GIVING OR GAINING? HOW THE ENROLLMENT OF OUT-OF-STATE GRANT AID RECIPIENTS IMPACTS SOCIOECONOMIC DIVERSITY AND REVENUE AT UNIVERSITIES

by

Carly Dotson

Submitted to the Distinguished Majors Program
Department of Economics
University of Virginia
April 27, 2022
Advisor: Sarah Turner

GIVING OR GAINING? HOW THE ENROLLMENT OF OUT-OF-STATE GRANT AID RECIPIENTS IMPACTS SOCIOECONOMIC DIVERSITY AND REVENUE AT UNIVERSITIES

Carly Dotson

Abstract

The enrollment of out-of-state students who receive need-based grant aid at public universities has markedly increased since the 2008-09 academic year. University enrollment behavior behind this increasing trend could be explained by either of two incentives that universities face. The first incentive is to increase socioeconomic diversity and maintain standing in academic rankings by enrolling low-income out-of-state students. The second is by raising revenue from students that can partially pay to attend college in response to the decline of other revenue sources such as foreign student enrollment and state appropriations. I provide evidence suggesting that out-of-state aid recipient enrollment does not increase socioeconomic diversity, while it does increase in response to a decline in foreign student enrollment. I estimate that between the 2008-09 and 2019-20 academic years, a decline in the enrollment of foreign students by 0.71% is associated with an increase in the enrollment of out-of-state aid recipients by 1.19%.

Acknowledgments: I would like to thank Sarah Turner for her invaluable guidance throughout this process, as well as Emily Cook for providing me with data access. I would also like to thank Amalia Miller and the DMP cohort for their helpful advice and encouragement.

Contents

1. Introduction

Out-of-state enrollment at public research universities has steadily risen from 2009 to 2020. The percentage of first-time full-time out-of-state students at public institutions has risen from 17.0% in the 2008-09 academic year, to 27.8% in the 2018-19 academic year.[1] The debate about the representation of out-of-state students at public universities usually focuses on the tradeoff between the additional revenue accrued by enrolling out-of-state students that pay the out-of-state tuition price, and the possibility of crowding out qualified in-state students, especially students from underrepresented groups (Jaquette et al., 2016). There is evidence that suggests public universities do treat out-of-state students as a means of generating revenue—prior research shows that public universities increase out-of-state enrollment when state appropriations decline (Jaquette & Curs, 2015). However, another concurrent phenomenon is an increase in the number of students who receive grant aid to attend public universities as out-of-state students. The percentage of out-of-state first-time full-time students at public research universities that have received grant aid from the state government, federal government, or the institution has increased from 58.4% in 2008-9 to 64.6% in 2018-19.[2] This raises the question of why universities are enrolling more out-of-state aid recipients who do not pay the full tuition price. This paper poses two possible explanations for this behavior on the part of institutions: the first is that universities are enrolling more out-of-state students who receive need-based aid to increase socioeconomic diversity and maintain their standing in academic rankings. The second

[1] Calculated using data from the Integrated Postsecondary Education System, National Center for Education Statistics.

[2] Public research universities are designated as such by the Carnegie Classification, which categorizes institutions into groups based on research activity. Public research universities consist of R1 and R2 universities, which are those with "very high research activity" and "high research activity," respectively.

is that universities are price discriminating such that they are still generating revenue by enrolling out-of-state students that can pay at least part of the out-of-state tuition cost.

In this paper, I first address the motivation for why universities would want to increase socioeconomic diversity from the pool of out-of-state students, and whether universities are providing substantial price discounts to low-income out-of-state students to make this a possibility. However, at many public universities, the financial aid offered to out-of-state low-income students is limited, making these institutions inaccessible to these students without significant borrowing. At the same time, the average public research institution would still generate more revenue by enrolling a middle-income student with some price discount than if they enrolled an in-state student who could pay the full in-state tuition price.

To capture university incentives, I present a model of the public university objective function which shows the tradeoffs among revenue generation and student characteristics that may impact institutional ranking. Empirical analysis linking enrollment patterns and pricing provides a test to distinguish among different explanations for the enrollment of out-of-state students who receive financial aid. I find that there is a statistically significant negative effect of the enrollment of out-of-state aid recipients on the enrollment of Pell grant recipients, and that public research universities are likely not enrolling out-of-state aid recipients to increase socioeconomic diversity. I find some evidence that public research universities are enrolling students to generate tuition revenue. A decline in foreign student enrollment, a known revenue source for public universities, is associated with an increase in the enrollment of out-of-state aid recipients, indicating that public universities enroll out-of-state aid recipients to make up for less revenue from international students. There is also a negative relationship between state

appropriations per student and out-of-state aid enrollment, but this result is not statistically significant.

2. Research Framework and Background

2.1 The Objective Function of Universities

The market of higher education is a complex one, characterized by a hierarchy of institutions differentiated by wealth and quality (Winston, 1999). Because most higher education institutions are nonprofits, the goals of colleges and universities are not equivalent to the profit maximization goal of a for-profit firm (Winston, 1999). The goals of institutions also differ by sector, since public colleges typically aim to provide educational access to in-state students (Winston, 1999). A unique characteristic of the higher education market is that it is a customer-input technology, such that the customer inputs, or "peer effects" of students who purchase an education are also inputs of production, and they therefore affect the quality of education themselves. Consequently, colleges and universities aim to recruit students by which they can maximize the "quality" of the student body (Winston, 1999). As described below, students contribute to the quality of education financially and academically.

The literature provides multiple variations on the theory of quality maximization. Epple, Romano, and Sieg (2006) maintain that school quality is a function of the ability of the student body, per-student expenditure, and the "relative mean income" of the student body. The mean income component represents universities' concern with increasing socio-economic diversity (Epple et al., 2006). Another model makes the distinction between the objective functions of public and private sector colleges (Epple et al., 2013). Private institutions seek to maximize quality as a function of student ability and per-student expenditure, while public institutions maximize the "aggregate achievement" or "future income" of in-state students (Epple et al.,

2013). Bound, Braga, Khanna, and Turner (2020) follow the Epple et al. (2006) and Epple et al. (2013) models, maintaining that the objective function for public schools is school quality as a function of the ability of the student body and per-student expenditure. Tuition revenue and state appropriations determine per-student expenditures (Bound et al., 2020). When considering the enrollment of out-of-state or international students, universities consider how overall school quality will change, as both student attributes and institutional resources impact university outcomes (Bound et al., 2020).

In summary, which students a university enrolls impacts the quality of education through peer effects and through revenue generated from tuition payments; students differ in how they impact these inputs. “Peer effects” can be defined by academic ability and by socioeconomic diversity. It is possible that universities enroll out-of-state aid recipients with these desired “student attributes” in order to generate these peer effects. Out-of-state aid recipients may be low-income Pell grant recipients that would contribute to the socioeconomic diversity of the student body. Out-of-state aid recipients may also be more academically qualified— the marginal out-of-state student may be more academically qualified than the marginal out-of-state full pay or in-state student. Alternatively, public universities may be using out-of-state aid recipients to maximize quality via tuition revenue by enrolling academically qualified out-of-state students that can pay part of the tuition price.

Evidence from Jaquette et al. (2016) casts some initial doubt on the former idea, since nonresident enrollment is associated with a decline in the enrollment of Pell grant recipients, particularly at selective public universities. Insights from Bound et al. (2020), and Jaquette and Curs (2015) suggest that the latter idea is more likely. Jaquette and Curs (2015) find a negative relationship between nonresident enrollment and state appropriations for the 2002-2003 and

2012-13 academic years. Using state-level appropriations as an instrumental variable for institution-level appropriations, Bound et al. (2020) find that public research universities enroll more foreign students as a response to declines in state appropriations. The demand for a U.S. college education has risen for foreign students able to pay the full out-of-state tuition price over time (Bound et al., 2020). However, this trend experienced a reversal from the 2018-19 school year to the 2019-20 school year – foreign undergraduate enrollment decreased by 13.6%.[3] Figure 1 shows the trend in foreign undergraduate and out-of-state aid enrollment over time. As Figure 1 illustrates, there is a corresponding increase in out-of-state aid enrollment as foreign undergraduate enrollment declines, indicating the possibility that as revenue from foreign enrollment declines, public research universities are seeking tuition revenue elsewhere.

2.2 Socioeconomic Diversity in Public Research Universities

Public research universities face an incentive to enroll a socio-economically diverse student body. Not only is it the mission of many public institutions to provide an affordable education to in-state students, but social mobility is a factor in the *US News and World Report's* overall ranking of colleges.[4] No prestigious public university would want the negative publicity that the University of Virginia received in a 2017 *New York Times* article titled "Virginia, Betraying Jefferson" by David Leonhardt, where UVA was cited as "one of the least economically diverse colleges in the country."

