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. States have an interest in using universities to attract and retain high ability individuals because they pay higher taxes and contribute more to economic development. Universities have an interest in their graduates being successful, but little interest in where 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, but states have an interest in universities favoring in-state students.

We test the model for public and private universities and find that both types of universities favor in-state students in admissions. We also find that states gain more in expected future tax revenues when marginal in-state rather than marginal out-of-state students are admitted to public universities, since in-state students' higher probability of locating in the state when they attend university there than offsets their lower future state tax payments. Finally we investigated whether states gain when very high ability students attend public universities. We found that states are better off when public universities are not highly selective and when public universities restrict admission of out-of-state students, even those of high ability.

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

Jeff Groen and Michelle J. White

States have an interest in using their public universities as tools to encourage economic development. Universities are useful tools of state economic development because university graduates have higher productivity and higher future earnings, so that they pay more in state taxes. Also, attending university in a particular state raises graduates' probability of locating in that state as adults, but the increase is greater for students from in-state than those from out-of-state. States therefore have an interest in universities favoring in-state over out-of-state students as applicants for admission, because in-state students' higher future earnings are more likely to remain in-state.

However, universities' interests are different 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 or famous, but they have little or no 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 public 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 suggests 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 in particular on states' interest versus public and private universities' behavior in admitting in-state versus out-of-state students. We develop and test several behavioral rules representing states' interest and universities' interest and test them on data for both public and private universities.

After a brief literature review, section 3 presents several simple theoretical models which illustrate the divergence of interest between universities and their state governments. The theoretical models yield conditions that determine the optimal split between in-state and out-of-state students from both universities' and state governments' viewpoints. Section 3 estimates the

models using the Mellon Foundation's *College and Beyond* dataset. Our main result is that public universities behave surprisingly like private universities and both favor in-state over out-of-state applicants at the margin. We also find that states gain more in expected future state tax revenues when marginal in-state rather than out-of-state students are admitted, but the difference is more than offset by the higher tuition charge levied on out-of-state students.

1. **Literature Review**

In a historical study of the development of higher education in the U.S., Goldin and Katz (1998) provide support for the idea that state governments have historically viewed public universities as a tool for encouraging economic development. They show that most public universities were founded around the turn of the 20th century, a time when manufacturing, mining and agriculture were all becoming more specialized and science-based. Public universities were founded both to train educated workers in these fields and to conduct research to advance the fields. Goldin and Katz document that individual states established specialized faculties at public universities to conduct research and provide training in specific areas that each state's economy specialized in. Examples include tobacco production in North Carolina, dairy farming in Wisconsin, mining in Colorado, and oil exploration/refining in Texas. When students studied these areas, their productivity would increase by more if they remained in the state than if they left for an alternate state.[2]

Quigley and Rubinfeld (1993) examined how the supply of public universities varies across states. They show that states with higher private university enrollment have lower public university enrollment and vice versa. They also show that there is wide variation across states in the level of tuition and the level of state support for public universities. They estimate a reduced form model which explains the size of public universities, using aggregate data for U.S. states over time. An interesting result of their analysis is that, in states with more mobile populations, less money is spent on public higher education. Presumably these states expect to attract educated migrants from

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[1] We are grateful to John Bound, Rohini Somanathan and seminar participants at Michigan for helpful comments.

[2] Goldin and Katz also argue that increasing specialization of knowledge around the turn of the 20th century meant that the efficient scale of universities increased substantially. This made it difficult for new entry of private universities to occur.

other states and/or expect local students to move elsewhere, so that they have less need to provide public universities to educate the local population. See also Hoenack and Pierro (1990).

There has been quite a bit of research on the economics of higher education more generally. Rothschild and White (1994) provide a model of production of higher education in which students are both purchasers of the output of higher education and inputs into the production process for higher education, because of peer effects on learning. Epple, Romano and Sieg (1999) test the important of peer effects by examining how universities set financial aid (tuition discounts) for individual students. They find that universities that have average student quality in the middle of the overall student quality distribution charge lower tuition to more able students, presumably because these students have positive peer effects. Hoxby (1998) argues that, over the period since World War II, U.S. universities have been transformed from local autarkies into competitors, since students who previously attended universities close to home have become more likely attend universities that are further away. This means that universities are increasingly forced to compete for students on regional or national markets. Hoxby argues that the increase in competition gave universities an incentive to raise quality, since investments in increasing quality have higher returns when markets are larger. The result is that tuition has risen and universities' student bodies have become more homogeneous, *i.e.*, the top students are more likely to attend the best universities, and students with lower ability levels are more likely to attend lower quality universities. Hoxby documents these trends by showing that students have become less likely to attend university in their home states, that the standard deviation of students' SAT scores has declined over time at all types of universities, and that tuition levels have increased rapidly. See also Cook and Frank (1993).

There are at least two other explanations for the rise in higher education tuition levels. Clotfelter (1991) argues that the return to a college education has been rising over time and that this has increased demand for higher education and allowed universities to raise tuition without cutting class size. Brewer, Eide and Ehrenberg (1996) also found that the return to a college education varies with university quality and is higher for students who attend higher quality universities. This would suggest that higher quality universities are able to raise tuition by more than lower quality universities---a testable hypothesis. Mixon and Hsing (1994) find that demand by out-of-state students to enroll at public universities rises as quality increases. Another approach to explaining

the rise in tuition uses Baumol's (1967) argument that the cost of producing services rises more quickly than the cost of producing goods, since productivity improvements occur more quickly in manufacturing than in services. Clotfelter (1996) examines four universities in detail to explore how and why costs have risen. See also McPherson, Schapiro, and Winston (1993).[3]

2. **Theory**

We first examine public and private universities' interest in admitting in-state versus out-of-state students and then examine the state's interest. Our goal is to develop a set of testable hypotheses, so that we intentionally keep the theory simple.

