Pricing and University Autonomy: The Case of Tuition Deregulation in Texas[*]

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Abstract

This paper investigates changes in tuition policies in the wake of tuition deregulation in Texas, which transferred tuition-setting authority from the state legislature to institutions in 2003. We find that price increases accelerated across the state following this sharp change in tuition-setting authority, particularly at the most selective institutions. Institutions also began differentiating price by undergraduate program, raising relative prices for the most costly and lucrative majors, including engineering, business, and architecture. Price increases were particularly large for those institutions with the greatest initial cost and for selective programs within institutions, though lower for institutions with more low-income students. This suggests that public postsecondary institutions respond to microeconomic incentives when given greater autonomy to set price, while also taking some measures to alleviate impacts on low income students. The Texas experience suggests that decentralized price-setting generates greater price differentiation within the public higher education system, both across and within institutions.

Keywords: Tuition, Deregulation, College Pricing

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I. Introduction

Colleges are increasingly being judged by the value they provide to their students, as critics point to skyrocketing tuition, low graduation rates, and poor job prospects of recent graduates. Lawmakers and policy-makers at many levels have joined this chorus of criticism and have been introducing ways to hold colleges more accountable for their value. The Obama Administration has proposed tying federal financial aid to different measures of value and many states have introduced performance-based funding. However, diminished direct state support for higher education has made it difficult for colleges to maintain, much less improve, the quality of their programs. In fact, Bound, Lovenheim, and Turner (2010) found that much of the decline in graduation rates since the 1970s can be traced to reductions in educational resources and enrollment shifts to less-resourced sectors.

Declines in state support have also raised affordability concerns as many institutions have responded by raising tuition. Although shifting costs to students via tuition increases would be a way to compensate for lost state revenue, this option is limited for many public colleges and universities that possess limited flexibility to set prices. The responsibility for setting tuition is left to individual institutions in only ten states, while state legislatures or other broad government boards have primary authority in the others (SHEEO, 2011). This pattern is changing, however, as a handful of states (Florida, Virginia, Texas) decentralized tuition-setting authority in some way recently, and lawmakers in New York, Washington, Ohio, and Wisconsin have considered doing so (McBain, 2010; Deaton, 2006; Camou & Patton, 2012; Marley & Herzog, 2015).

In this paper we study the experience of public universities in the state of Texas, which underwent an enormous change in pricing control in 2003 when tuition-setting authority was transferred from the state legislature to the governing board of each public university. Texas represents a particularly good setting to examine the topic of deregulation due to its institutional diversity and the scope of the policy changes.

Despite the policy relevance and potential impacts on access and affordability, there is little evidence on how public institutions alter their tuition levels or policies when given more autonomy over

tuition-setting. Much prior research on university pricing has focused on private, particularly elite, institutions (Clotfelter, 1996; Ehrenberg, 2001; Epple, Romano, & Sieg, 2005) and has generally not focused on tuition-setting structures. The limited analysis of the public sector that has examined tuition-setting and governance structures has been very mixed. Lowry (2001a) found that tuition at public universities is higher when there are multiple governing boards in a state, Rizzo and Ehrenberg (2004) found no relationship, and McLendon, Hearn, and Hammond (2013) found that tuition is lower in states with more governing boards. Since the number of governing boards in each state varies little over time, each of these studies essentially relies on the cross-sectional relationship between state governance structures and tuition levels, which may be subject to various forms of bias.[1] Flores and Shepard (2014) recently examined the effect of tuition deregulation at seven Texas institutions, finding that institution-level price accelerated but effects on enrollment of underrepresented minority students was mixed.

To this prior work, we make three contributions. First, we focus on a sharp change in the financial independence of public universities specifically as it relates to tuition-setting authority, rather than focusing on cross-sectional relationships between general measures of governance structure and tuition levels. Examining tuition changes around a known policy change and for a fixed set of institutions eliminates many sources of bias inherent in previous cross-sectional work. Second, in addition to studying institution-level price variation (as done in the prior literature), we also examine program-specific prices within institutions. This program-specific analysis is enabled by novel data about pricing practices at a program level within institutions, which we assembled from numerous historical and archival sources. Third, we focus broadly on public four-year colleges and universities in the state, rather than on private institutions or selective public flagships. This is important as the majority of college students attend public four-year colleges outside the flagships.

[1] Rizzo and Ehrenberg (2004) do use panel data, but omit governing board measures from their longitudinal analysis presumably because they do not change much over time. McLendon et al (2013) include several measures of governance structure (including number of governing boards) in longitudinal analysis that includes institution fixed effects, but they do not explicitly assess the extent to which governing board measures actually change over time, which is necessary for identification.

Our analysis proceeds in two parts. First we compare the experience of Texas to other states using institution-level data and a difference-in-differences approach. We find that price increases accelerated across the state in the wake of deregulation. In fact, the raw price gap between public universities in Texas and elsewhere closed in the years following deregulation. Event study estimates suggest that college prices in Texas were trending similarly to those in other states in the years leading up to deregulation, but diverged immediately afterwards. Relative price growth was particularly large at the most selective institutions and was not fully offset by additional grant aid, thus Texas college students' net price increased considerably. We next look within Texas, comparing price growth across institutions and programs. We find that price increases were particularly large for those institutions with the greatest initial costs, for high-cost fields, and for the most selective programs within institutions. Institutions with many low-income students experienced lower price growth and additional grant aid also offsets some of the price growth for low-income students. This suggests that institutions respond to microeconomic incentives when setting prices, while also taking measures to somewhat mitigate impacts on low-income students. One implication is that deregulation results in much greater differentiation within the public higher education system. The equity and efficiency consequences of these price changes hinge on how they altered the sorting of students into programs, changed institutional capacity, and impacted program quality. A necessary first step to answering these normative questions is to simply document and understand how institutions alter pricing practices when given full autonomy to do so.

