, respectively). But at private universities, the ranking is reversed and in-state students' average tax payments are higher than those of out-of-state students ($273,000 versus $264,000, respectively). Since we have adjusted for location preferences, the remaining differential probably reflects differences in average ability levels between out-of-state and in-state students.

Now turn to the value of *Difference* for the marginal group of students. The average unadjusted value for public universities is $9,400 and the range for the various institutions in our sample is

[20] See Council of State Governments (1996), tables 6.21 and 6.23. Tax rates are as of January 1, 1996. Note that most states' income taxes are approximately constant rather than strongly progressive.
[21] We again use the lowest 20% of in-state and out-of-state students (by SAT score) at each institution.

from \$3,600 to \$16,800. This reflects the balance of two opposing effects: in-state students earn less and therefore pay lower state taxes than out-of-state students, but the effect of attending university in the state on their adult location choices is higher. Since *Difference* is positive, the latter effect more than offsets the former. But with adjusted figures, the picture changes. The average adjusted value of *Difference* for public universities is -\$2,000, because in-state students earn less than out-of-state students and the "pull" of attending university in the state is about the same. The implication is that, as of 1976, states would have benefited financially if public universities had *reduced* the advantage they gave to marginal in-state students and accepted more marginal out-of-state students.

For private universities, the results are different. The unadjusted average value of *Difference* for private universities is \$32,600 and the adjusted figure is \$17,400. Therefore state governments would collect more tax revenues if private universities had used lower minimum cutoff levels for in-state students in 1976.

3.5 *Test of the "tuition offset rule"*

Now consider the "tuition offset rule," eq. (8). Under this rule, the present value of extra state tax payments collected from a marginal in-state student rather than a marginal out-of-state student (*Difference*) should just offset the tuition differential between out-of-state and in-state students at public universities. To evaluate this rule, we need information for 1976 on the tuition differential between out-of-state and in-state students ($T_o - T_i$) at each of the four public universities in the *C&B*. We multiply the tuition differential by four years of college and then convert the result to 1995 dollars using the consumer price index. We adjust the tuition differential to take account of the fact that it is collected 16 to 19 years earlier than the date for which we calculate *Difference,* which is 1995, using a real discount rate of .02 per year. The resulting average tuition differential is \$25,600.

The results in table 3 show that a marginal in-state student at a public university generates either \$9,400 more in lifetime state tax payments or \$2,000 less, depending on whether the adjusted or unadjusted figures are used. Combining these figures with the \$25,600 in-state tuition differential, we find that states lose each time their public universities substitute a marginal in-state student for a marginal out-of-state student: the per student expected loss is -\$16,200 or -\$27,700, depending on whether the adjusted or unadjusted figures are used. Our results suggest that states would have gained substantially if public universities had not favored in-state students as strongly as they did in 1976.

3.6 *Do states have an interest in setting maximum as well as minimum cutoffs?*

Now turn to whether states would gain if universities set maximum as well as minimum cutoff levels for in-state or out-of-state students. To investigate this issue, we calculate *Difference* separately for all three ability regions of the SAT distribution: the lowest quintile, the three middle quintiles, and the highest quintile. Instead of calculating *Difference* for each institution and then summarizing across groups of institutions (our procedure in the previous sections), we instead pool the individual-level data across institutions, keeping public versus private university students separate. For each group, we calculate average lifetime state tax payment.[22] This procedure abstracts from the characteristics of existing institutions because we wish to address the general question of whether states gain when high ability students attend public or private universities within their borders. We use the same procedure to adjust for location preference as above.

Table 4 gives the results. For in-state students at public universities, the probabilities of locating in the home state after graduation (p_{yy}) are .45, .42, and .39 for the lowest, middle, and highest ability groups, respectively. For out-of-state students, the probabilities of locating in the home state (p_{yn}) are .34, .28, and .19 for the three groups, respectively. Thus home state becomes a smaller influence on adult location choice as ability increases, both for in-state and out-of-state students. This is probably because higher ability students have better opportunities generally than lower ability students, so that their best opportunities are more likely to involve leaving their home states. But a surprising result is that, because p_{yn} falls faster than p_{yy}, $\Delta p_i(s_i)$ rises as ability increases: the figures are .11, .13, and .20 for the low, middle, and high ability groups, respectively.[23] For in-state private university students, the highest value of $\Delta p_i(s_i)$ is again the value for high ability students: the figures are .08, .06, and .09 for the low, middle and high ability groups, respectively. Thus high ability students are more influenced in their adult location choices by attending college in their home states than are middle or low ability students, regardless of whether they attend public or private universities.