2.1 Universities' interest

The "equal cutoff rule." Consider first the interest of public and private universities in admitting in-state versus out-of-state students. We start with considerations that apply to both types of universities. Suppose the ability level of in-state students is denoted s_i and the ability level of out-of-state students is denoted s_o. (For private universities, a more natural interpretation is that in-state and out-of-state students are those whose homes are near the university versus far away from the university, regardless of state boundaries.) The number of in-state students of ability level s_i who apply to the university and would attend if accepted is denoted $n_i(s_i)$. Similarly, the number of out-of-state students of ability level s_o who apply to the university and would attend if accepted is $n_o(s_o)$. Universities are assumed to select students by adopting minimum cutoff scores of $\bar{s}_i$ for in-state applicants and $\bar{s}_o$ for out-of-state applicants. They reject all in-state applicants with $s_i < \bar{s}_i$ and accept all in-state applicants with $s_i \geq \bar{s}_i$. They apply the same rule for out-of-state applicants, using the cutoff $\bar{s}_o$.[4] Universities also have a binding capacity constraint (total

[3] Bowen and Bok (1998) examine the experiences of African-American versus white students at 30 colleges and universities. We use their dataset in the empirical work reported below.

[4] Because we assume that universities accept all in-state applicants who have $s_i \geq \bar{s}_i$, $n_i(s_i)$ equals the number of in-state applicants of ability level s_i times the "yield rate" for in-state applicants of ability level s_i. (The yield rate is the probability of an accepted student attending the university.) The same applies to $n_o s_o$. The functions $n_i(s_i)$ and $n_o(s_o)$ are likely to differ because some students wish to attend university near their homes. As a result, the yield rate

class size) of $\overline{N}$. Assume that the universities' goal is to maximize the average ability level of their students, subject to the capacity constraint. They therefore set the cutoff levels $\overline{s}_i$ and $\overline{s}_o$ so as to maximize:

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

subject to the capacity constraint:[5]

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

The first order condition is:

$$\overline{s}_i = \overline{s}_o . \quad (3)$$

This condition says that the cutoff levels for admission of in-state and out-of-state students should be the same. We refer to this result as the "equal cutoff rule." 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 the equal cutoff 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 admit more in-state students.

The "equal marginal revenue rule." Another formulation of universities' interest assumes that they wish to maximize a hybrid of average student ability and total revenues. Suppose universities still admit students in declining order of ability until they reach the relevant cutoff, but they set the cutoff levels so as to maximize total revenues collected from in-state and out-of-state students, rather than to maximize average student ability. Suppose T_i and T_o denote tuition levels charged in-state and out-of-state students, respectively. Tuition levels for in-state versus out-of-state students always differ at public universities, but they may also differ at private universities if universities systematically give larger tuition discounts/financial aid to one group of students or the

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will tend to be higher for in-state than out-of-state students at the same ability level. We treat these functions as fixed because our dataset does not contain information on applicants.

[5] The capacity constraint must be binding or else universities could maximize average ability by accepting only the single student with the highest ability who is willing to attend.

other. Universities also collect revenue from graduates in the form of donations.[6] Suppose $D_i(s_i)$ and $D_o(s_o)$ denote the expected present value of future donations made by in-state and out-of-state students of ability levels s_i and s_o, respectively. Future donations are assumed to depend on student ability, because higher ability students have higher average earnings. Universities are now assumed to 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:

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

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 expression says that universities have an interest in setting the cutoff levels for in-state and out-of-state students such that the same amount of revenue in the form of tuition plus future donations is collected from the marginal student of each type admitted.[7]

Eq. (5) suggests several reasons why both public and private universities may have an incentive to set lower cutoff levels for in-state students (or for students who live nearby), rather than equal cutoffs. One reason that applies to both types of universities is that in-state students are more likely to locate near the university as adults and this may cause them to donate more on average than out-of-state students having the same ability levels. This would give universities an incentive to favor in-state students by setting a lower cutoff level for them. Another reason, which applies more to private than public universities, emerges from the fact that universities have spatial monopoly power over in-state (nearby) students, because some of these students wish to attend university near their homes. Private universities may take advantage of this power by charging nearby students higher tuition/giving them less financial aid. (See Epple et al., 1999, for discussion.)

[6] Donations have historically been an important source of revenues for private universities, but not for public universities, although that appears to be changing.

[7] We don't currently have data to test this prediction, but we hope to test it in the future.

These considerations suggest that both public and private universities have an interest in setting lower cutoffs level for in-state students. For public unversities, this is because marginal in-state students will make higher expected donations than marginal out-of-state students. For private universities, it is because marginal in-state students will both pay higher tuition and make higher donations in the future than marginal out-of-state students. An additional motive may be that public universities favor in-state students because the state wishes them to do so, while private universities favor in-state students because they wish to maintain support/good will from their local communities.[8]

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 our discussion above of states using 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 taxes. High ability individuals tend to have higher incomes and therefore to pay higher taxes. (Individuals that have high incomes tend to pay higher amounts of other state taxes, such as property taxes and business taxes, as well.) Therefore state *X* has an interest in both 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 have a choice between attending university in state *X* or in some other state. If students attend university in state *X* rather than another state, we assume that their probability of locating in state *X* as adults rises, regardless of whether they are from state *X* or from another state.[9]

Suppose the probability that students from state *X* locate in state *X* as adults is denoted p_i if they attend university there and p'_i if they attend university in another state. Both p_i and p'_i are assumed to depend on ability s_i. Therefore $\Delta p_i(s_i) = p_i(s_i) - p'_i(s_i)$ denotes the increase in the

[8] An alternate interpretation of private universities' behavior would be that "in-state" students are those whose parents attended the university. Private universities have an incentive to set lower cutoffs for these students, because they and their parents are expected to donate more and are willing to pay higher tuition, holding everything else constant.