This paper is organized as follows. The next section provides background on the higher education system in Texas, the policy change we study, and prior literature. Section III introduces a conceptual framework for understanding university price-setting. Section IV uses institution-level data to compare the experience of Texas to other states. Section V introduces our new data on program-specific prices and reports how these prices are altered following deregulation. We conclude in Section VI with a discussion of the potential equity and efficiency consequences of deregulation.

II. Background

A. Higher Education in Texas

Texas has a large and diverse public higher education system, with 39 four-year colleges, which range from very selective top research universities to relatively unselective regional campuses. As in many other states, these institutions have historically relied heavily on state appropriations as the main source of funding. In 2000, state appropriations accounted for 38% of the revenue at four-year institutions, followed by tuition (18%)[2] (South Regional Education Board, 2013), though appropriations have been declining in Texas for last five years (Palmer, 2013).

State appropriations in Texas are determined by a funding formula that reimburses institutions a fixed rate for the number of weighted semester credit hours its students earn. Weights vary across five academic levels and twenty discipline areas, with weights determined by cost differences.[3] Importantly, weights within these level-discipline cells are the same across all institutions; a flagship institution receives the same appropriation for a lower-division liberal arts course as a less selective institution, despite potentially investing more resources in this course. Thus institutions whose students would demand (or benefit from) a greater level of investment in a given discipline-level will find it difficult to do so, as this spending would not be reimbursed.

Higher tuition and fees is one way that institutions could potentially fund greater levels of investment than is supported by the state. Historically, however, tuition and fees in Texas were controlled quite closely by the state legislature. Tuition at public universities consists of Statutory and Designated tuition (THECB, 2010b). Statutory tuition is a tuition charge authorized under Texas Education Code (TEC) 54.051, which is a fixed rate per credit hour that differs only by residency status, but is otherwise constant across institutions. Designated tuition is a charge authorized by TEC 54.0513 that permits institutions to impose an additional tuition charge that the governing board of the institution deems

[2] In 2005, state appropriations accounted for 24.6% of the revenue at four-year institutions, and tuition accounted for 19.2%.

[3] The five levels include lower division undergraduates, upper division undergraduates, graduate students, doctoral students, and professional students. The twenty discipline areas are liberal arts, science, fine arts, teacher education, agriculture, engineering, home economics, law, social sciences, library sciences, development education, vocational training, physical training, health services, pharmacy, business administration, optometry, teacher education practice, technology, nursing, and veterinary medicine. Weights are normalized to 1.00 for lower division liberal arts courses, and are updated every few years (THECB, 2010a).

appropriate and necessary. Designated tuition was previously known as a "Building Use Fee," and was intended to permit institutions with greater costs to capture some of that cost through fees. Though designated tuition charges were determined by institutions, the legislature historically capped designated tuition at the level of statutory tuition.

In addition to the statutory and designated tuition, universities were allowed to charge mandatory and course fees. Under TEC 55.16, amended in 2001, all public institutions were allowed to charge extra fees for costs that are associated with services or activities. Mandatory fees are charged to a student upon enrollment to provide services available to every student. On the other hand, course fees include fees charged for students enrolled in a particular course, or discretionary fees for students participating in a special activity.

B. Tuition Deregulation

Due to the economic downturn, the state decreased revenue appropriations in 2002 (Hernandez, 2009). With leadership from the state's research-intensive universities, particularly University of Texas and Texas A&M system, many institutions advocated for more flexibility in setting tuitions in this time of reduced state support. The UT system leadership argued that the traditional tuition model did not provide sufficient pricing options for the array of services offered and did not adequately consider variation across institutions in terms of market demand, types of programs offered or the national prominence of these programs (UT System, 2008). The argument was that tuition flexibility would permit not only maintenance of existing levels of service, but would increase institutional agility to anticipate and meet state-wide educational and economic development needs. Institutions would be able to actively engage in enrollment management using the market forces of supply and demand. Furthermore, the advocates insisted that tuition deregulation will improve institutional performance as the market-driven pricing models encourage students to take higher course loads and minimize exposure to tuition escalation.

In September 2003, the legislation passed HB 3015, which modified TEC 54.0513 to allow governing boards of public universities to set different designated tuition rates, with no upper limit.

Furthermore, the amount can vary by program, course level, academic period, term, and credit load and any other dimension institutions deem appropriate.

The major concern about tuition deregulation was that large tuition increases may create financial burdens for low-income students. Thus, tuition deregulation came with a requirement that 20% of the proceeds from Texas resident undergraduate rates greater than $46 per SCH be set aside to provide financial assistance to students (HB 3015).[4] In addition, the legislature mandated that every institution participating in tuition deregulation had to meet performance criteria and show progress toward the goals outlined in the Texas master plan for higher education (McBain, 2010).

C. Prior Evidence

Most of the previous research on college price-setting has examined the determinants of institution-level price, focusing on state appropriations, federal and state aid programs, market pressure, and governance structures.[5]

State appropriations. Given the significant dependence of public institutions on public subsidizes, several researchers have investigated how state context matters for public institutions' pricing (e.g., Hearn, Griswold, & Marine, 1996; Kane, 1999; Paulsen, 2000; Toutkoushian & Hollis, 1998). Studies have found that declines in state support were followed by increases in in-state tuition in subsequent years (Koshal & Koshal, 2000). Lowry (2001) found that less state funding for public institutions led to higher net tuition revenue, but the reverse was not true. Rizzo and Ehrenberg (2004) also found that higher state appropriations per students are associated with lower tuition, though the elasticity is far from unity.

The impact of state finance on tuition might be mediated by institutional characteristics. McLendon, Hearn, and Hammond (2013) found that as state appropriation increases, tuition at public flagships grows more slowly. Factors such as proportion of out-of-state students also influences tuition

[4] Of the 20%, 5% funds the Texas B-On-Time Loan Program, which is a no-interest loan and the entire loan amount can be forgiven upon graduation if students graduate with a minimum of B grade GPA. The remaining 15% is allocated for each institution's need-based financial aid.