One may question why public research universities, who primarily serve in-state students, would seek to improve measures of socioeconomic diversity from the pool of out-of-state

[3] Calculated using data from the Integrated Postsecondary Education System, National Center for Education Statistics.
[4] *US News* incorporates a social mobility ranking of colleges, which takes into account the graduation rate and performance of Pell grant recipients at a higher education institution (Morse & Brooks 2021).

students. However, selective public universities also enroll a substantial number of out-of-state students from other states, due to their highly-regarded reputation (Cook, 2020). For example, 35 percent of first-time full-time students are from out-of-state at the University of Virginia, a highly-ranked public university by US News. By contrast, roughly 8 percent of first-time full-time students are from out-of-state at the less-selective Virginia Commonwealth University. Similarly, at The Ohio State University, another top-ranking public school, approximately 34 percent of first-time full-time students are from out-of-state. By comparison, at Ohio University, approximately 14 percent of first-time full-time students are from out-of-state.[5] The incentive to increase socioeconomic diversity, combined with the ability to enroll more out-of-state students, indicates the possibility that the increasing enrollment of out-of-state aid recipients may reflect the goals of selective public institutions to increase socio-economic diversity and maintain their standing in academic rankings. Corroborating anecdotal evidence comes from the University of Virginia, which recently established a scholarship fund that will go towards middle-income out-of-state students. The stated benefits of the program are the increase in cultural and socioeconomic diversity that the recipients of the scholarship will bring to the student body (Cocke, 2022).

2.3 Price Discrimination at Public Universities

There is evidence suggesting that universities price discriminate both to increase socioeconomic diversity and to increase revenue. Using administrative data from a private Midwestern university, Lawson and Zerkle (2006) find that both minority and high-ability low-income students receive more financial aid. Andrews and Stange (2016) find that after Texas

[5] Calculated using data from the IPEDS, for the 2018-19 academic year.

public universities were given the authority to set their own tuition prices, low-income students received more aid, and expenditures per student increased. Cook and Turner (2022) find that public research universities price discriminate progressively by family income for in-state students. This behavior by institutions has benefited in-state students from the lowest income groups, despite increasing tuition prices (Cook & Turner, 2022).

However, as Cook and Turner aptly put it, "recent pricing trends are unambiguously more generous for low-income students only if aid increases are coupled with steady or increasing low-income enrollment" (2022). If colleges are indeed enrolling out-of-state aid recipients who are low-income, then this would seem to be the case – out-of-state aid enrollment has been steadily increasing. Figure 2 shows the trend in the enrollment of Pell grant recipients and the enrollment of out-of-state aid recipients over time. Except for an increase from the 2016-17 academic year to the 2018-19 year, the enrollment of Pell grant recipients has been on the decline since 2012, as out-of-state aid enrollment has continued to increase. Figure 2 does not illustrate an unambiguous increase in low-income enrollment at public research universities as out-of-state aid enrollment has increased.

Rather, the increase in the level of out-of-state aid recipients may be explained by the fact that universities are enrolling out-of-state students above the Pell-eligibility threshold, who can pay part of the cost of attendance and still generate some revenue for the university. Prior evidence indicates that universities do price discriminate for this purpose. Waldfogel (2015) finds evidence of first-degree price discrimination at a graduate public university, which is associated with an increase in tuition revenue. Tiffany and Ankrom (1998) also find evidence of price discrimination at private universities for revenue purposes. An increase in the sticker price of attending a private institution is associated with an increase in enrollment and net revenue.

This suggests that private universities increase the sticker price to discount students with a lower willingness to pay, increasing overall enrollment and net revenue as a result (Tiffany & Ankrom, 1998). Similar evidence from Epple, Romano, Sarpça, Sieg, and Zaber (2019) indicates that the market power of private universities increases with quality, such that they are able to raise the sticker price of attendance, knowing that there is a group of high-income students who will pay the full price. The authors find that this additional revenue is used to give financial aid to high-need high-ability students, and to increase expenditure per-student (Epple et al., 2019). As will be discussed later in this paper, in addition to private universities, public research universities may also have the market power to price discriminate.

The theory and evidence described above also indicates that responsiveness to tuition differs across income groups. Curs and Singell (2010) use the net price of attending college to estimate enrollment elasticity by need, ability, and residency status at the University of Oregon. They find that out-of-state students in the middle of the need distribution are the most price responsive (Curs & Singell, 2010). Therefore, it stands to reason that engaging in price discriminating behavior that discounts middle-income out-of-state students would effectively increase the number of students enrolled from this demographic. As the next section will demonstrate, increased enrollment from this demographic is likely a means of generating revenue for public universities.

2.4 The Pricing Structure for Out-of-State Students

Figure 3 highlights the pricing behavior for a selection of public research universities. Figure 3 shows the net and sticker price of attendance by income, for both in-state and out-of-

state students, as well as the difference between net and sticker price for out-of-state students.[6] Across all of these universities, the net price of attendance for out-of-state students increases progressively by income. This could suggest universities' intent to make a college education more affordable for an out-of-state student. The University of North Carolina at Chapel Hill, the University of Virginia, and the University of Michigan all discount out-of-state low-income students by more than $40,000, which is above and beyond the federal aid they would receive from the Pell grant.[7] UVA and UNC in particular are unique in that they both have financial aid policies committed to meeting the financial need of low-income students.[8] But as this figure demonstrates, public research universities differ greatly in their generosity to out-of-state students. The University of Texas, the University of Iowa, and Pennsylvania State University only discount a Pell-eligible out-of-state student $4,482, $2,776, and $2,646 above the maximum Pell grant amount, respectively. A low-income student with a family income of $30,000 would have to pay $44,715 to attend Penn State. While an admitted low-income student might be able to afford an education at UVA, UNC, or perhaps the University of Michigan, financing an education at another out-of-state public university is infeasible. In fact, UVA and UNC are the only public universities with financial aid policies that commit to meeting 100% of demonstrated need of resident and nonresident students, and their aid to out-of-state students is the most generous out of this sample of universities.

[6] Data was collected using each institution's net price calculator. The net price of attending college is defined by the College Board as what the student must pay after all sources of financial aid are subtracted from the listed tuition price (Ma & Pender 2021).

[7] The maximum Pell grant amount awarded in the 2021-22 academic year was $6,495. Students eligible for the Pell grant in this academic year were those with an expected family contribution of $5,846 and below (https://fsapartners.ed.gov/knowledge-center/library/dear-colleague-letters/2021-01-22/2021-2022-federal-pell-grant-payment-and-disbursement-schedules).

[8] Founded in 2004, Both the AccessUVA and the Carolina Covenant programs at UVA and UNC are dedicated to meeting 100% of demonstrated financial need of students.

For public universities, students generate "net revenue" if their tuition payments exceed the per-student cost of providing education. For students who do not receive financial aid, it is unambiguous that out-of-state students bring in more revenue than in-state students, with this difference averaging about $25,531.66. To the extent that adding revenue is one motivation for enrolling out-of-state students, those out-of-state students that require aid beyond Pell grants may be less attractive than those who pay the full fare. Using data collected from federal net price calculators for a sample of 31 public research universities, Figure 4 also shows the average net price and sticker price of attendance, for both in-state and out-of-state students, as well as the difference between net and sticker price for out-of-state students by income across all institutions in the sample. Figure 4 illustrates that out-of-state students pay a higher net price than in-state students who pay the full price at all income levels. It is true that an out-of-state student with a family income of $70,000 raises approximately $6,063 less revenue than a full pay out-of-state student, but this student still raises roughly $19,468 more revenue than an in-state student paying the full tuition price.[9]

3. Model

Following the frameworks provided by Bound et al. (2020) and Tiffany and Ankrom (1998), I develop a model for which I can test my empirical analysis. In short, public universities

[9] The approximate per-student cost of providing education is calculated to be $43,294.63 for this sample of universities. This estimate was derived by calculating expenditures per full-time equivalent student ($52,983.26), and subtracting state appropriations per full-time equivalent student ($9688.623). According to this estimate, enrolling a full pay out-of-state student raises a net revenue of $12,820.62. Enrolling a full pay in-state student is not revenue generating, and universities instead incur a loss of $12,711.04. The net revenue was of an out-of-state student was calculated using the estimated net price of attendance ($45,052.04), and an assumed Pell grant award of $5,000 ($45,052.04 + $5,000 - $43,294.63 = $6,757.41). Estimates were calculated using IPEDS data on expenditures and state appropriations per full-time equivalent student. It should be noted that the estimate per-student cost is a rough estimate and likely does not account for other revenue sources such as endowments that would lower per-student cost. This exercise still illustrates how out-of-state aid recipients can raise more revenue than a full pay in-state student.

want to maximize the quality of education through expenditure per student (via tuition revenue and appropriations), and through student attributes. Public universities consider how the enrollment of an additional in-state, out-of-state, or international student will change the quality of education (Bound et al., 2020). Moreover, in this framework public institutions have the market power to price discriminate such that they engage in first-degree price discrimination. It is reasonable to assume that institutions can precisely determine a consumer's ability to pay for a good – when applying to college, applicants must submit financial aid information on family income and assets (Tiffany & Ankrom, 1998).

Following Bound et al. (2020), the objective function of public research universities in this model is to maximize the quality of education provided. The quality of education is a function of investment per-student (in the form of expenditures) and student attributes. The maximization problem of public research universities is that universities must consider the amount of educational investment and the enrollment of in-state, out-of-state, and foreign students such that quality is maximized (Bound et al., 2020). Public research universities consider the change in the quality that occurs when deciding whether to enroll another in-state, out-of-state, or international student (Bound et al., 2020).