[9] Some in-state students' alternative to attending the public university in state *X* is to attend a less selective public university in state *X*, rather than to attend a university in some other state. In this case students' probability of locating in state *X* as adults is unaffected by whether they are admitted to the selective public university in *X* or not, so that---according to our model---state *X* does not benefit when they are admitted to the selective public university. However another benefit of admitting these students is that attending the selective public university raises students' productivity relative to attending a less selective public university. We ignore this benefit here, because our dataset includes only selective universities and does not include any second tier public universities.

probability of students from state *X* locating in state *X* as adults if they attend university there rather than elsewhere. Similarly, the probability that students from other states (~*X*) locate in state *X* as adults is denoted p_o if they attend university in state *X* and denoted p'_o if they attend university in other states (~*X*). Thus $\Delta p_o(s_o) = p_o(s_o) - p'_o(s_o)$ denotes the increase in the probability of students from ~*X* locating in state *X* as adults if they attend college in state *X* rather than in some other state. We assume that both $\Delta p_i(s_i)$ and $\Delta p_o(s_o)$ are positive and that $\Delta p_i(s_i) > \Delta p_o(s_o)$ at any $s_i = s_o$. (We present evidence in support of these assumptions below).

Suppose $\tau_i(s_i)$ denotes the average present value of future state tax payments by in-state graduates having ability level s_i, conditional on locating in state *X* as adults. Similarly, $\tau_o(s_o)$ denotes the average present value of future state tax payments by out-of-state graduates having ability level s_o, conditional on locating in state *X*. We assume that the present value of future state tax revenues is positively related to ability for both types of students.

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

$$\max\left[\int_{\bar{s}_i}^{\infty} \Delta p_i(s_i)\tau_i(s_i)n_i(s_i)ds_i + \int_{\bar{s}_o}^{\infty} \Delta p_o(s_o)\tau_o(s_o)n_o(s_o)ds_o\right] \tag{6}$$

subject to the same capacity constraint, eq. (1). The first order condition is:

$$\Delta p_o(\bar{s}_o)\tau_o(\bar{s}_o) = \Delta p_i(\bar{s}_i)\tau_i(\bar{s}_i) \tag{7}$$

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 cutoffs $\bar{s}_i$ and $\bar{s}_o$ for in-state and out-of-state students should be the same. But since we assumed that $\Delta p_i(s) > \Delta p_o(s)$, the state will favor a lower cutoff level for in-state students. Note that if $\Delta p_o(\bar{s}_o)$ were equal to zero, then the state would favor admitting no out-of-state students at that ability level. The same applies to in-state students if $\Delta p_i(\bar{s}_i) = 0$.

The "tuition offset rule." States in fact receive revenue from students in two forms: tuition payments from current students and state tax payments from graduates in the future. 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, or:

$$\max[\int_{\bar{s}_i}^{\infty}(T_i + \Delta p_i(s_i)\tau(s_i))n_i(s_i)ds_i + \int_{\bar{s}_o}^{\infty}(T_o + \Delta p_o(s_o)\tau(s_o))n_o(s_o)ds_o] \quad (8)$$

subject to the capacity constraint, eq. (1).

The first order condition implies that:

$$T_o - T_i = \Delta p_i(\bar{s}_i)\tau_i(\bar{s}_i) - \Delta p_o(\bar{s}_o)\tau_o(\bar{s}_o) \quad (9)$$

Eq. (9) says that the extra tuition charge paid by out-of-state relative to in-state students should just offset the difference between the expected increase in future state tax payments by the marginal in-state relative to out-of-state student admitted to the public university. If this condition holds as an equality, then public universities are acting according to the state's interest. But if the left hand side of condition (9) 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 refer to this result as the "tuition offset rule" and we test it below.

Maximum cutoffs. So far we have assumed that it is in the state's interest for universities to admit students in descending order of ability and to set only minimum cutoff levels of $\bar{s}_i$ and $\bar{s}_o$ for in-state and out-of-state students, respectively. 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 wish to 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 are unlikely to settle in the state even if they attend university there. 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 $\Delta p_o(s_o)$ may be either increasing or decreasing with ability. (We present data below.) Then one possibility is for $\Delta p_i(s_i)\tau_i(s_i)$ and $\Delta p_o(s_o)\tau_o(s_o)$ to have the shapes shown in figure 1. Here $\Delta p_i(s_i)\tau_i(s_i)$ increases monotonoically as s_i rises, but

$\Delta p_o(s_o)\tau_o(s_o)$ rises and then falls as s_o rises. As a result, states want universities to set minimum cutoffs of $\bar{s}_i$ and $\bar{s}_o$ for in-state and out-of-state students respectively, but in addition states want their universities to set a maximum cutoff of $\tilde{s}_o$ for out-of-state students. This is because the increase in expected future state tax payments by out-of-state students as a result of attending university there declines rapidly at very high levels of student ability. If the curve for in-state students also turned downward at high ability levels, then states might also want universities to set maximum cutoff levels for in-state students.[10] This consideration suggests a rationale for Federal intervention to subsidize provision of public universities in states that have high emigration rates.[11]