[5] There is also a very long literature on the effects of tuition increases on student enrollment and success, which is indirectly relevant here in that students' enrollment responses should influence institutions' pricing decisions. For a recent overview of this literature, see Kane (2006). Shin and Milton (2008) and Stange (2014) examine program-specific enrollment responses to price.

level. Rizzo and Ehrenberg (2004) also showed that schools with higher Barron's selectivity rankings, higher endowment per student, higher ratio of graduate to undergraduate students, and higher seating capacity charge more in-state undergraduate tuition.

Federal and state aid. Several studies have investigated whether institutions capture the benefits of federal and state aid programs by increasing tuition; the so-called "Bennett Hypothesis." Private selective institutions do capture some of the benefits of Pell grants via higher net tuition, though public institutions do not appear to do so (Singell & Stone, 2007; Turner, 2012). Long (2004) found that the Georgia HOPE scholarship decreased tuition at public institutions by 3%, while increasing it at private institutions by about 5%. The author explains these different patterns by the limited flexibility of public schools to raise tuition and the nature of the scholarship. Rizzo and Ehrenberg (2004) found somewhat mixed results on state merit-aid programs, depending on the states. Yet, this study showed that more generous Pell grant and federal subsidized loans significantly increased in-state tuition.

Market structure. Hoxby (1997) presents the most comprehensive study on the changing market structure of higher education and its implication for institution quality and price. Using changes in several exogenous factors as instruments (telecommunications, travel costs, use of standardized admissions tests, tuition reciprocity agreements), she found that market expansion resulted in greater vertical differentiation, higher average quality, and increased average price as students increasingly sorted based on ability. Colleges also increased subsidies to high ability students, whose input quality is high.

This study and several others found significant differences between public and private institutions in response to market changes; the increase in tuition and subsidizes being most significant at "elite" private institutions (Clotfelter, 1996). One explanation is that public institutions' ability to change tuition in response to market forces is often constrained by state policies and political pressures. While institutions aggressively seek resources, various pressures from local governments, interest groups, alumni, governing boards, and appointment and evaluation of leaderships can also impact pricing decisions (Ehrenberg, 2001).

Governance structure. In light of these observed differences between public and private institutions and the vast differences in public institutions across states, several researchers have also examined governance structures as a mediating factor. Lowry (2001) found that in the states where public universities have more financial autonomy, tuition and fee revenues tend to be higher. On the contrary, Rizzo and Ehrenberg (2004) found no evidence for the relationship between autonomous governance structures and higher tuition. This finding is echoed by McLendon, Hearn, and Hammond (2013), who found that having a weak governing board (a measure of institutional autonomy) had no significant association with tuition prices. A limitation of prior work on governance structures is that such structures rarely change over time. Previous work may thus conflate the effects of governance structure per se with other state-level factors that are correlated with it.

Program-specific pricing. Almost all previous research on price-setting has focused on factors that determine overall institution-level price, with no analysis of price differences across programs within institutions. This is surprising as many institutions have turned to "differential tuition" to maintain program quality in the face of diminished state appropriations. Differential pricing is particularly compelling for costly majors and for those that lead to jobs with higher economic returns (Ward & Douglass, 2005; Heller, 2006; Mortenson, 2004; Ehrenberg, 2007). Only recently have these practices been documented on a national scale. In a broad survey of 165 public research universities, Nelson (2008) found that 45% of schools have at least one undergraduate program with differential tuition or fees in 2008, with most implementing them in the past decade. Many others, such as the University of California System, have recently considered such a scheme. Differential pricing by level, independent of major program, is rarer, but still present at some institutions (Simone 2010, Ehrenberg, 2012). A recent survey found a continuation of this trend: Ehrenberg (2012) reports that 42% of all public doctoral institutions had some form of tuition differential in 2010-2011, as did many public masters and bachelors-level public institutions (18% and 30%, respectively), with steady growth since the mid-1990s (Cornell Higher Education Research Institute, 2012). In survey responses, campus administrators perceived that differential tuition increased tuition revenue, but did not perceive any effects on total enrollment or

enrollment by major (Nelson, 2008). The increased tuition revenue is allocated to colleges or departments, and spent on teaching expenditure, equipment and technology support, and financial aid.

III. Theoretical Framework

To structure our empirical work, we briefly sketch several prominent economic factors potentially influencing public institutions' pricing policies in the wake of tuition deregulation. We pay particular attention to factors that might explain why institutions may increase price for particular programs rather than increase them at the same rate across the board. Our starting point is a model of price-setting where universities have some market power (demand is not perfectly price elastic) and offer multiple products, such as training in different academic disciplines. Market power can arise either from students' geographic immobility or vertical differentiation with a small number of options at each quality level. Universities are assumed to choose prices and spending levels to maximize an objective (e.g., prestige, surplus, diversity, or student success) subject to a budget constraint that educational spending must be covered by tuition and state revenue.[6]

A first prediction is that institutions or programs with greater costs at baseline should charge higher prices after deregulation. Disciplines require different teaching technologies, creating variation in costs of facilities or faculty salary (Johnson & Turner, 2009; American Association of University Professors, 2007). For instance, engineering instruction is much more costly than instruction in liberal arts (Middaugh et al., 2003). In some academic fields, faculty can command greater compensation due to private sector competition, and this may force institutions to generate more revenue to retain them (Deaton, 2006). Prior to deregulation, institutions did not have the flexibility to align price very closely with inherent costs, thus some programs were underpriced relative to their cost. An observably similar, though conceptually distinct, prediction is that price increases should be greatest for those programs that were already making the largest educational investments prior to deregulation. Vertical differentiation across institutions arises due to heterogeneous demand for college quality and complementarity between

[6] We do not take a stand on institutional objective, though the predictions we make likely hold for several plausible institutional objective functions. Furthermore, institutions have other sources of revenue too, including alumni donations and federal and state grants. We ignore these in this study.

student ability and college quality (Rothschild & White, 1995; Hoxby, 2009). Price regulation constrains the extent of quality differentiation that is possible, as students with very high demand for educational inputs are not able to obtain (and pay for) them. Deregulation thus should increase price and educational inputs most dramatically at institutions and for programs that already had high levels of inputs, similar to the effects of increased market competition (Hoxby, 1997; 2009). [7]

A second prediction is that institutions and programs facing more elastic demand should be more reluctant to raise price. This is basic tenant of monopolistic pricing and has been examined in the context of university pricing by Ehrenberg and Sherman (1987) and Epple, Romano, and Seig (2006). At the program level, demand for majors may be less elastic if students expect the degree to pay off in the job market much more than their next alternative (e.g. business) or if the degree is required for entry to the related occupation (e.g. nursing). While it is difficult to infer demand elasticity directly without putting more structure on the nature of the higher education market, we propose several markers for demand elasticity at the institution and program level.