The maximization problem of public research universities can be formally written as:

$$max_{I,K_s,K_O,K_f}, q(I,\theta),$$

where I is expenditure per student, θ is the average quality of the student body as determined by student attributes, K_s is the number of in-state students enrolled, K_o is the number of out-of-state students, and K_f is the number of international students enrolled.

As in Bound et al. (2020), the cost function includes the costs of increasing enrollment and "educational investments":

$$C(I, K_s, K_o, K_f) = \varphi(K_s, K_o, K_f) + \rho IK$$

This model relaxes the assumption of Bound et al. (2020), that public universities operate in a perfectly competitive market with private universities and therefore cannot price discriminate. Rather, I apply Tiffany and Ankrom's (1998) assumption for private universities to public ones – that public universities exist within a market structure of monopolistic competition and can therefore price discriminate for both in-state and out-of-state students by income. It is reasonable to assume that even though public universities are in competition with the private sector, they are still highly differentiated by quality, as well as by scale and amenities offered. Additionally, more resource-intensive public research universities are at least comparable in quality to private universities, and sometimes more so.[10] It is therefore also reasonable to assume that public universities have the market power to price discriminate. I assume that public research universities practice first-degree price discrimination with in-state and out-of-state students. I also assume that public research universities do not price discriminate with international students and only charge the sticker price, since international students often do not demonstrate financial need.[11]

Following the model of Tiffany and Ankrom (1998), I assume that public research universities face an inverse linear demand curve for in-state and out-of-state students. The demand of in-state students is the following:

[10] For example, the Association of American Universities (AAU) includes 64 leading research universities, 36 of which are public universities. These universities are considered to be more selective and resource-intensive.
[11] Bound et al. (2020a) find that institutional aid for students from China, who make up a substantial proportion of international student enrollment, was 3.5% of overall financial aid.

$$p(K_s) = p_s - mK_s$$

where p_s is the in-state sticker tuition price, and demand for out-of-state students is:

$$p(K_O) = p_O - mK_O$$

where p_O is the out-of-state sticker tuition price. These demand functions reflect the assumption of Tiffany and Ankrom (1998) that universities practice first-degree price discrimination such that one student pays the full price, and all other students pay the sticker tuition price minus a discount given them in the form of institutional grant aid, based on family income.

With these assumptions, the revenue function is the following:

$$Rev(K_s, K_o, K_f) = R(K_s) + \int_0^{K_s} (p_s - mx)dx + \int_0^{K_o} (p_0 - mx)dx + p_0 K_f$$

As in Bound et al. (2020), $R(K_s)$ is revenue from state appropriations, which is a function of the number of in-state students enrolled at the university. It is assumed that the state government will be more generous with funding if more in-state students are enrolled (Bound et al., 2020). Therefore, the optimization problem of the public research university is to enroll in-state, out-of-state, and international students in order to maximize the quality of education, subject to a budget constraint:

$$R(K_s) + \int_0^{K_s} (p_s - mx)dx + \int_0^{K_o} (p_0 - mx)dx + p_0 K_f = C(I, K_s, K_o, K_f) = \varphi(K_s, K_o, K_f) + \rho IK$$

Given this model of the public research university's optimization problem, I can derive the marginal benefit of enrolling an in-state, out-of-state, and international student, respectively.

The marginal benefit of enrolling an another in-state student is the increase in state appropriations and tuition revenue acquired:

$$MB_s = R'(K_s) + (P_s - mK_s)$$

The marginal benefit of enrolling an out-of-state student is the increase in tuition revenue acquired:

$$MB_o = P_o - mK_o$$

Finally, the marginal benefit of enrolling an international student is also the increase in tuition revenue acquired:

$$MB_o = P_o$$

As in Bound et al. (2020), when state appropriations decline, there is a "relatively higher return" to out-of-state and international enrollment, since nonresident tuition price is greater than in-state tuition. This model also indicates that the marginal benefit of enrolling an international student is always greater than enrolling an out-of-state student when universities price discriminate. If a public research university receives less state funding, and is faced with the decision of enrolling either an out-of-state student or an international student (of equal ability), then that university will enroll the international student. However, if this university cannot enroll any more international students, then enrolling an out-of-state aid recipient would be the next best alternative. This leads to the hypothesis that variation in the enrollment of international students will impact the enrollment of domestic out-of-state students who do not pay the full price.

4. Empirical Framework

In my empirical analysis, I use regressions with year- and institution-specific fixed effects to test my hypothesis – that public research universities are not enrolling out-of-state aid recipients to increase socioeconomic diversity, but are instead price discriminating to increase revenue. My regression analysis focuses on the relationship between out-of-state aid recipients and Pell grant recipient enrollment, and the response in out-of-state aid enrollment to changes in foreign-student enrollment and state appropriations. Any variables included in the analysis that are not proportions are logged.

For all three regression models, I use panel data of public research institutions, controlling for time-varying state-level covariates, year-, and institution-specific fixed effects. My first estimation model is as follows:

$$(1)\ y_{it} = \beta_0 + \beta_1 OSAid_{it} + X_{it}\lambda + \gamma_{it} + \delta_{it} + \varepsilon_{it}\ ,$$

where y_{it} is the proportion of first-time full-time students that receive Pell grant aid at institution *(i)* in year *(t)*, $OSAid_{it}$ is the proportion of first-time full-time students that are out-of-state aid recipients, X_{it} are time-varying state controls, γ_{it} are year-specific fixed effects, and δ_{it} are institution-specific fixed effects. By controlling for institution-specific fixed effects, the model controls for differences across institutions that do not change over time, and that could affect the dependent variable. The fixed effects model therefore focuses on the variation within each institution over time (Wooldridge, 2015). The model also controls for year-specific fixed effects to control for changes over time that could affect Pell recipient enrollment, both overall changes in demand for higher education and in the availability of financial aid (Bound et al., 2020; Jaquette et al., 2016). Following the approaches of Bound et al. (2020), Jaquette et al. (2016), and Kelchen (2021), the model incorporates state-level covariates to control for economic and demographic factors that could affect the enrollment of Pell grant recipients. This model controls

for the state population age 18-24 because differing college-age population sizes may affect the number of out-of-state students enrolled at a given university. States with fewer college-age individuals are more likely to enroll out-of-state students (Bound et al., 2020). I also control for the state poverty rate, the unemployment rate, and per capita income (adjusted for inflation), since these factors could also influence the enrollment of low-income students. Lastly, I include an indicator for whether the state governor is a democrat, since institutions in more liberal states may have missions more targeted towards enrolling low-income students. I also incorporate institutional controls that may also affect the enrollment of Pell grant recipients. Following the approach of Jaquette et al. (2016), the model controls for undergraduate enrollment, and average state, federal, and institutional aid. The tables below show results with and without these controls.

In this model, β_1 represents the change in the enrollment of Pell grant recipients associated with the change in out-of-state aid recipients. If institutions are enrolling out-of-state aid recipients to increase socioeconomic diversity, then β_1 will be positive, since Pell enrollment increases with out-of-state aid enrollment. If institutions are not enrolling out-of-state aid recipients to increase economic diversity, then the expectation is that there would be a negligible effect of out-of-state aid enrollment on Pell enrollment.

My estimation model for the response in enrollment of out-of-state aid recipients to changes in enrollment of foreign students is:

$$(2)\ y_{it} = \beta_0 + \beta_1 Foreign_{it} + X_{it}\lambda + \gamma_{it} + \delta_{it} + \varepsilon_{it}\ ,$$

where y_{it} is the proportion of out-of-state students that receive aid at institution *(i)* in year *(t)*, and $Foreign_{it}$ is the proportion of undergraduate students that are nonresident aliens. β_1 represents the change in the proportion of out-of-state students that receive aid associated with

the change in the enrollment of foreign students. If institutions are enrolling out-of-state aid recipients to increase socioeconomic diversity, then β_1 will be positive – institutions can afford to enroll more out-of-state low-income students with an increase in foreign students paying the full tuition price. If institutions are price discriminating for revenue purposes and are enrolling out-of-state students that can pay more than in-state students, then β_1 will be negative. If the enrollment of foreign students paying the full price declines, then institutions will enroll more out-of-state aid recipients. I incorporate the same control variables in this model as the one above.

The final estimation model for the response in enrollment of out-of-state aid recipients to changes in state appropriations is:

$$(3)\ y_{it} = \beta_0 + \beta_1 Appr_{it} + X_{it}\lambda + \gamma_{it} + \delta_{it} + \varepsilon_{it}\ ,$$

where y_{it} is the number of out-of-state students that receive aid at institution *(i)* in year *(t)*, and $Appr_{it}$ is the amount of state appropriations per student afforded to the institution. Both the dependent and independent variables are logged to generate an easily interpretable coefficient. I incorporate the same state controls as in the previous two models, and I also control for the number of international students enrolled, to account for the idea that institutions will enroll out-of-state aid students in response to state appropriations when they cannot enroll any more international students.