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[22] In the calculations, we use only students who applied to colleges in more than one state. The SAT score ranges for the three groups of students are: 400-1040, 1040-1330, and 1330-1600.

[23] The difference between the figures for the low versus high ability groups is statistically significant (see table 4).

Now consider out-of-state students. For public universities, p_{ny} and p_{nn} are not monotonically related to ability and therefore $\Delta p_o(s_o)$ does not have a consistent pattern: it is .10, .09, and .11 for the low, middle, and high ability groups, respectively. At private universities, $\Delta p_o(s_o)$ is lower and again does not have a monotonic relationship with ability: it is .02, .04, and .03 for the low, middle, and high ability groups, respectively. Thus there is little relationship between ability and how out-of-state students' location choices are influenced by where they attend college. The only strong pattern for out-of-state students is that their adult location choices are more strongly influenced by where they attend college if they attend a public rather than private institution.

Now turn to the lifetime state tax payment figures in table 4. As expected, they increase monotonically with ability for all types of students. For example, in-state public university students have lifetime state tax payments of $205,000, $237,000, and $292,000 in the lowest, middle, and highest SAT categories, respectively. The increases are similar for other groups of students. Also within ability levels, out-of-state students have higher lifetime state tax payments than in-state students at public universities, but the pattern is reversed at private universities. (However, the differences are usually not statistically significant.)

The figures for *Difference*, $\Delta p_i(\bar{s}_i)\tau_i(\bar{s}_i) - \Delta p_o(\bar{s}_o)\tau_o(\bar{s}_o)$, are given at the bottom of table 4. Because both the "pull" of attending college in a particular state and lifetime state tax payments increase with ability, *Difference* also increases with ability. For public university students, the figures are -$700, $5,100, and $22,900 for the lowest, middle, and highest ability groups, respectively, and for private university students, they are $16,800, $8,000, and $20,600. Because *Difference* is negative only for low ability public university students, the results suggest that states lose financially when public universities admit additional in-state students from the lowest ability group and gain financially when they admit additional in-state students from either the middle or the highest ability groups.

Putting these results together, they suggest the following: (1) States would gain financially if public universities reduced the extent to which they favor in-state over out-of-state students at the low ability margin. (2) States would also gain financially if public universities attracted more high ability students, both from in-state and out-of-state. This is because high ability students tend to be *more* influenced in their adult location decisions by where they attend college than are middle or low ability in-state students and they also pay the highest state taxes. This suggests a rationale for public support of at least one flagship public university that has high academic quality and is likely to attract high ability students from both in-state and out-of-state. (3) States also have a large financial gain when private universities within their boundaries attract high ability in-state students, although the gain is lower when private universities attract high ability out-of-state students. This suggests a rationale for states to subsidize scholarships for high-ability in-state students at private universities within their boundaries. (4) Finally, our data do not support the idea of imposing maximum cutoff levels at public universities for either in-state or out-of-state students. This is because states gain more financially when an additional high ability student is admitted than when an additional low ability student from in-state is admitted, regardless of whether the high ability student is from in-state or out-of-state.

4. Conclusions

In this paper, we examine the divergence of interest between universities and state governments concerning standards for admitting in-state versus out-of-state students. States have an interest in using universities to attract and retain high ability individuals because they pay higher state taxes and contribute more to economic development. In contrast, universities have an interest in their graduates being successful, but little interest in where their students come from or where they go after graduation. We show that universities have an incentive to set equal admissions cutoffs for marginal in-state versus out-of-state students. In contrast, states may gain when universities set lower minimum admissions cutoffs for in-state than out-of-state students, if in-state students' future location choices are more affected by attending public university than are out-of-state students'.

We test the predictions of the model for both public and private universities, using the Mellon Foundation's *College & Beyond* dataset. Because the *C&B* dataset covers only a limited number of universities that were not randomly selected, our results are more tentative than they would be with a larger and more representative set of institutions.

We find that when athletes and minorities are omitted from the analysis, public universities consistently set lower minimum admissions cutoffs for in-state than out-of-state students. The proportion of students who are between the in-state and out-of-state minimum cutoffs is 5 to 8 percent. Private universities, in contrast, treat in-state and out-of-state applicants equally. Surprisingly, we find that states gain more in expected future state tax revenues when marginal out-of-state students are admitted to public universities than when marginal in-state students are admitted. Thus when states pressure their public universities to set lower cutoffs for in-state than out-of-state applicants, they are acting against their own financial interest.