Third, it is likely that institutions whose students are lower income or otherwise underrepresented in college would, all else equal, have more restrained price increases following deregulation. Public universities have multiple objectives, including providing access to postsecondary education for socioeconomically disadvantaged students. In fact, increasing access and success for disadvantaged students was one of the main objectives of Texas' master plan for higher education in 2000 (THECB, 2000). Price increases at institutions that serve many low-income students may thus be particularly detrimental to states' access goals. Finally, institutions' pricing decisions following deregulation could reflect other objectives, such as responding to market needs for certain types of work forces (Deaton,

[7] Institutional reluctance for cross-subsidization among the academic programs might also result in differential pricing. Differential pricing is considered to be a fairer way of charging tuition, as it alleviates undue expense on students in academic majors that are not as costly (Harwell, 2013). Some argue it is a better pricing strategy for low income students since they would be least able to afford higher tuition rates for the higher expenses of only a few programs (Little, O'Toole, & Wetzel, 1997). Furthermore, institutions may perceive that maintaining programs with high price elasticity will be more difficult (e.g., filling classrooms, degree production) if prices are increased across board (e.g., Taylor, Cantwell, & Slaughter, 2013). Thus, schools will increase the prices for some majors, while keeping tuition rates lower for lower-cost majors (Berg & Hoenack, 1987; Hoenack, & Weiler, 1975; Yanikoski & Wilson, 1984). In order to fully investigate these factors, how revenue is generated and funding is distributed across departments should be considered (e.g., Fethke, 2014), yet little is known about this systemically.

2006). For example, institutions may not want to increase price for certain majors that are deemed critical to the local workforce. We do not investigate this factor directly.

IV. Cross-state Comparisons

We begin our analysis by contrasting the experience of public universities in Texas to similar universities in other states, which were not subject to the regulatory change. From IPEDS, we assemble data on in-state tuition and fees, revenues by category, and total enrollment for each public 4-year university in the country from 2000 to 2010.[8] To this data we merge on information about Barron's selectivity in 2004 and also the state unemployment rate in each year. The full sample includes a total of 6,599 observations, corresponding to 32 Texas institutions and approximately 570 non-Texas institutions per year for eleven years. Figure 1 situates Texas institutions in the national landscape, depicting the average in-state tuition and fees at Texas and all non-Texas public universities over time. Though both groups of institutions have been raising prices over this time period, there is a notable price jump at Texas universities in 2004. In fact, Texas universities proceed to increase prices at a higher rate and ultimately close the price gap by 2008. Figure 2 examines revenue sources. Though all universities have become more dependent on tuition revenue over time, Texas universities are more tuition-dependent in the post-deregulation period (Figure 2, Panel A). The share of revenue coming from state appropriations also dropped in Texas relative to other institutions following deregulation, though it recovered eventually (Figure 2, Panel B).

To examine the robustness of these patterns to various control groups and to perform statistical inference, we estimate a generalized difference-in-differences (or event study) model. Specifically we regress an outcome (e.g. in-state tuition and fees) on an indicator for the institution being a Texas public institution, a full set of year fixed effects, and interactions between these year fixed effects and whether the institution is a Texas public university.

[8] We do not adjust nominal variables (prices and revenues) for inflation as aggregate price trends will be absorbed by trends in control institutions.

$$Y_{jt} = \beta_0 \cdot TexasPublic_j + \sum_{s=2000}^{2010} \gamma_t 1(year_t = s) + \beta_t 1(year_t = s) \cdot TexasPublic_j + e_{jt}$$

We omit the interaction term for the year 2003, setting this year as our base year against which we measure changes in relative price. The model produces a set of coefficients β_t which indicate the difference in prices between Texas and non-Texas public universities in each year over-and-above what prevailed in 2003. Coefficients for the years prior to deregulation offer a test of whether Texas and non-Texas institutions were trending similarly prior to deregulation. In most of our analysis we restrict our sample to institutions in sixteen Southeast and Southwest states, though we also examine other sets of institutions as potential control groups.[9] This restricted sample includes approximately 184 non-Texas institutions per year and a total of 2096 non-Texas observations. Appendix Table A1 provides summary statistics for the sample. Our analysis weights each observation according to its total undergraduate enrollment, though unweighted results are quite similar for all the outcomes we examine. As a robustness check, we also control for the state unemployment rate in some specifications, as Texas may have experienced a different economic shock during the recession, which could lead us to falsely attribute outcome differences to deregulation. To account for the possibility that state-specific factors may make the pricing decisions of institutions correlated within states, we cluster standard errors by state.

Figure 3 plots the point estimates and 95% confidence interval of the β_t's for in-state tuition and required fees, estimated using all public institutions in the Southeast or Southwest as controls. Though there is no discernable trend difference between Texas and other states prior to deregulation, the relative price in Texas rises sharply in 2004 and continues to grow through 2009. Ultimately in-state sticker price increases by almost $1,500 within five years of deregulation, netting out the time trend for non-Texas institutions.[10] A lack of trend prior to deregulation suggests that Texas and non-Texas institutions had

[9] These states include AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV in the Southeast and AZ, NM, OK, and TX in the Southwest.