A positive β_1 would indicate that an increase in state appropriations is associated with an increase in out-of-state aid recipients. This would suggest that institutions use additional revenue from state appropriations to enroll out-of-state students with financial need, subsequently increasing socioeconomic diversity. A negative β_1 would suggest that public research institutions

increase the enrollment of out-of-state aid recipients as a response to lost revenue from state appropriations.

5. Data

The main data source used for this empirical analysis comes from the Integrated Postsecondary Education Data System (IPEDS). This source contains surveys conducted by the National Center for Education Statistics (NCES).[12] This analysis uses three survey modules from IPEDS: the Student Financial Aid and Net Price, Fall Enrollment, and Finance Modules, for the 2008-09 academic year to the 2019-20 academic year. The unit of observation is the institution, and my analysis contains 145 institutions and 1,673 observations. My main analysis is restricted to four-year public research universities, since these universities have greater resources and more access to students outside of their state. I also include non-research universities as a comparison to the main group of interest.

The key variable of interest, the number of out-of-state students who receive state, local, federal, or institutional grant aid, comes from the Student Financial Aid and Net Price Module. Since this variable is not directly reported by institutions, I backed out this variable using two reported components from the survey. Specifically, I subtracted the number of first-time full-time students paying the in-state tuition price who received grant aid from the total number of first-time full-time students who received grant aid, in order to estimate the number of first-time full-time out-of-state grant aid recipients. This survey module also reports the number of first-time full-time Pell grant recipients at each institution (resident and nonresident students).

[12] The NCES is an agency within the U.S. Department of Education's Institute of Education Sciences, that collects and publishes data on education in the U.S.

I also used the Student Financial Aid and Net Price Module to calculate the total number of first-time full-time out-of-state students enrolled. In this module, institutions report the number of first-time full-time students who pay the "out-of-state" tuition price. However, this variable is not an accurate proxy for out-of-state students enrolled at an institution. Some colleges and universities have more than two tuition prices, due to regional exchange programs. For example, some universities are part of tuition reciprocity agreements with other states. Such universities often have tuition rates for in-state, out-of-state, international, and tuition reciprocity students. The latter category of students often pays a tuition price close to, but different from, the in-state price. It is up to these institutions to decide whether to report non-resident students participating in a reciprocity agreement as paying the in-state or out-of-state tuition price, when in fact they are paying a different price altogether. Some institutions decide to report participants in tuition reciprocity agreements as paying the out-of-state tuition price, while others report them as paying the in-state price. However, the main concern is that some institutions do not report this group of students in either category.[13] To circumvent this reporting issue, I estimate the number of first-time full-time out-of-state students by subtracting the number of first-time full-time students paying the in-state tuition rate from the total number of first-time full-time students.

As mentioned above, the key variable of interest is the number of out-of-state students who receive state, federal, or institutional grant aid. This includes both need- and merit-based

[13] This reporting issue came to my attention when I noticed that the number of out-of-state aid recipients exceeded the total number of out-of-state students at some institutions. I discovered the reason for the data discrepancy described above after contacting institutions directly to find out how they report their data. As described above, the issue is that some institutions do not report tuition reciprocity participants as paying either the in-state or out-of-state rate, while these students are still reported in other categories, such as in the total number of students who receive aid. Based on the responses I received from institutions, this problem does not also occur with international students, as they are consistently reported in the out-of-state tuition category.

aid. For public research universities, the mean percentage of state, federal, and institutional aid that is need-based is 80.5%, 97.9%, and 60.9% respectively.[14]

Data on the number of undergraduate foreign students comes from the Fall Enrollment survey. State appropriations data comes from the Finance survey.[15] State appropriations are funding afforded to institutions by the state government. The data for state controls used in my analysis come from various sources. Undergraduate enrollment and average institutional, state, and institutional grant aid comes from the IPEDS Student Financial Aid and Net Price Survey. The state unemployment rate comes from the Bureau of Labor Statistics. The state poverty rate and the population age 18-24 come from the U.S. Census Bureau. Per capita income data (adjusted for inflation) comes from the Bureau of Economic Analysis. Finally, data on whether the state governor is a democrat comes from the University of Kentucky Center for Poverty Research National Welfare Data.

6. Results

6.1 The Effect of Out-of-State Aid Recipient Enrollment on Pell Recipient Enrollment:

Table 3 shows the OLS with fixed effects regression results of Pell enrollment on out-of-state aid enrollment with and without the additional state and institutional controls. Results are also shown for R1 and R2 universities separately, as well as for non-research universities. The results indicate that an increase in the enrollment of out-of-state aid recipients by one percentage point at an institution is associated with a decrease in the enrollment of Pell grant recipients by

[14] Data on need-based aid comes from The Institute for College Access and Success' College Insight data source. Need-based aid is defined as the "amount of grant aid used to meet the calculated need for degree-seeking undergraduates." Merit aid is defined as grant aid awarded that is in excess of calculated need.
[15] Special thanks to Dr. Emily Cook at Tulane University for sending me the state appropriations data. State appropriations are in 2019 dollars.

0.0771 percentage points at that institution. On average, the enrollment of out-of-state aid recipients increased by 22.9% from 2009 to 2020. An increase in the enrollment of out-of-state aid recipients by 22.9% at the average university is therefore associated with a 1.8% decrease in the enrollment of Pell grant recipients. My interpretation of this result is consistent with the findings of Jaquette et al. (2016), who find that increasing enrollment of nonresident students crowds out low-income students. My results suggest that this crowd-out effect may also be explained by out-of-state aid recipients. In summary, these results suggest that public research universities are not enrolling out-of-state aid recipients to increase socioeconomic diversity.

At R1 universities specifically, there is a negligible and statistically insignificant effect of out-of-state aid recipients on Pell recipient enrollment, while there is a statistically significant negative effect at R2 universities. This suggests that the crowd-out effect captured in the main regression estimation is concentrated at R2 universities. The explanation behind these results may be that higher-resourced R1 institutions do not enroll out-of-state aid recipients at the expense of Pell grant recipients, while they do at R2 universities. While results differ for R1 universities, there is still no evidence that public research universities enroll out-of-state aid recipients to increase socioeconomic diversity. It is important to note that the evidence from Table 3 is descriptive, since I do not assume that the variation in out-of-state aid recipient enrollment is exogenous.

6.2 The Effect of Foreign Enrollment on Out-of-State Aid Enrollment

Table 4 shows the regression results of the enrollment of out-of-state aid recipients on the enrollment of foreign undergraduates. An increase in the proportion of undergraduate students that are foreign students by 1 percentage point is associated with a decrease in the proportion of out-of-state students that receive grant aid by approximately 1.670 percentage points. On

average, foreign undergraduate enrollment declined by 0.71% from 2019 to 2020. A decrease in foreign enrollment at the average public research university by 0.71% is associated with an increase in the enrollment of out-of-state aid students by 1.19%. These results are consistent with my hypothesis that public research universities are price discriminating by income and enrolling out-of-state students that can pay enough of the out-of-state tuition price to still generate more revenue than they would by enrolling an in-state student. These results suggest that as the enrollment of foreign students paying the full nonresident price declines, universities enroll more out-of-state aid recipients to make up for lost revenue. This negative effect persists at R1 and R2 universities, but not at non-research universities, which is consistent with evidence from Bound et al. (2020) that non-research universities have little access to a wider market of students, out-of-state and abroad.

In an alternative specification, I use the proportion of first-time full-time students that are out-of-state aid recipients instead of the proportion of total out-of-state students as the dependent variable (Table 6 in the appendix). I find that there is a smaller, but still negative relationship between foreign enrollment and out-of-state aid recipient enrollment. However, my results lose statistical significance after adding state and institutional controls. This may be due to the fact that the proportion of first-time full-time students is relatively small even as it has increased over time. While this may cast some doubt on my results, the statistically significant relationship between the proportion of out-of-state students that receive grant aid and foreign enrollment does suggest that institutions resort to enrolling out-of-state students that can pay part of the tuition price. As less foreign students enroll, and there are no more able nonresident students who can pay the full price that can be enrolled, then institutions enroll more out-of-state students that can pay part of the tuition price to raise revenue. I interpret the results from Table 4 as causal, since it

is reasonable to assume that foreign student enrollment is exogenous and determined by outside factors such as visa policies and exchange rates.

6.3 The Effect of State Appropriations on the Enrollment of Out-of-State Aid Recipients

Table 5 shows the regression results for the response of both the enrollment of out-of-state aid recipients and of out-of-state students who pay the full tuition price to changes in state appropriations. There is a negative, but statistically insignificant effect of state appropriations per student on out-of-state aid enrollment at research universities. There is a statistically significant negative effect of state appropriations on out-of-state full pay enrollment at public research universities, but there are no statistically significant results for R1 and R2 universities separately. Overall, there is inconclusive evidence that public research universities enroll out-of-state students, full pay and not full pay, as a response to declines in state appropriations.

There is a statistically significant negative effect of state appropriations on out-of-state aid enrollment at R1 universities after adding state and institutional controls. This suggests the possibility that the most resource-intensive universities do respond to declines in state appropriations by increasing out-of-state aid enrollment. To further test this, I ran an additional regression analysis to see if these results held for all public AAU universities, the most resource-intensive public schools, but there is no statistically significant effect (Table 7 in the appendix). In consequence, the statistically significant negative effect of state appropriations on out-of-state aid enrollment at R1 universities should be taken with caution.