We also investigate whether states would gain if public universities set maximum as well as minimum cutoffs for admission of in-state or out-of-state students, i.e., if they discouraged high ability students from attending. We find that as ability increases, students are more rather than less influenced in their location decisions by where they attend college, regardless of whether they are from in-state or out-of-state. And because higher ability students pay higher state taxes, states benefit when higher ability students from both in-state and out-of-state attend public universities. Thus states would not benefit from public universities setting maximum cutoffs for admission. On the contrary, they gain from having a flagship university that attracts high ability students from both in-state and out-of-state.

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Figure 1:
Student Ability and Future State Tax Payments by
In-State vs. Out-of-State Students:
An Example

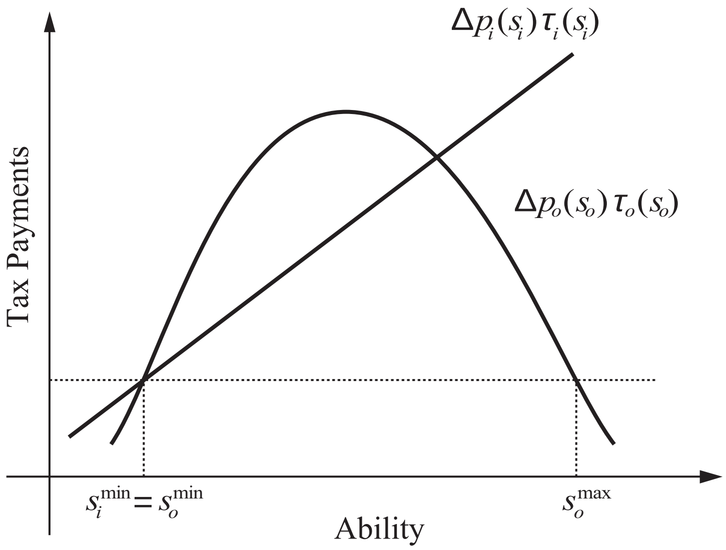

Table 1:
Tests of the Equal Cutoff Rule
Using the Lowest Decile of Students

All students

	1976 cohort		*1989 cohort*	
	Public	Private	Public	Private
Number of institutions	4	23	4	23
Proportion in-state	.83	.29	.76	.23

Non-athletes and non-minorities

$(\bar{s}_o - \bar{s}_i)$ (mean)	51	10	84	36
$(\bar{s}_o - \bar{s}_i)$ (min, max)	8, 77	-122, 81	33, 117	-66, 137
Share between $\bar{s}_i$ and $\bar{s}_o$ (mean)	.05	.00	.08	.01

Results using HERI data (2001 cohort)

	More selective sample		Less selective sample	
$(\bar{s}_o - \bar{s}_i)$ (mean)	49	33	38	23
$(\bar{s}_o - \bar{s}_i)$ (min, max)	12, 98	-46, 128	-15, 98	-89, 128
Share between $\bar{s}_i$ and $\bar{s}_o$ (mean)	.04	.02	.03	.01

Table 2:
Effect of Attending College in a State on the Probability of Locating in the State after College
Students in the Lowest SAT Quintile

	Not adjusted for selection bias:			*Adjusted for selection bias:*	
	(1)	(2)		(3)	(4)
	Public	Private		Public	Private
$\Delta p_i(\bar{s}_i)$	0.226 (0.005)	0.189 (0.007)	$\Delta p_i(\bar{s}_i)$	0.114 (0.008)	0.082 (0.011)
p_{yy}	0.55	0.51	p_{yy}	0.45	0.42
p_{yn}	0.32	0.32	p_{yn}	0.34	0.34
$\Delta p_o(\bar{s}_o)$	0.136 (0.011)	0.057 (0.003)	$\Delta p_o(\bar{s}_o)$	0.102 (0.011)	0.019 (0.002)
p_{ny}	0.15	0.07	p_{ny}	0.14	0.06
p_{nn}	0.01	0.01	p_{nn}	0.04	0.04

Notes: p_{yy} is the probability of students locating in their home states as adults if they attend college there, p_{yn} is the probability of students locating in their home states as adults if they attend college out-of-state, and $\Delta p_i = p_{yy} - p_{yn}$ is the increase in the probability of in-state students locating in their home states if they attend college there rather than elsewhere. p_{ny}, p_{nn}, and Δp_o are analogously defined for students who attend college out-of-state. All values are for students in the lowest quintile of SAT scores and are for a representative state. Standard errors are in parentheses.