[10] Though not reported here, these patterns are mostly unchanged if we use different control groups, namely all public institutions, only the Southeast, only the Southwest, or the Southeast excluding Florida. Texas private intuitions do not provide a good control group as their tuition rates are rising relative to Texas public institutions even before deregulation.

similar price trajectories prior to deregulation and might have been expected to continue this pattern in the absence of deregulation.[11]

Figure 4 separates institutions by selectivity. The steepest price increase is seen at the five institutions deemed "Highly Competitive" or "Very Competitive" by Barrons (UT-Austin, UT-Dallas, Texas A&M, Texas State – San Marcos, and Texas Tech), though sizable relative price increases are seen in all other sectors as well.[12]

Figure 5 examines two alternative, revenue-based, measures of price. In Panel A, estimates for tuition and fee revenue per full-time-equivalent (FTE) student are very similar to those for in-state sticker price, though more noisy. To address concerns that tuition increases would create financial hardship for low-income students, deregulation came with the requirement that 20% of the incremental proceeds from resident undergraduate tuition be set aside to fund need-based institutional aid and loan programs. Panel B of Figure 5 presents estimates of changes in net tuition revenue (tuition revenue minus institutional grants) following deregulation. Though the magnitude is somewhat smaller than for sticker price, the general pattern is quite similar. This trend suggests that some of the additional tuition revenue was devoted to financial aid. Panel C indicates that Texas public institutions have increased institutional grant aid after deregulation, compared to their southwest or southeast counterparts.

Figure 6 examines changes in state appropriations per student following deregulation using the same difference-in-differences model. Texas institutions had a similar time path of state support in the years leading up to deregulation, though a sizable drop in state support in the four years following. The decline in state support (which was partially enabled by deregulation through political compromise) is thus an alternative explanation for the steep tuition increases immediately following deregulation. Interestingly, Texas institutions continued to expand their prices relative to peer institution through 2008 and 2009, despite the fact that state appropriations returned to parity.

[11] Tables A2 and A3 in the Appendix report estimates using various other control groups, not weighted by enrollment, and controlling for state unemployment rate. Estimates from these other specifications are usually similar qualitatively and quantitatively as our base model.

[12] We do see large price increases in the non-competitive sector as well, but given the small number of institutions in this sector in Texas (6), these results are quite imprecise, especially for later years.

V. Within Texas Comparisons

A. Data

Though information on average or typical tuition and fees are available for institutions from a number of standard sources, no systematic data exists about prices of specific undergraduate programs within institutions or how these prices vary with credit load or undergraduate level. To fill this gap, we collected detailed information on each Texas public institution's tuition and fees from the academic years of 2000 to 2011. We capture price separately by the five-way interaction of major/program, credit load, entering cohort, residency and undergraduate level. This level of granularity is critical, as many Texas institutions adopted price schedules that vary according to all of these characteristics. Our data come from historical universities' tuition and fee schedule documents, university catalogs, and campus and system documents on tuition policy, obtained from a number of sources. We only include tuition and fees (sticker price) for on-campus, undergraduate students. Tuition is the sum of statutory tuition and designated tuition, and fees include only mandatory fees, excluding voluntary or incremental fees. We also include program fees which are charged to all students who enrolled in specific programs or schools with regard to advising and career services, instructional technology, and learning resource centers.

To examine the correlates of price changes, we also collected information about programs and institutions in 2002 (the year prior to deregulation passing and two years before it became effective) from several other sources. Information about expenditure by discipline and level was obtained from the Public General Academic Institution Expenditure Study, conducted by the Texas Higher Education Coordinating Board (THECB). The study provides information about the relative expenditure per student credit hour for twenty disciplines and five levels of instruction, using lower-division liberal arts courses as the reference. Instruction expenditure is calculated based on teaching salary, academic support expenses, institutional support, student services, and departmental operating expenses. We are able to estimate total grant aid (and thus net price) for needy students using micro data contained in the Financial Aid Database compiled by THECB (2003-2011). This micro data contains grant aid information for all students who are eligible for need-based aid and enrolled in a Texas public institution. From this data we estimate the total,

Pell, and non-Pell grant aid for need-eligible in-state juniors enrolled full-time, averaged separately for each program, institution, and year whenever there are at least five students.[13]

As a proxy for pent-up demand in each major, we obtained indicators of whether each program used an admissions process that was separate from that for overall freshman admissions to the university in 2002, collected from the same sources as the price information. This typically means that admissions to these programs were more selective than for other majors. To characterize overall institutional selectively, we calculated the freshman acceptance rate from THECB data. Finally, the fraction of students receiving federal grant aid (a proxy for low-income) for the institution overall was drawn from IPEDS.

Though we collected price data on all academic programs, in the analysis below we restrict our sample to Liberal Arts, Engineering, Business, Nursing, and Architecture programs. Liberal Arts is the base program against which we compare the price and cost of others and the four others are the ones for which differential pricing is implemented most frequently (Nelson 2008).

B. Method

We aim to document and characterize how institutions' program-specific pricing changed following tuition deregulation. We begin with descriptive analysis, depicting price trends over time, across institution, and across programs. We also describe the various non-standard pricing policies that institutions adopted following deregulation. These trends and practices have not previously been documented for the state of Texas and, as far as we can find, for any set of institutions following a pricing policy shift as dramatic as tuition deregulation.

[13] The financial aid data has a few caveats. First, it only consistently includes students that receive need-based aid, so net price can only be constructed for this group. Second, the target sample for the database changes over time. From 2001 to 2006 the database includes only students who received any type of need-based aid, or any type of aid which requires a need analysis. From 2007 to 2009 the database included students who are enrolled and completed either a FAFSA or TASFA (Texas Application for State Financial Aid), some of which may not have received any aid.. Since 2010, the database was expanded to include students who did not apply for need-based aid, but received merit or performance-based aid. In order to keep our sample of students consistent, we restrict to students that received a positive amount of grant aid from at least one need-based aid program (Pell, SEOG, Texas Grant, TPEG, or HB 3015). Finally, data confidentiality requirements prevent us from disclosing grant aid for observations with fewer than five students. Thus analysis of program-specific net price will be performed on fewer observations than that for sticker price.