7. Conclusion

To review, the two likely explanations for why public research universities have increasingly enrolled out-of-state aid recipients from the 2008-09 to the 2019-20 academic years

are to either increase socioeconomic diversity or to increase revenue by price discriminating. However, there is no evidence that the increasing enrollment of out-of-state aid recipients is explained by an aim to increase socioeconomic diversity. At R1 universities, there is no statistically significant effect of out-of-state aid recipient enrollment on Pell grant recipient enrollment, suggesting that out-of-state aid recipients are not low-income students. Results also indicate that the more resource-constrained R2 universities may be enrolling out-of-state aid recipients at the cost to low-income students, and that they are redistributing resources that would aid in low-income enrollment in order to recruit out-of-state students. An idea for future research would be to inquire further into these results.

Descriptive evidence from university-specific net price calculators supports the idea that public research universities are price discriminating to raise revenue, and suggests that enrolling an out-of-state aid recipient who does not pay the full tuition price does raise more net revenue than an in-state student who does pay the full tuition price. This idea is further supported by evidence that public research universities enroll more out-of-state aid recipients in response to declines in international student enrollment. This is consistent with my model and hypothesis that when public universities cannot enroll any more qualified international students, there is a relatively higher return to enrolling an out-of-state aid recipient that can pay part of the tuition price.

The absence of a statistically significant effect of state appropriations per student on out-of-state aid enrollment is an unexpected result that is inconsistent with the predictions of the model above. One possible explanation may be that since universities will likely only enroll an out-of-state aid recipient if they cannot enroll another qualified full pay out-of-state or international student, universities may only enroll a small number of out-of-state aid recipients in

response to declining state appropriations. As a consequence, out-of-state aid enrollment may only be directly impacted by foreign student enrollment.

There are multiple limitations of this analysis of out-of-state aid recipient enrollment at public universities. To begin with, there are several endogeneity concerns with regard to the OLS regression equations above. The first is that there may be other time-varying institutional characteristics that are related to the enrollment of out-of-state aid recipients, Pell grant recipients, foreign students, or the amount of state appropriations granted to institutions, that are not accounted for with the included control variables. One example is that there may be universities that have changed their non-resident enrollment caps over time (Kelchen, 2019). Increasing the maximum number of nonresident students that can be enrolled, or removing the limit altogether could explain changes in the enrollment of nonresident students and any changes in state appropriations at a university (presumably, eliminating nonresident enrollment caps may displease the state legislature and result in lower appropriations). Additionally, there may be reverse causality concerns. Bound et al. (2020) point out that colleges and universities may be punished with lower appropriations amounts due to greater international and out-of-state enrollment.

While time constraints limited the ability to address the endogeneity concerns of an OLS approach, one way in which these limitations could be addressed would be to use state-level appropriations as an instrumental variable for institution-level appropriations, since state-level appropriations likely would not directly affect out-of-state aid enrollment (Bound et al., 2020). With regard to the effect of foreign student enrollment in particular, a way to address the endogeneity concerns of OLS would be to exploit the exogenous shock from the Covid pandemic on foreign student enrollment once additional years of data become available.

There are also multiple data limitations. The primary limitation is that institutions self-report this data. As described earlier, institutions reported the number of students paying out-of-state tuition according to different definitions. I was able to address this particular issue in the data, but it may also be the case that universities also report other data according to different definitions. Another limitation is that international students could be counted in the out-of-state aid recipient variable. Therefore, any measured effect of out-of-state aid enrollment explained by foreign enrollment may not capture the change in domestic out-of-state enrollment. For this analysis, I must assume that the proportion of out-of-state aid recipients that are international students is not meaningfully large enough to affect the results. A way in which this limitation could be addressed in further research would be to obtain data on the number of foreign students enrolled at public research institutions who receive grant aid. One potential source would be data on F-1 visa recipients (Bound et al., 2020). Another data limitation more difficult to address is that Pell grant recipient enrollment may not accurately capture measures of diversity that institutions would want to increase. While the fact that the socioeconomic diversity criterion in the *US News* ranking is based on Pell grant recipients does make it likely that universities would focus attempts to increase socioeconomic diversity through the enrollment of Pell grant recipients, universities may still be enrolling out-of-state aid recipients to capture other kinds of diversity, such as geographic diversity, or socioeconomic diversity from students above the Pell-grant eligibility threshold. Finally, another limitation is that the key variable of interest, out-of-state aid recipients, is restricted to first-time full-time students. The results therefore may only apply to this group of students, and may not be generalizable to a university's overall enrollment behavior. Data on all undergraduate out-of-state students who receive grant aid does not

currently exist; addressing this limitation would require institutions to start reporting this data for all students.

In conclusion, this analysis is the first to examine the enrollment of out-of-state aid recipients at public research universities. Evidence from this analysis suggests that in addition to nonresident and international students that pay the full tuition price, universities are increasingly tapping into a market of less affluent, but still revenue-generating, group of out-of-state students in order to meet their financial goals. Future research should further examine both the explanations behind increasing out-of-state aid recipient enrollment, and the resulting outcomes.

References

Andrews, R., & Stange, K. (2016). Price regulation, Price Discrimination, and Equality of Opportunity in Higher Education: Evidence from Texas (Working Paper No. 22901; Working Paper Series). *National Bureau of Economic Research.* https://doi.org/10.3386/w22901

Bound, J., Braga, B., Khanna, G., & Turner, S. (2020). A Passage to America: University Funding and International Students. *American Economic Journal: Economic Policy*, *12*(1), 97–126. https://doi.org/10.1257/pol.20170620

Cocke, W. (2022). New Middle-Income Scholarship Helps Out-of-State UVA Students. *UVA Today*. https://news.virginia.edu/content/new-middle-income-scholarship-helps-out-state-uva-students

Cook, E. (2020). Competing Campuses: An Equilibrium Model of the U.S. Higher Education Market. Working paper, University of Virginia.

Cook, E., & Turner, S. (2022). Progressivity of pricing at US public universities. *Economics of Education Review*, *88*, 102239.

Curs, B. R., & Singell, L. D. (2010). Aim high or go low? Pricing strategies and enrollment effects when the net price elasticity varies with need and ability. *Journal of Higher Education*, *81*, 515–543.

Epple, D., Romano, R., & Sieg, H. (2006). Admission, tuition, and financial aid policies in the market for higher education. *Econometrica 74*, no. 4: 885-928.

Epple, D., Romano, R., Sarpça, S & Sieg, H. (2013). The US Market for Higher Education: A General Equilibrium Analysis of State and Private Colleges and Public Funding Policies. No. w19298. *National Bureau of Economic Research*

Epple, D., Romano, R., Sarpça, S., Sieg, H., & Zaber, M. (2019). Market power and price discrimination in the US market for higher education. *The RAND Journal of Economics, 50*(1), 201-225.

Jaquette, O., & Curs, B. R. (2015). Creating the out-of-state university: Do public universities increase nonresident freshman enrollment in response to declining state appropriations? *Research in Higher Education, 56*(6), 535-565. https://doi.or g /10.10 07/s11162 - 015 - 93 62 -2

Jaquette, O., Curs, B. R., & Posselt, J. R. (2016). Tuition rich, mission poor: Non-resident enrollment and the changing proportions of low-income and underrep-resented minority students at public research universities. *The Journal of Higher Education, 87*(5), 635-673. https://doi.org/10.1080/00221546.2016.11777417

Kelchen, R. (2019). Do Nonresident Students Affect Prices for In-State Students at Public Colleges? *Teachers College Record, 121*(2), 1-27.

Kelchen, R. (2021). An Exploration of Nonresident Student Enrollment and Institutional Finances at Public Universities. *Journal of Postsecondary Student Success, 1*(1), 81-105.

Lawson, R., & Zerkle, A. (2006). Price discrimination in college tuition: an empirical case study. *Journal of Economics and Finance Education, 5*(1), 1-7.

Leonhardt, D. (2017, September 18). Virginia, Betraying Jefferson. *New York Times.* https://www.nytimes.com/2017/09/18/opinion/university-virginia-uva-mar-a-lago.html.

Ma, J., & Pender, M. (n.d.). Trends in college pricing and student aid 2021. Retrieved December 17, 2021, from https://research.collegeboard.org/pdf/trends-college-pricing-student-aid-2021.pdf

Morse, R., & Brooks, E. (2021, September 12). How U.S. News Calculated the 2022 Best Colleges Rankings. *usnews.com*. https://www.usnews.com/education/best-colleges/articles/how-us-news-calculated-the-rankings

The Institute for College Access & Success, College Insight, https://college-insight.org. College-level student debt and undergraduate financial aid data © 2020 Peterson's LLC, all rights reserved.

Tiffany, F. G., & Ankrom, J. A. (1998). The competitive use of price discrimination by colleges. *Eastern Economic Journal, 24*(1), 99-110.

U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS). (2009-2020). Student Financial Aid and Net Price [Data File]. Retrieved from https://nces.ed.gov/ipeds/.