These arguments suggest that states may have an interest in their public universities having an intermediate quality level: not too high because the highest quality students are unlikely to be influenced in their location decisions by whether they attend university in the state, but not too low because then high quality in-state students would attend university elsewhere and this would make them less likely to settle in the state as adults.[12]

2.4 Summary

The theoretical discussion resulted in several testable hypotheses. First, if universities wish to maximize average student ability and are free to follow their own interests, then they are predicted to follow the "equal cutoff rule." However, states prefer that universities set a lower minimum cutoff for in-state students and public universities may be influenced by states' preferences. Second, our analysis suggested several reasons why private as well as public universities have an incentive to set lower minimum cutoffs for in-state students or for students who live near the university. The reasons are that in-state/nearby students are willing to pay higher tuition in order to attend university near their homes and/or because these students are likely to make higher donations to the university in the future. Third, states may have an interest in setting maximum as

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[10] Giving incentives to high-ability students to stay in the state would be an alternate response. A note in the *Chronicle of Higher Education*, Nov., 6, 1998, indicates that the state of Alaska is considering giving $10,800 to high ability in-state students who attend the University of Alaska for four years. Other states give high ability students scholarships to attend public and sometimes also private universities in the state.

[11] Quigley and Rubinfeld (1993) noted the negative effect of higher migration on states' incentive to spend money on public universities, but did not investigate the quality versus quantity tradeoff.

[12] An additional argument for states to favor admitting high quality students from either in-state or out-of-state is the fact that students are both purchasers of universities' services and an input into the production process, since peer effects are a factor in the learning environment and higher ability students improve the learning environment for all students (Rothschild and White, 1995).

well as minimum cutoffs for in-state or out-of-state students, if the highest ability students are uninfluenced in their adult location decisions by attending the state university. Finally, if states have a goal of maximizing the sum of tuition payments and future state tax revenues, then they may not have an interest in public universities setting lower minimum cutoffs for out-of-state students, since the loss of future tax revenue from admitting an out-of-state students may be offset by higher tuition charges.

We test these hypotheses for both public and private universities. We use both types on the grounds that private universities are unlikely to be influenced by their states' preferences, so that their behavior is likely to follow the model of university behavior discussed above. In contrast, public universities are likely to follow a path that intermediate between their states' preferences and private universities' preferences.

3. **Empirical Work**

Our data are taken from the Mellon Foundation's *College and Beyond* dataset. This dataset includes college records and background information from students at 28 fairly to highly selective colleges and universities, including four public universities.[13] There are three separate cohorts of students, of which we analyze two here:[14] the earlier cohort consists of college records of 32,000 students who entered in 1976 and the later cohort consists of college records of 36,000 students who entered in 1989. A second source of information for both cohorts comes from a survey conducted in 1996. It includes questions concerning state of residence, income, etc., at the time of the survey. The sample sizes for the survey are 23,500 and 11,500 for 1979 and 1986, respectively.[15] We added additional information concerning tuition levels at the time each cohort attended college.

[13] A drawback of the dataset is that the universities were not randomly chosen (in part because they were chosen on the basis of willingness to participate. However they are generally representative of selective universities/colleges and had similar admissions criteria. Four universities in the dataset are omitted from our study because their student records did not include information on students' home states. A list of universities is given in the appendix. For all universities except the largest few, all students in the entering class were included in the dataset. For the largest universities, a random sample of 2,000 students from each entering class was selected.

[14] The third cohort matriculated in 1951. We have not yet analyzed it, mainly because few of the observations include standardized test scores, which we use as our measure of student ability. (Standardized tests were not widely used at that time.)

[15] The survey response rate was 70 percent for the 1976 cohort and 76 percent for the 1989 cohort. For purposes of this study, Doug Mills of the Mellon Foundation added current state of residence for survey respondents to the dataset. We are very grateful for his help.

3.1 *Do universities use 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 students in the lowest decile of the distribution of in-state/out-of-state students at each college/university as marginal in-state/out-of-state students. For each university/college in the dataset, we construct the average SAT score for marginal in-state students, $\bar{s}_i$, and the average SAT score for marginal out-of-state students, $\bar{s}_o$. We use these to construct the difference between the two cutoffs for each college/university, $(\bar{s}_o - \bar{s}_i)$.[16] Because the rules of the *C&B* dataset do not allow us to identify individual universities, we report values of $(\bar{s}_o - \bar{s}_i)$ averaged over the groups of public and private universities.

The results are given in table 1. For the public universities in the 1976 cohort, the average value of the difference between the out-of-state and in-state cutoffs, $(\bar{s}_o - \bar{s}_i)$, is 37 points and the standard deviation is 10. While there are only four public universities, all of them set higher cutoffs for out-of-state students. Thus the results suggest that public universities consistently follow their states' preferences by favoring marginal in-state over out-of-state students for admission. Now turn to the private universities. The mean value of $(\bar{s}_o - \bar{s}_i)$ among the 24 private universities is 25 points and the standard deviation is 53. Thus on average, private universities also set lower cutoff levels for in-state than out-of-state students. However private universities have a wider range of differences, with the minimum being a 78 point advantage to out-of-state students and the maximum being a 139 point advantage to in-state students. Thus private as well as public universities generally give in-state students an advantage in admissions, although the advantage is larger on average at the public than the private universities.[17] Note that the proportion of in-state students varies widely, from .80 at the public universities to .29 at the private universities in 1976. Thus universities consistently give in-state students an advantage in admissions, despite having widely differing proportions of in-state relative to out-of-state students.