In order to investigate the specific role of different factors in explaining these price trends, we look at the dollar change in total price (tuition + fees) for each program as a function of fixed characteristics of each program and institution prior to deregulation. We estimate equation (1) using OLS.

$$\Delta Price_{j,k} = \beta_0 + \beta_1 \left(\frac{Exp}{SCH}\right)_{jk,2002} + \beta_2 (Selective)_{jk} + \delta_k + \beta_z Z_j + \varepsilon_{jk} \qquad (1)$$

Our main outcome, $\Delta Price_{j,k}$, is the change in price for program k at institution j between 2002 and 2011.[14] We investigate three categories of explanatory variables. Our theoretical framework suggests that programs that have greater costs in the baseline period should have larger increases in price when they are permitted greater price-setting flexibility. Since institutions that spend more within narrow disciplines and levels are not provided greater funding per student, these institutions have an incentive to charge more when they are permitted to do so. The coefficient on $\left(\frac{Exp}{SCH}\right)_{jk,2002}$ captures whether programs that are more costly to provide experienced larger increases in price following deregulation. This cost variation is both across institutions and within institutions, across programs. Second, $Selective_{jk}$ is an indicator for whether program k at institution j had a separate or selective admissions policy in 2002 that was distinct from that for other majors. For instance, students at UT-Arlington have to apply separately to enter the engineering program, where applicants are required to present higher minimum SAT/ACT scores than other majors. We use this variable as a proxy for a program having excess demand. Programs (within institutions) having excess demand should, all else equal, face a less elastic demand and thus could raise prices without curtailing enrollment. Third, we examine a small set of institutional characteristics, Z_j, such as overall selectivity and demographic composition (% eligible for Pell). Finally, in some specifications we include program and/or institution fixed effects (replacing institutional characteristics) to examine cross-program price changes after netting out overall price increases at institutions.

C. Descriptive Evidence

[14] We will also examine other years as the pre- and post-years, though we do not expect that adding more years to the analysis will improve precision since our main variables of interest are time-invariant.

Figure 7 depicts the trend in the total price (tuition plus mandatory fees) for several institutions from 2000 to 2011 for in-state juniors majoring in liberal arts and taking 15 credit hours. The tuition and fees for each institution increased considerably following deregulation, with a notable jump occurring in the first year institutions had tuition setting authority. On average, tuition is increased by $1,997 (120%) from 2002 to 2011.[15] However, there is quite a bit of variation around this average, with UT-Dallas raising price by $2,783 (117%) and University of Houston-Victoria raising price by $1,459 (100%).

On top of this secular increase, three different forms of new pricing structures emerged: differential tuition, flat-rate pricing, and guaranteed tuition. Institutions' use of these practices following deregulation is summarized in Table 1. More than one-third (13) of the universities began differentiating tuition by major/program or assigned program specific fees that had the same effect, referred to as *differential tuition.* The programs typically affected are engineering (10), business (12), nursing (6), and architecture (4). Many of these were adopted in 2004. There was variation in price across institutions and programs even before deregulation, thanks to variation in fees and the fact that some institutions were not hitting the cap on designated tuition. However, there is a very clear increase in the dispersion of prices across institutions and programs from 2004 onwards (Figure 8).

In adopting differential pricing by program, Texas's colleges and universities joined a national trend of universities implementing more complex pricing policies over the past few decades. Ehrenberg (2012), Nelson (2008), and Stange (2014) found that many public universities have adopted differential pricing by program over the past two decades. Furthermore, the programs targeted by Texas are quite similar to those for which differential pricing is used nationally. Only three institutions differentiated price by level, which is surprising given the huge cost differences between upper and lower division coursework. Finally, six schools combined all tuition, mandatory fess, program fees, and course fees into a single price that applies to all students taking a full credit load or higher, referred to as *flat-rate pricing*. Hemelt and Stange (2014) found modest to no effect of flat (vs. per-credit) pricing on the average number

[15] THECB (2010) reported that between the fall of 2003 and the fall of 2009 the statewide average of total academic charges for a student taking 15 semester credit hours increased by 72% or $1,389.

of credits taken and earned, suggesting that flat pricing may not increase student graduation despite reducing tuition revenue. Finally, one school fixed a tuition rate for each entering cohort (referred to as *guaranteed tuition*), though this is now mandated of all institutions as of 2012 (Texas Guaranteed Tuition Plan, 2012).

D. Difference Regressions

In order to characterize the role of economic factors in institutions' pricing decisions, we now turn to simple regression analysis. The top of Table 2 summarizes our two key measures of program cost and excess demand, separately by program. Across all institutions, colleges spend $210 per undergraduate student credit hour in liberal arts, ranging from about $100 to $400 across institutions. The other four programs we examine are all significantly more expensive, including $401 for engineering, $267 for business, $525 for nursing, and $341 for architecture. As these programs are much more expensive than liberal arts, it is not surprising that these are targeted for differential pricing. Interestingly, there is quite a bit of variation across institutions in the expenditure devoted to these programs. Furthermore, about one-third of these programs have a separate (and likely more selective) application process. We interpret this as a measure of excess demand for enrollment in the program.

As our primary outcome, we calculate the per-semester price change from 2002 to 2011 for each program at each institution. Table 2 also summarizes the variation in price of these five programs across institutions. Since price data is only available for some years and not all institutions have nursing and architecture programs, this table and our subsequent analysis relies on 88 observations: 26 liberal arts programs, 14 engineering programs, 26 business programs, 12 nursing programs, and 10 architecture programs. As was seen in the earlier figures, average price and range of prices was similar across all five programs prior to deregulation in 2002. The third panel depicts changes in price from 2002 to 2011. Average price more than doubled, increasing by $1,997 for liberal arts programs, about $100 more for business programs, $340 more for engineering, and $400 more for architecture programs. On average, nursing programs increased their prices at about the same rate as liberal arts programs overall. However, these averages mask quite a bit of heterogeneity in price response. The standard deviation and range

(max-min) of price changes was quite a bit higher for engineering, business, and architecture. Meanwhile, the actual amount students pay (net tuition and fees) might not experience the same variation across programs, as grant aid partially offsets sticker price increases. Between 2003 and 2011, the average change in the net tuition for need-eligible students was actually lowest in engineering, whose students experienced the largest increase in non-Pell grant aid. The change in the Pell grant-aid was similar across the programs.