Table 3:
Tests of the "Equal Additional Tax Payments Rule"

	Unadjusted		*Adjusted*	
	Public	**Private**	**Public**	**Private**
$\Delta p_i(\bar{s}_i)$	0.226	0.189	0.114	0.082
$\Delta p_o(\bar{s}_o)$	0.136	0.057	0.102	0.019
$\tau_i(\bar{s}_i)$ (mean)	\$177,100	\$254,500	\$185,300	\$273,300
$\tau_o(\bar{s}_o)$ (mean)	\$225,400	\$272,300	\$227,100	\$264,400
Difference (mean)	\$9,400	\$32,600	-\$2,000	\$17,400
Difference (min, max)	\$3,600, \$16,800	\$11,000, \$59,000	-\$8,600, \$4,900	\$6,100, \$39,000

Table 4:
Do States Gain When High and Middle Ability Students Attend College in the State?

	Public			**Private**		
SAT category	*Low*	*Middle*	*High*	*Low*	*Middle*	*High*
p_{yy}	.45	.42	.39	.42	.34	.28
p_{yn}	.34	.28	.19	.34	.28	.19
$\Delta p_i(s_i)$	.114 (.008)	.131 (.009)	.198 (.022)	.082 (.011)	.060 (.011)	.091 (.005)
p_{ny}	.14	.13	.15	.06	.07	.07
p_{nn}	.04	.03	.04	.04	.03	.04
$\Delta p_o(s_o)$	.102 (.011)	.094 (.006)	.114 (.023)	.019 (.002)	.037 (.003)	.034 (.001)
$\tau_i(s_i)$	\$205,100 (9,000)	\$236,700 (8,000)	\$291,900 (22,900)	\$262,100 (17,800)	\$309,600 (8,700)	\$347,900 (14,000)
$\tau_o(s_o)$	\$236,600 (16,900)	\$275,600 (13,000)	\$305,900 (29,100)	\$248,800 (8,500)	\$286,500 (3,800)	\$326,400 (6,300)
$\Delta p_i(s_i)\tau_i(s_i)$	\$23,400	\$31,000	\$57,800	\$21,500	\$19,000	\$31,700
$\Delta p_o(s_o)\tau_o(s_o)$	\$24,100	\$25,900	\$34,900	\$4,700	\$10,600	\$11,100
Difference	-\$700	\$5,100	\$22,900	\$16,800	\$8,000	\$20,600

Notes: All figures are adjusted for location preferences. Standard errors are in parentheses.

Appendix Table 1:
Institutions in the *College and Beyond* Dataset Used in Our Study

Public Institutions

Miami University (Ohio)
University of Michigan (Ann Arbor)
University of North Carolina (Chapel Hill)
Pennsylvania State University

Private Institutions

Universities	Colleges
Columbia University	Barnard College
Duke University	Bryn Mawr College
Emory University	Denison University
Georgetown University	Hamilton College
Northwestern University	Kenyon College
University of Notre Dame	Oberlin College
University of Pennsylvania	Smith College
Princeton University	Swarthmore College
Rice University	Wellesley College
Stanford University	Wesleyan College
Tufts University	Williams College
Tulane University	
Vanderbilt University	
Washington University	
Yale University	

Appendix Table 2:
Conditional Logit Model Estimates
Without Controls for Initial Location Preferences

Variable	Coefficient	Std. Error
home	2.804	0.029
home × {SAT low} × public	-0.067	0.151
home × {SAT low} × private	0.338	0.068
home × {SAT middle} × public	-0.119	0.110
home × {SAT high} × public	-0.617	0.251
home × {SAT high} × private	-0.399	0.055
college	1.630	0.044
college × {SAT low} × public	0.701	0.191
college × {SAT low} × private	0.024	0.116
college × {SAT middle} × public	0.532	0.150
college × {SAT high} × public	0.455	0.301
college × {SAT high} × private	-0.159	0.078
home × *college*	-1.185	0.071
home × *college* × {SAT low} × public	0.001	0.281
home × *college* × {SAT low} × private	0.124	0.178
home × college × {SAT middle} × public	0.010	0.214
home × *college* × {SAT high} × public	0.329	0.449
home × *college* × {SAT high} × private	0.244	0.136
State fixed effects	Yes	
Log-Likelihood	-48,999	
Pseudo R^2	0.3480	

Notes: *home* is an indicator for students being from the state and *college* is an indicator for students attending college in the state. {SAT low}, {SAT middle}, and {SAT high} indicate SAT scores in the lowest quintile, the middle three quintiles, and the highest quintile, respectively, of the distribution of SAT scores. {public} and {private} indicate that the student attended a public or private university/college. The sample size is 19,113.