U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS). (2009-2020). Finance [Data File]. Retrieved from https://nces.ed.gov/ipeds/.

U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS). (2009-2020). Fall Enrollment [Data File]. Retrieved from https://nces.ed.gov/ipeds/.

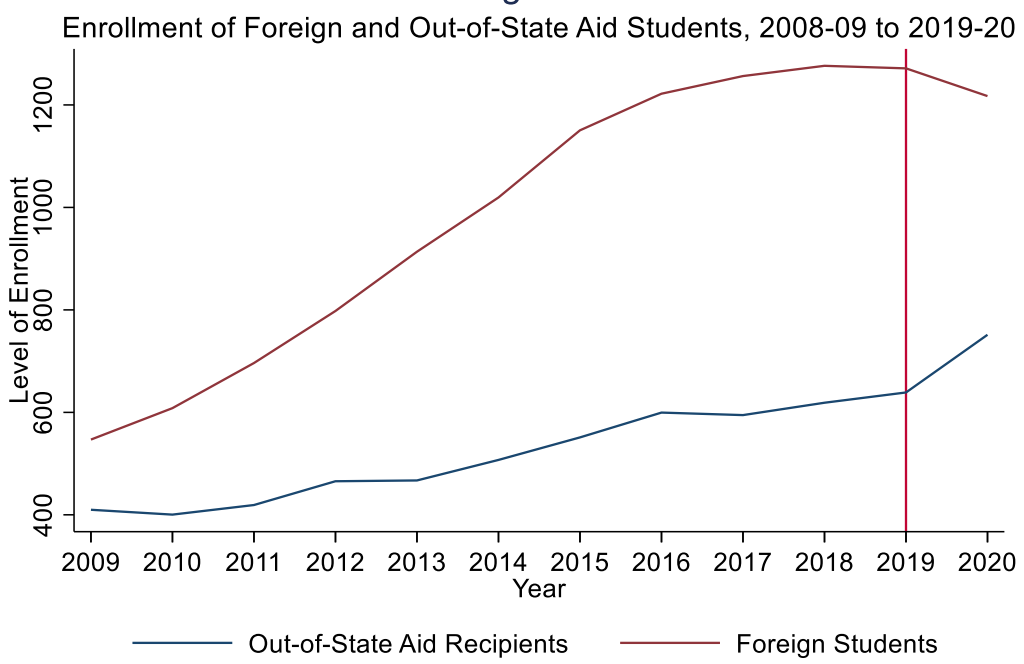
U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS). (2020). 12-Month Enrollment [Data File]. Retrieved from https://nces.ed.gov/ipeds/.

Waldfogel, J. (2015). First degree price discrimination goes to school. *The Journal of Industrial Economics, 63*(4), 569-597.

Winston, Gordon, C. (1999). Subsidies, Hierarchy and Peers: The Awkward Economics of Higher Education. *Journal of Economic Perspectives*, *13* (1): 13-36.DOI: 10.1257/jep.13.1.13

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Cengage learning.

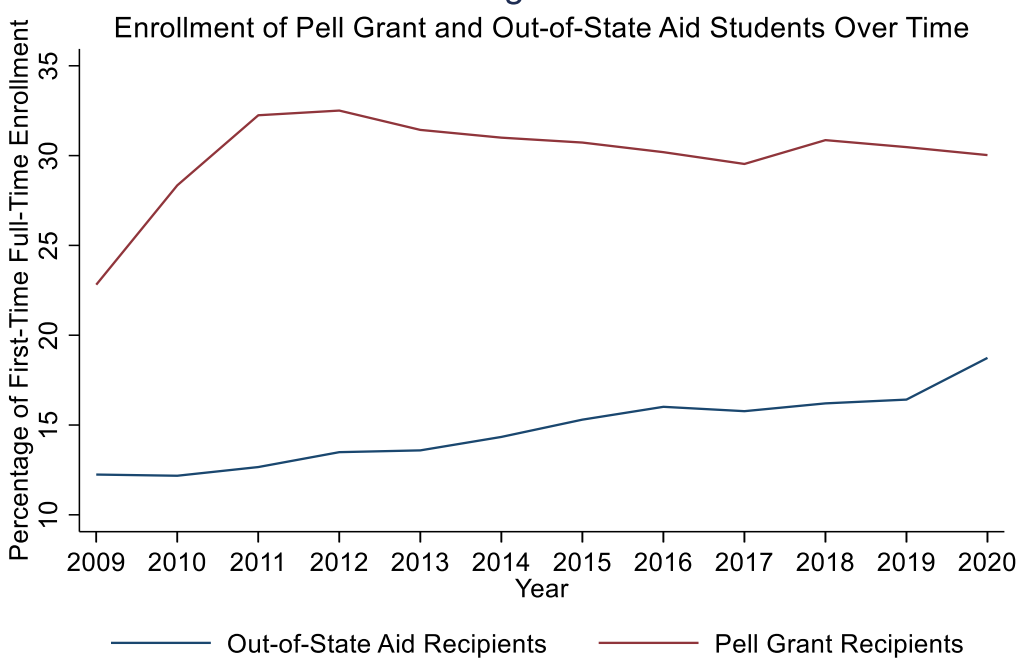
Figure 1



Note: This figure shows the enrollment of first-time full-time out-of-state aid recipients and undergraduate foreign students over time at public research universities. Public research universities are designated as such by the Carnegie Classification, which categorizes institutions into groups based on research activity. Public research universities consist of R1 and R2 universities, which are those with "very high research activity" and "high research activity," respectively. Labeled years refer to the end of the academic year (ex. The 2008-09 academic year is labeled as 2009).

Source: IPEDS Enrollment and Student Financial Aid and Net Price surveys.

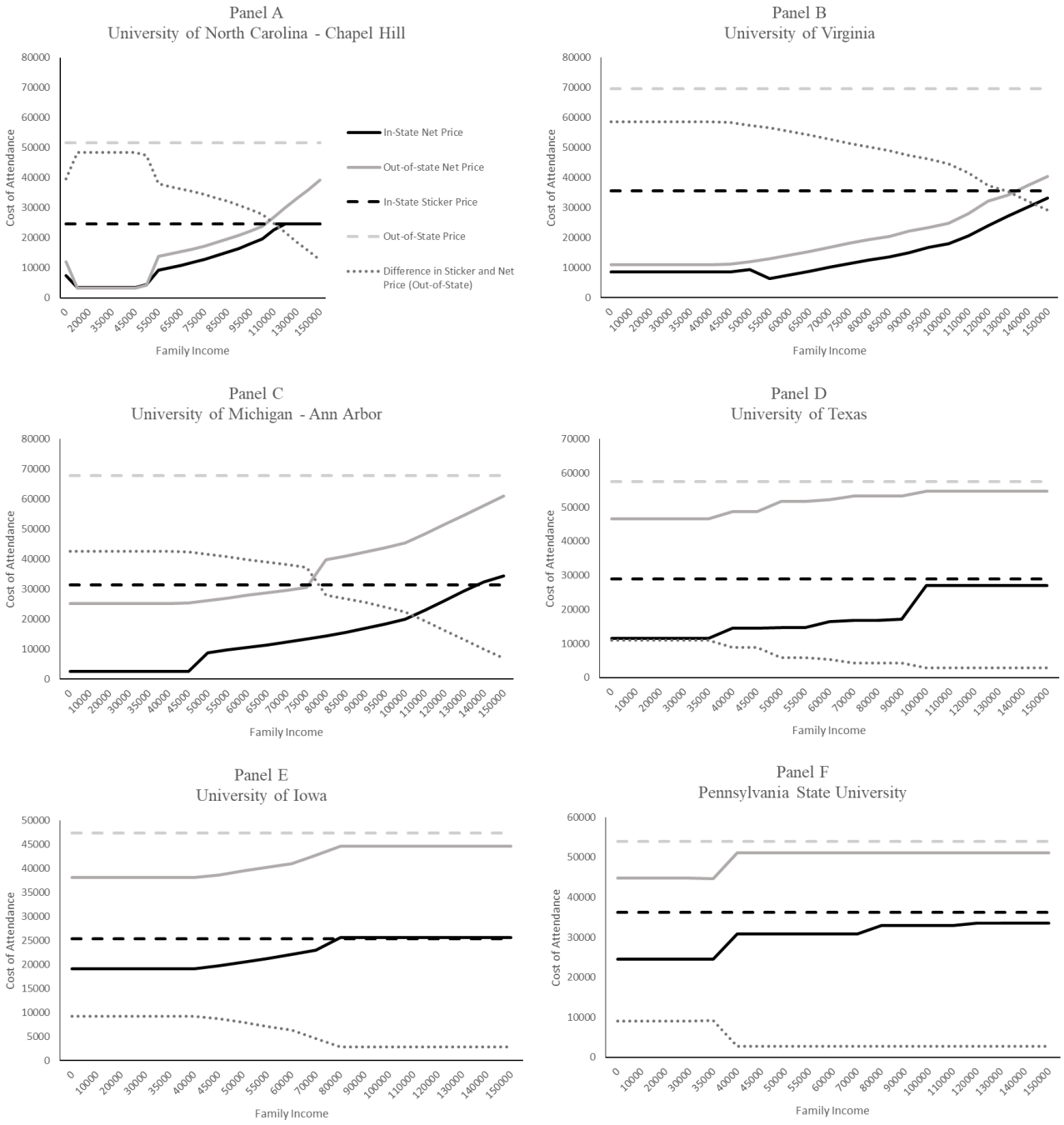
Figure 2



Note: This figure shows the enrollment of first-time full-time out-of-state aid recipients and first-time full-time Pell grant recipients over time at public research universities. Labeled years refer to the end of the academic year.