Table 3 examines the correlates of price changes for liberal arts programs. Institutions with greater expenditure per student (combining lower and upper division courses) experienced greater price change following deregulation, though the estimate is imprecise.[16] Specifications (2) and (3) examine the correlation with two other economic factors: the institutional acceptance rate and the fraction of students that are receiving federal grant aid (a marker for fraction of students that are low income). Both relationships go in the expected direction. Institutions with a low acceptance rate experience larger price increases, consistent with the prediction that excess demand enables institutions to raise prices. However, institutions with many low income students (as proxied by the fraction of students receiving federal grant aid) have more restrained price increases. Specification (4) examines these three explanations together. The patterns generally hold, though the relationship for expenditure is stronger and now significant. Institutions with the greatest price increases following tuition deregulation have higher expenditure per student credit hour prior, greater excess demand, and fewer low-income students prior to deregulation. These patterns are all consistent with the economic framework presented above. Specifications (5) and (6) probe the robustness of these results to different measures of program expenditure, whether using lower division undergraduates or upper division undergraduates. Results are qualitatively similar regardless of the expenditure measure used, though larger in magnitude when expenditures for upper-division undergraduates are used. Finally, specifications (7)-(10) examine the correlates of changes in

[16] Figure A1 in the appendix plots the price changes against baseline expenditure in 2002, separately by program. It is clear that the price increase is greatest at engineering and architecture programs with the greatest expenditure at baseline, but not so for business and nursing. The relationship between price increases and baseline expenditure is positive, though weak, for liberal arts programs.

grant aid and net price. Schools with greater expenditure per student at baseline increase grant aid for needy students the most following deregulation, particularly with non-Pell aid. Increases in net price was also significantly lower for schools with more low-income students.

Table 4 examine price changes for four particular programs which, other than nursing, experienced greater price increases than liberal arts. Here we find much weaker support for the importance of baseline program-specific cost to predicting price increases. Program selectivity and overall institution characteristics (e.g. liberal arts expenditure, institution selectivity, and student income) are fairly strong predictive of price changes, but program-specific expenditure is not. Price increased more for programs that had separate admissions processes (a marker for excess demand), yet did not for more expensive programs regardless of which other characteristics are controlled for. While selective programs are likely to increase price, these programs also provide more grant aid, particularly grants other than Pell. This result suggests that the net tuition for selective programs did not rise as fast for needy students as did sticker price.[17]

VI. Discussion and Conclusion

This research investigates changes in tuition policies in the wake of tuition deregulation in Texas. Texas offers a unique case study of a massive policy experiment that provided public higher education institutions with greater autonomy and flexibility to determine prices. Many institutions took advantage of this flexibility, accelerating price increases and adopting alternative pricing structures, particularly differential pricing by undergraduate program, after the deregulation. Engineering, business, nursing, and architecture programs were the most common targets for differential pricing, mirroring national trends. The UT and Texas A&M systems actively supported tuition deregulation, as they believed the change would make them flexible to market demands and faculty hiring, which in turn enhance their prestige and

[17] Table A4 in the appendix estimates models for each program separately. The pattern for engineering, business, and nursing programs are qualitatively similar: those programs that were initially devoting more resources to their students prior to deregulation did not increase their price appreciably following deregulation. This general pattern holds after controlling for expenditure in liberal arts (third specification in each panel) and the selectivity and income of students at the institution overall. Architecture has a different pattern than the other three, with baseline expenditure predictive of post-deregulation price changes.

quality of education (UT system, 2008). The assumption is that the quality of their educational offerings was held artificially low when prices were set by the legislature. Meanwhile, the rest of institutions in the state that still had physical capacity to accommodate additional enrollment were hesitant of the changes (Hernandez, 2009) and have been reluctant to enact differential prices.

Our findings are broadly consistent with these economic rationales; we found that overall price increases (for students in the liberal arts) were greatest at institutions that were already spending more per student, that had lower acceptance rates, and fewer low-income students. Since the state funding formula does not consider cross-institution differences in spending within narrow programs, this behavior can be explained by more resource-intensive institutions' desire to pay for their additional spending via price increases. The importance of selectivity and student income suggests that institutions also consider the demand and access consequences of the price changes, as institutions with more excess demand and higher-income students are more able to increase price without harming enrollment. Program-specific spending seems less important to explaining program-specific pricing, which is largely influenced by overall spending and program selectivity. Thus demand and overall cost may function as important contingencies for public universities in setting prices (Morphew & Eckel, 2009; Yanikoski & Wilson, 1984).

These results may shed light on the objectives of public universities. In a time when public institutions face scrutiny but diminished public support, many are exploring various financial models to maintain and improve scale, breadth of activities, and the ability to pursue public good (Duderstadt & Womack, 2003). Resource allocation post-deregulation may provide a view into which of these activities are valued the most. Figure 9 suggests that the increase in tuition and fees in the post-deregulation period might be used for education and related activities at institutional level. Yet, how differential tuition altered the revenues and expenses for different activities across academic programs within institutions is not well understood.

The Texas experience suggests that decentralized price-setting generates greater price differentiation within the public higher education system, both across and within institutions. While our

analysis is intended to be entirely positive, the normative implications can be framed around a potential tradeoff between efficiency and equity that depends on institution and student responses to deregulation-enabled price changes. Differential pricing could increase efficiency by aligning price more closely with marginal costs or by facilitating more quality differentiation across programs if there is strong complementarity between student ability and resources (Rothschild & White, 1995; Hoxby, 2009). In fact, efficiency concerns were the primary justification for tuition deregulation (UT system, 2008).