We repeated the analysis for the 1989 cohort and the results are shown in the lower panel of table 1. Public universities gave in-state students a slightly larger advantage in 1989 than in 1976:

[16] Only ACT scores are available for some students. We converted these to equivalent SAT scores, using the equipercentile method. The results shown in table 1 are based on 2745 students for 1976 and 3174 students for 1989.
[17] Add a measure of how much of the distribution is between the two cutoffs.

41 points versus 37 (although the variance was higher and one institution gave out-of-state students a slight advantage). But private universities gave in-state students a substantially larger advantage in 1989 than in 1976: 46 points compared to 25.[18]

The result that public universities give in-state students an advantage in admissions is as expected.[19] But we were surprised to find that private universities also give in-state students an advantage, although our model suggests various reasons why they might wish to do so. In future work, we plan to rerun the calculations for private institutions, but substituting students who live near the university for in-state students. This will be a more direct test of our model, since the model suggests that private universities have an incentive to favor students who live nearby in setting their cutoff levels, not to favor students who live in the same state. We also plan to rerun the model using "legacy" students in place of in-state students.

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

Now consider the "equal additional tax payments" rule, eq. (7). This says that state *X* would like public and private universities within its boundaries to set cutoff levels such that the expected increase in future state tax payments when universities admit an additional student is the same regardless of whether the marginal student is from in-state versus out-of-state. To determine the increase in the probability of marginal in-state students locating in their home states as adults if they attend college there, $\Delta p_i(\bar{s}_i)$, we calculate the probability that students whose home state is *X* who attend college in state *X* locate in state *X* as adults, $p_i(\bar{s}_i)$, and the probability that students whose home state is *X* who attend college in other states *(~X)* locate in state *X* as adults, $p_i'(\bar{s}_i)$. $\Delta p_i(\bar{s}_i)$ is the difference between them. To determine $\Delta p_o(\bar{s}_o)$, we take the difference between the probability that students whose home state is $\sim X$ who attend college in *X* locate in state *X* as adults, $p_o(\bar{s}_o)$, and the probability that students whose home state is $\sim X$ who attend college in $\sim X$ locate in state *X* as adults, $p_o'(\bar{s}_o)$. $\Delta p_o(\bar{s}_o)$ is the difference between them. We do the calculations separately for in-state versus out-of-state students at each institution. We then report the average values for public versus private universities. Because our location data are taken from the post-

[18] Note that both types of institutions had fewer in-state students in 1989 than in 1976. This is consistent with Hoxby's (1998) hypothesis that, over time, students have chosen to attend universities which are further away from their homes.
[19] We repeated the analysis using the lowest 20% of SAT scores, rather than the lowest 10%, and the results were similar.

college survey and it contains fewer observations than the sample of college records, we treat the lowest 20% (rather than the lowest 10%) of in-state and out-of-state students at each institution as marginal students.[20] The reported results are not for any specific state, but are averaged over all states.

The results for the 1976 cohort are shown in table 2. If marginal students from state *X* attend public university in state *X*, then their probability of locating in state *X* is .60, and if same students instead attend public university in state ~*X* , then their probability of locating in state *X* drops to .30. Thus attending public university in *X* rather than ~*X* raises state *X* students' probability of locating there as adults by .60 - .30 = .30. If marginal students from ~*X* attend public university in *X*, then their probability of locating in state *X* as adults is .15, compared to .01 if they attend university in ~*X*. Thus the effect of attending public university in state *X* rather than elsewhere is to raise the probability of students from ~*X* locating in state *X* by .14. Now turn to private universities. For students from state *X*, the probability of locating in state *X* is .59 if they attend private university in *X* and .37 if they attend private university in ~*X*, for a difference of .22. Finally, for students from ~*X* , the probability of locating in state *X* is .09 if they attend private university in *X* and .01 if they attend private university in ~*X*, for a difference of .08. Thus attending university in state *X* always raises the probability of graduates locating in the state by a substantial margin, but the effect is larger if students are from state *X* rather than elsewhere and if students attend public rather than private institutions. Note that the strong "pull" of attending college in state *X* on in-state students' location choice may partly be due to selection bias. Students may attend college in their home states if they intend to remain close to home after graduation and vice versa.[21]

Now turn to future state tax payments $\tau_i(\bar{s}_i)$ and $\tau_o(\bar{s}_o)$. We use the mean income of survey respondents as our proxy for future state tax payments,. Following the same procedure as we used to calculate $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$, we calculate mean income separately for in-state versus out-of-state students at each institution and report average figures for public versus private institutions. These figures give us a snapshot of earnings 16 years after graduation for the 1976 cohort. Because most states' income taxes are a fixed or rising proportion of income, income is a good proxy for state tax payments. Using income at a single point in time as a proxy for state tax payments ignores

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[20] Using this method takes account of the fact that different institutions have different levels of selectivity, so that the lowest 20% of students at the most selective universities may not be in the lowest 20% of the overall distribution.

the fact that residents pay state taxes every year, rather than in a single year. However, this simplification does not affect the comparison of expected future state taxes paid by in-state relative to out-of-state students.[22]

Table 2 shows that the average income in 1996 of in-state and out-of-state graduates from public universities who were in the lowest quintile of SAT scores was $46,700 and $62,200, respectively. For in-state and out-of-state graduates of private universities, the figures are $71,500 and $75,200, respectively. Thus out-of-state graduates in the bottom 20% of SAT scores have higher incomes than in-state graduates at both types of universities, but the difference is far greater for public than private universities. To some extent, the difference reflects the higher minimum cutoffs applied to out-of-state applicants by both types of universities. But presumably the lower incomes of in-state students who attend public universities also reflects selection of students who prefer to remain near their homes rather than increasing their incomes by moving further away.