Source: IPEDS Student Financial Aid and Net Price Surveys.

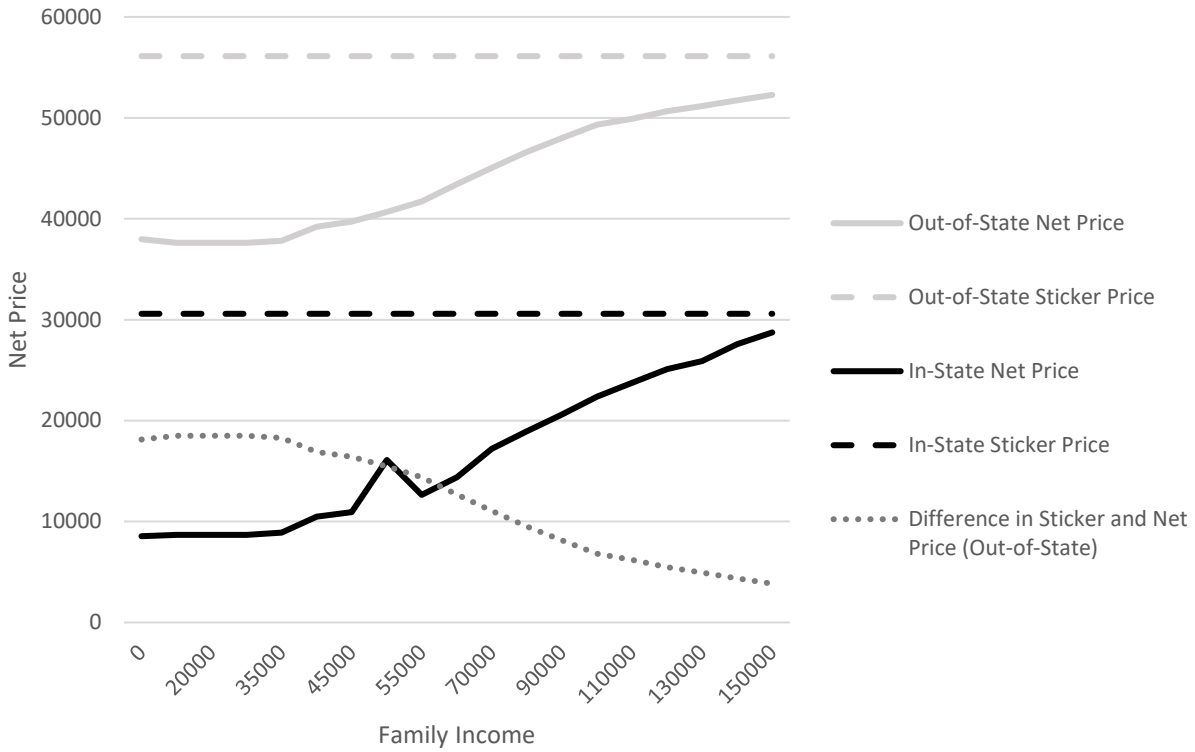
Figure 3



Note: This panel of figures shows the estimated net price and sticker price of attending college by income, for in-state and out-of-state students. The figures also show the difference between the out-of-state sticker price and net price for out-of-state students.

Source: Estimates were calculated using institution-specific net price calculators using the following parameters: Student date of birth in 2002, U.S. Citizen, oldest parent date of birth in 1977, family of four with only one member college age, parents are married, student has never been married, student has no income or assets. Net price estimates are for the 2021-22 year.

Figure 4
Net Price of Attending College, by Family Income



Note: This figure shows the average estimated net price and sticker price of attending college by income, for in-state and out-of-state students. Estimates are averaged using a sample of 31 public research universities. All schools in the sample are members of the American Association of Universities (AAU). These universities are considered to be more selective and resource-intensive. Net price estimates are for the 2021-22 academic year.

Source: Calculated using institution-specific net price calculators.

Table 1: Means for Selected Years

	Type of Public University			
2008-09	Research	R1	R2	Non-Research
Number of In-State Students	2,660	3,486	1,965	1,224
Number of Out-of-State Students	752.5	960.3	577.6	176.0
Number of Foreign Undergraduates	604.3	809.5	426.1	210.3
Number of Pell Grant Recipients	723.0	835.2	627.3	440.9
Number of In-State Grant Aid Recipients	1,804	2,301	1,386	795.1
Number of Out-of-State Aid Recipients	404.6	467.8	350.6	96.65
In-State Tuition and Fees	$24,218.0	$25,205.0	$23,389.0	$21,112.2
Out-of-State Tuition and Fees	$38,737.0	$42,277.5	$35,763.3	$30,627.5
State Appropriations per Student	$10,930.00	$12,616.00	$9,517.00	$7,385.00
2018-19	Research	R1	R2	Non-Research
Number of In-State Students	2,971	3,836	2,130	1,281
Number of Out-of-State Students	1,070	1,489	662.7	169.9
Number of Foreign Undergraduates	1,258	1,873	650.0	260.7
Number of Pell Grant Recipients	1,121	1,322	925.8	640.5
Number of In-State Grant Aid Recipients	2,233	2,795	1,685	1,001
Number of Out-of-State Aid Recipients	637.7	799.9	480.0	123.8
In-State Tuition and Fees	$27,327.70	$28,195.90	$26,483.00	$23,776.20
Out-of-State Tuition and Fees	$44,019.80	$48,020.60	$40,127.10	$33,610.90
State Appropriations per Student	$8,998.00	$10,580.0	$7,459.0	$7,191.0

Note: This table shows selected means for the 2008-09 and 2018-19 academic years by institution type. The tuition and fee variables are adjusted for inflation using the Higher Education Price Index (HEPI) in 2019 dollars. State appropriations are also in 2019 dollars.

Source: Data comes from the IPEDS Student Financial Aid and Net Price, Enrollment, and Finance surveys.

Table 2: Descriptive Statistics, 2008-09 to 2019-20

Panel A: Research Universities	Number of Universities	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Undergraduate Foreign Enrollment/Total Undergraduate Enrollment	145	1,673	0.0472	0.0346	0	0.194
Out-of-State Aid Enrollment/Out-of-State Enrollment			0.591	0.237	0	1
Out-of-State Aid Enrollment/Total First-Time Full-Time Enrollment			0.148	0.123	0	0.754
Out-of-State Full Pay Enrollment/Out-of-State Enrollment			0.409	0.237	0	1
State Appropriations Per Student			$9,007	$4,558	$72.50	$31,533
Panel B: R1 Universities	**Number of Universities**	**Number of Observations**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Undergraduate Foreign Enrollment/Total Undergraduate Enrollment	73	869	0.0560	0.0412	0	0.194
Out-of-State Aid Enrollment/Out-of-State Enrollment			0.551	0.279	0	4.244
Out-of-State Aid Enrollment/Total First-Time Full-Time Enrollment			0.140	0.107	0	0.516
Out-of-State Full Pay Enrollment/Out-of-State Enrollment			0.449	0.279	0.006	1
State Appropriations Per Student			$10,737.00	$5,227	$72.50	$40,062
Panel C: R2 Universities	**Number of Universities**	**Number of Observations**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Undergraduate Foreign Enrollment/Total Undergraduate Enrollment	74	889	0.0366	0.0225	0	0.148
Out-of-State Aid Enrollment/Out-of-State Enrollment			0.701	0.402	0	5.455
Out-of-State Aid Enrollment/Total First-Time Full-Time Enrollment			0.155	0.134	0	0.754
Out-of-State Full Pay Enrollment/Out-of-State Enrollment			0.299	0.402	0	1
State Appropriations Per Student			$7,581	$4,129	$745.40	$31,533
Panel D: Non-Research Universities	**Number of Universities**	**Number of Observations**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Undergraduate Foreign Enrollment/Total Undergraduate Enrollment	276	3,125	0.0259	0.0294	0	0.354
Out-of-State Aid Enrollment/Out-of-State Enrollment			0.580	0.290	0	1
Out-of-State Aid Enrollment/Total First-Time Full-Time Enrollment			0.0883	0.105	0	0.702
Out-of-State Full Pay Enrollment/Out-of-State Enrollment			0.420	0.290	0	1
State Appropriations Per Student			$6,823	$3,471	$164.70	$39,445

Note: This table shows descriptive statistics for selected variables, from 2008-09 to 2019-20 by institution type.

Source: Data comes from the IPEDS Student Financial Aid and Net Price, Enrollment, and Finance surveys. State appropriations are in 2019 dollars.