Appendix Table 3:
Conditional Logit Model Estimates
With Controls for Initial Location Preferences

Variable	Coefficient	Std. Error
home	2.723	0.035
home × *apply* × {SAT low} × public	-1.166	0.266
home × *apply* × {SAT low} × private	-0.476	0.139
home × *apply* × {SAT middle} × public	-0.988	0.188
home × *apply* × {SAT middle} × private	-0.671	0.072
home × *apply* × {SAT high} × public	-1.857	0.478
home × *apply* × {SAT high} × private	-1.149	0.103
college	0.954	0.245
college × {SAT low} × private	-0.470	0.291
college × {SAT middle} × public	0.141	0.307
college × {SAT middle} × private	-0.189	0.253
college × {SAT high} × public	0.327	0.464
college × {SAT high} × private	-0.309	0.262
home × *college*	-0.375	0.378
home × *college* × {SAT low} × private	0.074	0.443
home × *college* × {SAT middle} × public	-0.198	0.467
home × *college* × {SAT middle} × private	-0.192	0.391
home × *college* × {SAT high} × public	0.654	0.744
home × *college* × {SAT high} × private	0.109	0.409
apply	1.526	0.150
apply × {SAT low} × private	-0.443	0.183
apply × {SAT middle} × public	-0.276	0.189
apply × {SAT middle} × private	-0.571	0.157
apply × {SAT high} × public	-0.596	0.285
apply × {SAT high} × private	-0.550	0.165
State fixed effects	Yes	
Log-Likelihood	-34,087	
Pseudo R^2	0.3217	

Notes: *home* is an indicator for students being from the state and *college* is an indicator for students attending college in the state. *apply* is an indicator for students applying to a college in the state. {SAT low}, {SAT middle}, and {SAT high} indicate SAT scores in the lowest quintile, any of the middle three quintiles, and the highest quintile, respectively. {public} and {private} indicate that the student attended a public or private university. The sample size, 12,781, is smaller than in Appendix Table 2 because only students that applied to institutions in more than one state are included.

Appendix Table 4:
Institutions in the HERI Dataset Used in Our Study

First Sample

Public Universities	Private Universities	Private Colleges
Georgia Institute of Technology	Carnegie Mellon University	Babson College
Iowa State University	Duke University	Bard College
Miami University (Ohio)	Emory University	Barnard College
University of Massachusetts (Amherst)	Johns Hopkins University	Bates College
University of Michigan (Ann Arbor)	Northwestern University	Beloit College
University of Minnesota (Twin Cities)	Rice University	Bowdoin College
University of Pittsburgh	Stanford University	Bryn Mawr College
University of Vermont	University of Rochester	Bucknell University
University of Virginia	Vanderbilt University	Carleton College
Virginia Polytechnic Institute and State U		Claremont McKenna College
		Colby College
		Connecticut College
		Grinnell College
		Harvey Mudd College
		Haverford College
		Macalester College
		Middlebury College
		Reed College
		Rose-Hulman Institute of Technology
		Scripps College
		Stevens Institute of Technology
		Trinity College
		University of Richmond
		Washington and Lee University
		Wellesley College
		Wesleyan University
		Wheaton College
		Whitman College
		Williams College
		Worcester Polytechnic Institute

Additional Institutions in the Second Sample

Public Universities	Private Universities	Private Colleges
Ohio State University	Boston College	Allegheny College
Purdue University (Indiana)	Clarkson University	Bentley College
University of Alabama	Cornell University	Berry College
University of Arkansas (Fayetteville)	New York University	Bethany College
Utah State University	Rensselaer Polytechnic Institute	Centre College
	Santa Clara University	Chapman University
	Tulane University	Clark University
	University of San Diego	Coe College
	University of Southern California	Elizabethtown College
	Villanova University	Furman University
	Wake Forest University	Gettysburg College
	Washington University	Goucher College

Hamilton College
Hiram College
Hobart and William Smith Colleges
Hollins University
Illinois Wesleyan University
John Brown University
Juniata College
Kettering University
Knox College
Lafayette College
Milwaukee School of Engineering
Oklahoma Christian University
Pacific University
Pepperdine University
Pitzer College
Rochester Institute of Technology
Rollins College
Saint Lawrence University
Siena College
Ursinus College
Wabash College
Willamette University