Finally, table 2 gives the difference between expected additional state tax payments by in-state versus out-of-state students, which is $\tau_i(\bar{s}_i)\Delta p_i(\bar{s}_i) - \tau_o(\bar{s}_o)\Delta p_o(\bar{s}_o)$. We refer to this term as *Difference*. For the "equal additional tax payments rule" to be satisfied, *Difference* must equal zero. We calculate *Difference* for each university and report the average values for public versus private universities. For the 1976 cohort, the mean value of *Difference* is $5,400 for public universities and $9,300 for private universites. The fact that universities exert a stronger "pull" on in-state than out-of-state students' location choices tends to increase the value of *Difference*, but the fact that in-state students earn less than out-of-state students tends to decrease the value of *Difference*. Overall, the first effect outweighs the second, so that *Difference* is positive. Although there is wide variation in the values of *Difference*, a striking result is that it is positive for all 28 institutions in the sample.

These results suggest that states gain more when a marginal in-state student admitted to a public or private university than when a marginal out-of-state student is admitted, despite the fact that the cutoff for in-state students is lower. The fact that *Difference* is consistently positive suggests that states in fact have an interest in public and private universities setting even lower cutoffs for in-state relative to out-of-state students.

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[21] See the discussion below of regression estimates of $\Delta p_i(\bar{s}_i)$ and $\Delta p_o(\bar{s}_o)$.

[22] See below for further discussion.

We repeat the calculations for the 1989 cohort and the results are shown on the right hand side of table 2. They are qualitatively similar to the results for 1976, although the income figures are much lower because graduates have much less labor market experience. The main difference is that when students from state *X* attend a private university in state *X*, rather than a private university in ~*X*, their probability of locating in state *X* increases by only .10, compared to .22 for the earlier cohort. Because attending a private university in state *X* is less effective at retaining in-state students, *Difference* is approximately zero for private university students in 1989. Thus because attending private universities is relatively ineffective in retaining in-state students, private universities are satisfying the equal additional tax payments rule in 1989.

3.3 *Tests of the tuition offset rule*

Finally, consider the tuition offset rule, eq. (9). This rule says that the additional tuition collected from out-of-state students relative to in-state students should just offset the difference between expected additional tax payments by marginal in-state versus out-of-state students as a result of students attending university in state *X* rather than elsewhere. To evaluate this rule, we first obtain data on the average out-of-state versus in-state tuition differential at the four public universities in the dataset for 1976. This figure is $1,682 per year.[23] Multiplying by four years and converting the result to 1996 dollars, we get $19,000. We also assume a real discount rate of .02 per year and adjust to take account of the fact that the tuition differential is collected 16 to 20 years before we observe incomes. The resulting figure for $T_o - T_i$ is $27,000.[24] We wish to compare this figure to the difference between the value of additional state tax payments by marginal in-state versus out-of-state students at public universities, which is *Difference*. However in our previous calculations of *Difference*, we used income at a point in time to proxy for the lifetime value of state tax payments. To evaluate eq. (9), we must convert income of marginal public university graduates at a point in time into an estimate of lifetime state tax payments by marginal graduates.

From table 2, in-state and out-of-state students at public universities who were in the lowest quintiles of SAT scores had incomes of $46,700 and $62,200, respectively, in 1996. To convert income at a point in time into an estimate of lifetime income, we use age-earnings data for college

[23] The tuition differentials are $1,298 for Miami Univ., $1,254 for Penn State, $2,534 for Univ. of Michigan, and $1,644 for Univ. of North Carolina.

[24] The discount rate adjustment is $e^{.02(18)} = 1.43.$

graduates from Murphy and Welch (1990) and standard mortality tables.[25] The resulting estimates of lifetime income are $2.0 million for in-state students and $2.6 million for out-of-state students. Suppose state *X*'s income tax rate is 5%, which is the approximately the average income tax rate for U.S. states.[26] Under this assumption, state *X* will collect $98,000 and $131,000 in lifetime tax revenues from marginal in-state and out-of-state students, respectively. Substituting these values, the right hand side of eq. (9) becomes *Difference* = $\Delta p_i(\bar{s}_i)\tau_i(\bar{s}_i) - \Delta p_o(\bar{s}_o)\tau_o(\bar{s}_o)$ = (.30)($98,000) – (.14)($131,000) = $11,000. Thus public universities' extra tuition charge for out-of-state students is more than sufficient to offset states for their loss of expected future tax revenue when a marginal out-of-state student rather than in-state student is admitted.

These results suggest that, while states gain more in expected additional state tax revenue when public universities admit a marginal in-state student over a marginal out-of-state student, they more than make up for the loss by charging out-of-state students higher tuition. As a result, states gain rather than lose financially when public universities admit marginal out-of-state students.

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

Now turn to the question of whether states have an interest in setting maximum as well as minimum cutoffs for in-state or out-of-state students. To investigate this issue, we re-calculate *Difference* for all five quintiles of the distribution of SAT scores. We do these calculations differently from those in table 2. Instead of calculating the components of *Difference* for each institution and then averaging across groups of institutions, we instead divide the overall distribution of SAT scores for all public universities into quintiles and do the calculations for students in each quintile.[27] We follow the same procedure for students at private universities. This procedure is used because we wish to address the general question of whether states gain when high ability students attend public or private universities within their borders, so that we abstract from

[25] Murphy and Welch (1990) report that earnings of college graduates increase by .743 during the first 10 years of labor market experience, increase by .293 during the next 15 years of experience, and decline by .098 during the next 15 years of experience. (See their table 9, p. 227.) Our figure for income is assumed to be for the 16th year of labor market experience. Because our data are for earnings rather than income, we also assume for convenience that earnings and income have the same pattern of change over time. We discount each year's income by the probability of death in that year, using mortality data from the Statistical Abstract of the U.S., 1998, 118th edition, table 130, p. 95. We did not apply a discount rate, since the figures for earnings growth are in real terms. The result is that lifetime income equals 42 times the value of income in 1996.