Table 3: Estimates of the Effect of the Enrollment of Out-of-State Aid Recipients on the enrollment of Pell Grant Recipients

	Research		R1		R2		Doctoral/Masters	
Pell Grant Recipients (proportion of FTFT)	OLS	State Controls	OLS	State Controls	OLS	State Controls	OLS	State Controls
Out-of-State Aid Recipients (proportion of FTFT)	0.0775**	-0.0771***	-0.0269	-0.0127	-0.112*	-0.131***	-0.0648	-0.0312
	(0.0381)	(0.0217)	(0.0318)	(0.0280)	(0.0658)	(0.0404)	(0.0531)	(0.0463)
Constant	0.236***	0.772	0.202***	0.397	0.271***	0.467	0.347***	-2.306**
	(0.00471)	(0.512)	(0.00487)	(0.592)	(0.00858)	(0.940)	(0.00489)	(1.129)
Observations	1,671	1,166	844	584	827	582	3,015	2,120
R-squared	0.402	0.557	0.374	0.526	0.415	0.593	0.405	0.544
Number of Universities	149	149	76	76	85	85	309	304
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows coefficients from a regression of the proportion of first-time full-time students that are Pell grant recipients on the proportion of first-time full-time students that are out-of-state aid recipients by type of institution. Pell grant enrollment includes resident and nonresident first-time full-time students. The regressions include year and institution fixed effects, and the "State Controls" column includes state-level and institution-level controls: state population age 18-24, state poverty rate, state unemployment rate, per capita income (adjusted for inflation), whether the governor is a democrat, undergraduate enrollment, and average state, federal, and institutional aid. OLS estimates without state controls are clustered at the university level, and OLS estimates with state-level controls are clustered at the state level.

Source: Data comes from the IPEDS Student Financial Aid and Net Price Survey. Data for the state control variables comes from the Bureau of Labor Statistics, the U.S. Census Bureaus, the Bureau of Economic Analysis, and the University of Kentucky Center for Poverty Research National Welfare Data.

Table 4: Estimates of the Effect of Foreign Student Enrollment on the Enrollment of Out-of-State Aid Recipients

	Research		R1		R2		Doctoral/Masters	
Out-of-State Aid Recipients (proportion of Total Out-of-State Students)	OLS	State Controls	OLS	State Controls	OLS	State Controls	OLS	State Controls
Foreign Student Enrollment (proportion of FTFT)	1.674***	-1.670***	2.060***	-1.784**	-0.968	-1.354*	0.581	-0.0748
	(0.439)	(0.549)	(0.439)	(0.738)	(0.930)	(0.768)	(0.491)	(0.545)
Constant	0.610***	1.848	0.581***	3.777	0.621***	1.777	0.504***	-8.822
	(0.0289)	(2.493)	(0.0345)	(4.462)	(0.0501)	(3.241)	(0.0216)	(5.315)
Observations	1,671	1,166	844	584	827	582	3,015	2,120
R-squared	0.153	0.127	0.199	0.151	0.128	0.141	0.136	0.104
Number of Universities	149	149	76	76	85	85	309	304
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows coefficients from a regression of the proportion of first-time full-time out-of-state students that are aid recipients on the proportion of undergraduate students that are foreign students by type of institution. The regressions include year and institution fixed effects, and the "State Controls" column includes state-level and institution-level controls: state population age 18-24, state poverty rate, state unemployment rate, per capita income (adjusted for inflation), whether the governor is a democrat, undergraduate enrollment, and average state, federal, and institutional aid. OLS estimates without state controls are clustered at the university level, and OLS estimates with state-level controls are clustered at the state level.

Source: Data comes from the IPEDS Fall Enrollment and the Student Financial Aid and Net Price Surveys. Data for the state control variables comes from the Bureau of Labor Statistics, the U.S. Census Bureaus, the Bureau of Economic Analysis, and the University of Kentucky Center for Poverty Research National Welfare Data.

Table 5: Estimates of the Effect of State Appropriations on on the Enrollment of Out-of-State Aid Recipients and Out-of-State Full Pay Students

Panel A: Out-of-State Aid Recipients

	Research		R1		R2		Doctoral/Masters	
Log(Out-of-State Aid Recipients)	OLS	State Controls	OLS	State Controls	OLS	State Controls	OLS	State Controls
Log(State Appropriations per Student)	-0.236	-0.118	-0.0548	-0.231*	-0.349	-0.0656	-0.0473	0.0852
	(0.177)	(0.0906)	(0.183)	(0.134)	(0.284)	(0.112)	(0.156)	(0.176)
Constant	7.625***	8.213	6.166***	6.936	8.398***	14.07	4.522***	1.572
	(1.633)	(9.072)	(1.742)	(15.82)	(2.561)	(11.50)	(1.363)	(12.10)
Observations	1,554	1,114	766	551	788	563	2,879	2,027
R-squared	0.166	0.186	0.244	0.251	0.115	0.191	0.014	0.034
Number of Universities	146	146	73	73	86	86	305	300
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel B: Out-of-State Full Pay Students

	Research		R1		R2		Doctoral/Masters	
Log(Out-of-State Fullpay Students)	OLS	State Controls	OLS	State Controls	OLS	State Controls	OLS	State Controls
Log(State Appropriations per Student)	-0.161	-0.210*	-0.275	-0.112	-0.275	-0.229	-0.304**	-0.308**
	(0.135)	(0.118)	(0.201)	(0.164)	(0.201)	(0.169)	(0.149)	(0.130)
Constant	6.738***	-10.81	7.226***	-18.14	7.226***	-12.07	6.369***	-14.19
	(1.244)	(12.20)	(1.823)	-15.93	(1.823)	(18.63)	(1.322)	(14.90)
Observations	1,525	1,096	763	551	763	545	2,688	1,926
R-squared	0.028	0.135	0.051	0.247	0.051	0.088	0.060	0.073
Number of Universities	146	146	85	73	85	85	302	296
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: Panel A of this table shows coefficients from a regression of the enrollment of first-time full-time out-of-state aid recipients on state appropriations per student (in 2019 dollars) by type of institution. Panel B shows coefficients from a regression of the enrollment of first-time full-time out-of-state students who pay the full tuition price on state appropriations per student by type of institution. The regressions include year and institution fixed effects, and the "State Controls" column includes the same state-level and institution-level controls as in Tables 4 and 5, as well as foreign undergraduate enrollment. OLS estimates without state controls are clustered at the university level, and OLS estimates with state-level controls are clustered at the state level.

Source: Data comes from the IPEDS Student Financial Aid and Net Price Survey. Data for the state control variables comes from the Bureau of Labor Statistics, the U.S. Census Bureaus, the Bureau of Economic Analysis, and the University of Kentucky Center for Poverty Research National Welfare Data.

Appendix

Table 6: Estimates of the Effect of Foreign Student Enrollment on the Enrollment of Out-of-State Aid Recipients

Out-of-State Aid Recipients (proportion of FTFT)	OLS	State Controls
Foreign Student Enrollment (proportion of FTFT)	-0.332**	0.0112
Constant	-0.142 0.0792*** -0.00964	-0.137 0.996 -1.066
Observations	1,673	1,166
R-squared	0.296	0.211
Number of Universities	150	149
Institution FE	YES	YES
Year FE	YES	YES

Note: This table shows coefficients from a regression of the proportion of first-time full-time students that are out-of-state aid recipients on the proportion of undergraduate students that are foreign students at public research universities. The regressions include year and institution fixed effects, and the "State Controls" column includes state-level and institution-level controls: state population age 18-24, state poverty rate, state unemployment rate, per capita income (adjusted for inflation), whether the governor is a democrat, undergraduate enrollment, and average state, federal, and institutional aid. OLS estimates without state controls are clustered at the university level, and OLS estimates with state-level controls are clustered at the state level.

Source: Data comes from the IPEDS Fall Enrollment and the Student Financial Aid and Net Price Surveys. Data for the state control variables comes from the Bureau of Labor Statistics, the U.S. Census Bureaus, the Bureau of Economic Analysis, and the University of Kentucky Center for Poverty Research National Welfare Data.

Table 7: Estimates of the Effect of State Appropriations on on the Enrollment of Out-of-State Aid Recipients, AAU Universities

Log(Out-of-State Aid Recipients)	OLS	State Controls
Log(State Appropriations per Student)	0.184	-0.180
	(0.308)	(0.201)
Constant	4.209	-14.79
	(2.945)	(32.29)
Observations	372	268
R-squared	0.165	0.312
Number of Universities	34	34
Institution FE	YES	YES
Year FE	YES	YES

Note: This table shows shows coefficients from a regression of the enrollment of first-time full-time out-of-state aid recipients on state appropriations per student (in 2019 dollars) at AAU universities. The regressions include year and institution fixed effects, and the "State Controls" column includes the same state-level and institution-level controls as in Tables 4 and 5, as well as foreign undergraduate enrollment. OLS estimates without state controls are clustered at the university level, and OLS estimates with state-level controls are clustered at the state level.

Source: Data comes from the IPEDS Student Financial Aid and Net Price Survey. Data for the state control variables comes from the Bureau of Labor Statistics, the U.S. Census Bureaus, the Bureau of Economic Analysis, and the University of Kentucky Center for Poverty Research National Welfare Data.