[26] We need to use the actual average state income tax rate. Perhaps add state sales tax payments?

[27] The SAT ranges for each quintile are <1040, 1040-1140, 1140-1230, 1230-1330, and >1330.

the characteristics of existing institutions. We report the results by in-state versus out-of-state students and by public versus private institutions.

Table 3 gives the results. Examine the top panel first. For in-state students at public universities, the increase in the probability of locating in their home states if they attend university there rather than elsewhere is .27 at the lowest quintile and declines to .17 at the highest quintile, although the decline is not monotonic. This decline presumably reflects the increase in the probability of students entering occupations with national or regional, rather than local, job markets as ability rises. The same decline occurs for out-of-state students who attend public universities, from .15 at the lowest quintile to .11 at the highest. The decrease from the lowest to the highest ability quintile is 37% for in-state students and 27% for out-of-state students.[28] Average income levels increase with ability, for both froups of students. The increase is from $51,000 to $77,900 for in-state students and from $63,400 to $90,800 for out-of-state students. But at every quintile, average incomes of in-state students are lower than average incomes of out-of-state students. This again suggests that in-state students who choose to attend public universities differ systematically from those who attend private university or attend university out-of-state.

Because the "pull" of attending university in state *X* decreases and average income increases as ability rises, these two effects offset each other and expected additional state tax payments by in-state and out-of-state students do not vary systematically with ability. The difference between them, or *Difference*, is always positive, but is unrelated to ability. It ranges from a minimum of $1,000 in the middle quintile to a maximum of $6,200 in the fourth quintile. Because *Difference* is always positive, states gain when in-state rather than out-of-state students are admitted to public

[28] We also ran a multi-nomial logit model explaining where students locate as adults, in which each student enters as 50 separate observations---one for each state. The independent variables are a dummy variable which equals one if the student's adult location is his/her home state, a dummy variable which equals one if the student's adult location is his/her college state, and a dummy variable which equals one if the student's adult location is both his/her home state and college state. The excluded category is the student's adult location being different from his/her home state or college state. We also interacted each of the dummy variables with dummy variables for SAT quintiles and we included state fixed effects. The results for $\Delta p_i(s_i)$ for Ohio residents, by quintile, are (lowest to highest): .23, .22, .16, .16, and .16 and the results for $\Delta p_o(s_o)$ are .06 for all five quintiles. Because we did not interact the dummy variables with the vector of state fixed effects, the results for other states are quite similar. In future work, we plan to add additional controls to the model which will capture other individual characteristics besides home and college state that affect graduates' location choices.

universities, regardless of students' ability levels. These results suggest that states have an interst in public universities restricting admission of out-of-state students, even out-of-state students that have very high ability levels.

Now turn to the bottom panel of table 3, which gives results for private universities. For in-state students, the increase in the probability of locating in their home states if they attend private university there rather than elsewhere is always between .19 and .21, except at the lowest quintile where it is .17. For out-of-state students, the figures are .07 at the lowest quintile and .10 at the three highest quintiles. Thus the "pull" of attending university in a particular state does not have a strong relationship to ability for either type of student. But it is always higher for in-state than out-of-state students---the same pattern as we found for public university students. Average income levels increase monotonically with ability for both in-state and out-of-state students and, unlike the pattern at public universities, there is little difference between the two types of students. The value of expected additional tax payments rises monotonically with ability for both types of students. For in-state students, the figures range from $11,900 at the lowest ability quintile to $18,300 at the highest. For out-of-state students, they range from $6,800 at the lowest ability quintile to $9,800 at the highest. *Difference* also rises with ability, from $6,850 at the lowest quintile to $9,800 at the highest. Since *Difference* is always positive, states gain when private universities admit in-state rather than out-of-state students, regardless of ability level.

Overall, these results suggest that states do not gain when higher ability rather than lower ability students attend public universities, within the ability range covered by our sample. Thus states do not have an incentive for their public universities to be highly selective. Because expected additional tax payments by in-state students are higher at all ability levels than those by out-of-state students, states have an interest in public universities admitting only in-state students, even if marginal out-of-state students have higher ability. However states' interest in private universities' admissions policies is different. States gain more in expected additional tax payments when in-state than out-of-state students attend private universities and they gain more when either type of student attends a private rather than a public university. They also gain more when private university students have higher rather than lower ability. Thus states have an interest in encouraging private universities to admit more in-state students, particularly in-state students of high ability. States also have a general interest in private universities being selective. These results suggest that states would gain by offering scholarships to in-state students to attend private

universities within the state and that states would gain by encouraging their private universities to become more selective.

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 taxes and contribute more to economic development. Universities have an interest in their graduates being successful, but little interest in where their students come from or where they goafter 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 benefit when universities set lower minimum admissions cutoffs for in-state than out-of-state students, because attending university in a particular state raises in-state students' probability of locating in that state after graduation by more than it raises out-of-state students' probability.

We test the predictions of the model for both public and private universities, using the Mellon Foundation *College & Beyond* dataset. We find that public universities consistently set lower minimum admissions cutoffs for in-state than out-of-state students and, surprisingly, that private universities also set lower admissions cutoffs for in-state students. This is consistent with public universities ignoring their states' preferences and acting like private universities, but it also suggests that further research is needed to understand how private universities gain from favoring in-state students.

We also find that states gain more in expected future tax revenues when marginal in-state students are admitted to public universities than when marginal out-of-state students are admitted. Although in-state students pay less in state taxes than out-of-state students of the same ability levels, this effect is more than offset by the fact that in-state students' probability of locating in the state as adults increases more than out-of-state students' when both groups attend public university. However we found that this difference is more than offset by the higher tuition charge for out-of-state students.

We also investigated whether states would gain from public universities setting maximum as well as minimum admissions cutoffs for in-state or out-of-state students, i.e., discouraging high ability students from attending. We found that states gain about the same amount when students of

high versus low ability attend public universities, but the gain is larger when in-state than out-of-state students attend. Thus states have an interest in public universities not being highly selective and in public universities restricting admission of out-of-state students, even when these students have high ability. However states' interest in private universities is different. States gain when private universities admit in-state students and their gain is higher when the in-state students have higher ability. Thus states would gain from offering high ability in-state students scholarships to attend private universities within the state.

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Figure 1

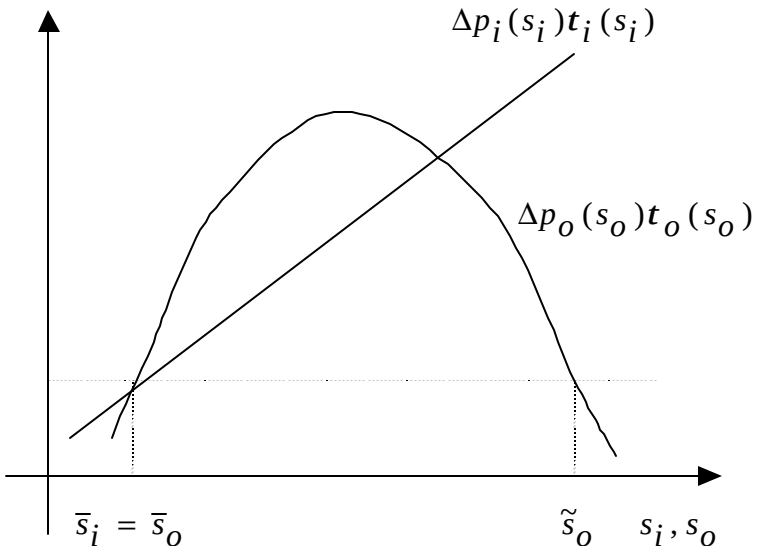

Table 1: **Tests of the Equal Cutoff Rule Using the Lowest Decile of Students**

	1976 cohort		1989 cohort	
	Public	Private	Public	Private
$(\bar{s}_o - \bar{s}_i)$ (mean)	37	25	41	46
$(\bar{s}_o - \bar{s}_i)$ (s.d.)	10	53	48	61
$(\bar{s}_o - \bar{s}_i)$ (min)	22	-78	-2	-112
$(\bar{s}_o - \bar{s}_i)$ (max)	44	139	108	165
Number of institutions	4	24	4	22
Proportion in-state	.81	.29	.76	.22

Table 2: **Calculations of The "Equal Additional Tax Payments Rule" Using the Lowest Quintile of Students**

	1976 cohort		1989 cohort	
	Public	Private	Public	Private
$p_i(\bar{s}_i)$	.60	.59	.70	.57
$p_i'(\bar{s}_i)$	.30	.37	.41	.47
$\Delta p_i(\bar{s}_i)$	.30	.22	.29	.10
$p_o'(\bar{s}_o)$	.15	.09	.15	.10
$p_o'(\bar{s}_o)$	.01	.01	.01	.01
$\Delta p_o(\bar{s}_o)$	.14	.08	.14	.09
$\boldsymbol{t}_i(s_i)$	$46,700	$71,500	$27,900	$28,500
$\boldsymbol{t}_o(s_o)$	$62,200	$75,200	$36,800	$28,800
Difference (mean)	$5,400	$9,300	$2,900	$300
Difference (s.d.)	$1,500	$4,100	$1,100	$500
Difference (min)	$4,000	$3,100	$1,800	-$300
Difference (max)	$7,400	$16,500	$4,200	$1,200

Table 3: **Tests of Whether States have an Interest in Setting Maximum Cutoff Levels**
1976 Cohort

Public Universities

	1 (lowest)	2	3	4	5 (highest)
$\Delta p_i(s_i)$	.27	.23	.15	.20	.17
$\Delta p_o(s_o)$	.15	.14	.10	.11	.11
$\tau_i(s_i)$	$51,000	$58,800	$62,800	$71,000	$77,900
$\tau_o(s_o)$	$63,400	$64,300	$84,300	$72,400	$90,800
$\Delta p_i(s_i)\tau_i(s_i)$	$13,770	$13,500	$9,400	$14,200	$13,200
$\Delta p_o(s_o)\tau_o(s_o)$	$9,500	$9,000	$8,400	$8,000	$10,000
Difference	$4,260	$4,522	$1,000	$6,236	$3,255

Private Universities

	1 (lowest)	2	3	4	5 (highest)
$\Delta p_i(s_i)$	.17	.19	.20	.21	.20
$\Delta p_o(s_o)$	.07	.08	.10	.10	.10
$\tau_i(s_i)$	$70,200	$75,700	$75,800	$83,300	$91,600
$\tau_o(s_o)$	$72,600	$77,500	$79,500	$82,300	$85,600
$\Delta p_i(s_i)\tau_i(s_i)$	$11,900	$14,350	$15,200	$17,500	$19,300
$\Delta p_o(s_o)\tau_o(s_o)$	$5,100	$6,200	$8,000	$8,200	$8,600
Difference	$6,852	$8,182	$7,210	$9,263	$9,760