On the other hand, differential pricing and greater price dispersion could also widen socio-economic gaps, as price increased overall and most dramatically at the most selective and best-resourced programs. These changes could price lower-income students out of desirable programs or make completion more difficult. However, we do find that institutional grant aid increased more in Texas following deregulation and that more selective programs awarded more non-Pell grant aid for students in financial need, offsetting some of the increases in sticker price. Whether this additional aid fully mitigated impacts on access or would have occurred had institutions not been required to set aside part of the raised revenue for need-based aid remains an open question. The increase in educational spending documented in Figure 9 also suggests that institutions might use the increased revenue for improving academic quality. At a department level, some schools report making significant investments in new computer labs and reduced class sizes with differential tuition dollars (e.g., TAMU, 2011). Again, whether these improvements in quality were particularly important to the success of low-income students or simply widened existing resource gaps between programs serving poor and non-poor students remains unclear. Across many universities nationally, Stange (2014) found that differential pricing for engineering is associated with fewer engineering degrees granted particularly for female and black students, but his analysis is unable to separate price (demand) and program quality (supply) channels. A full accounting of the equity and efficiency consequences of deregulation requires an assessment of how it altered the sorting of students into programs, changed institutional capacity, and impacted program quality. A necessary first step to answering these questions is to simply document and understand how institutions alter pricing practices when given full autonomy to do so.

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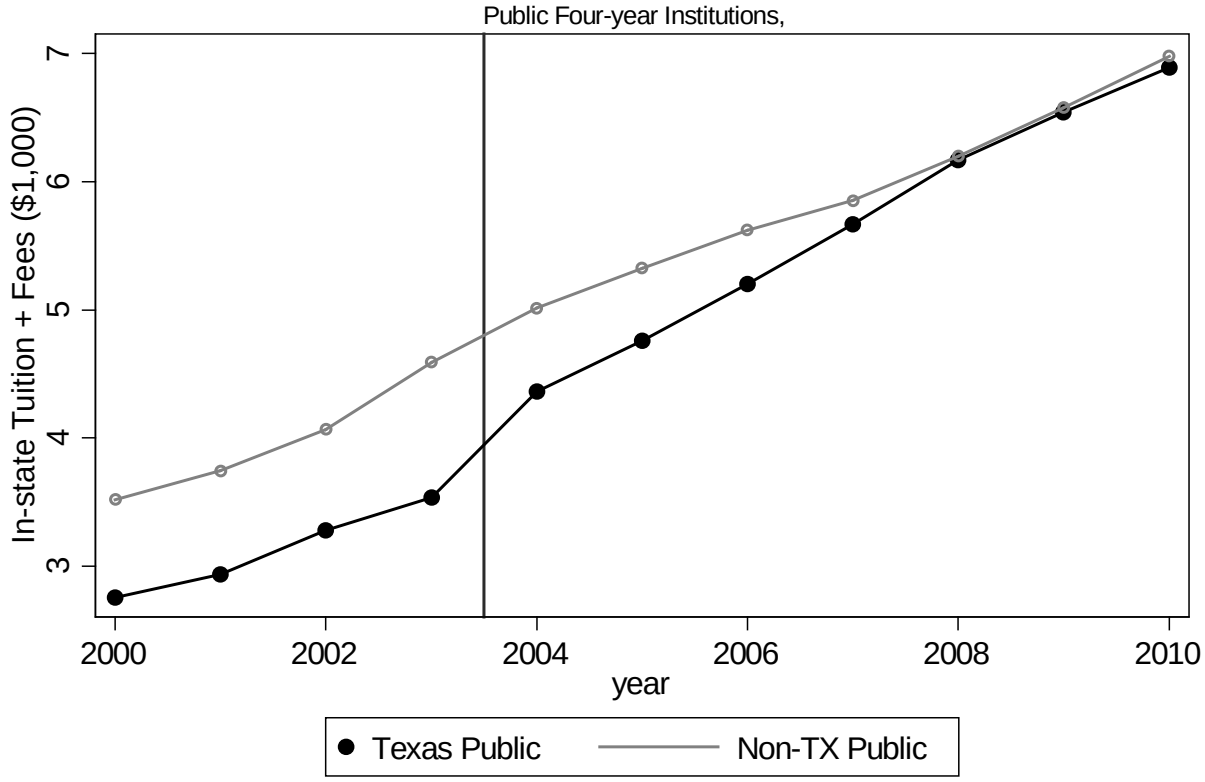
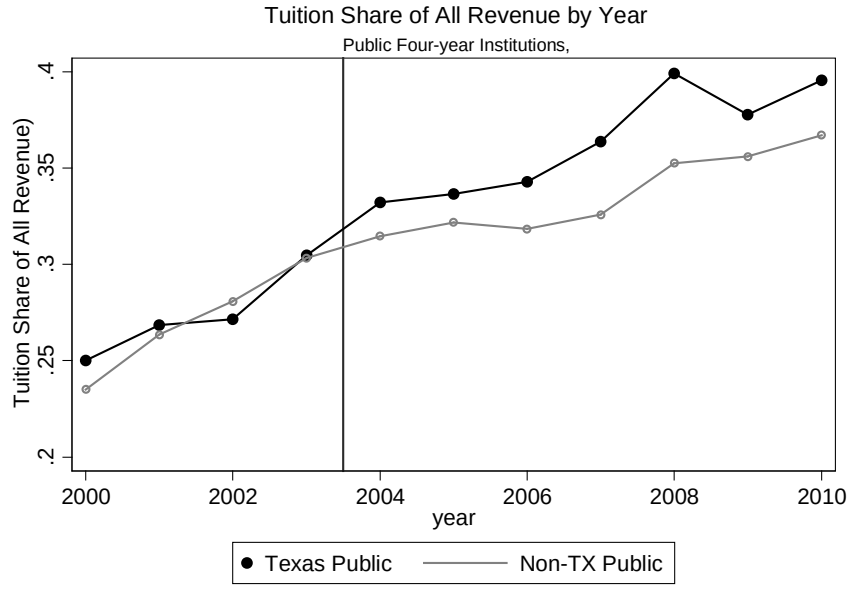
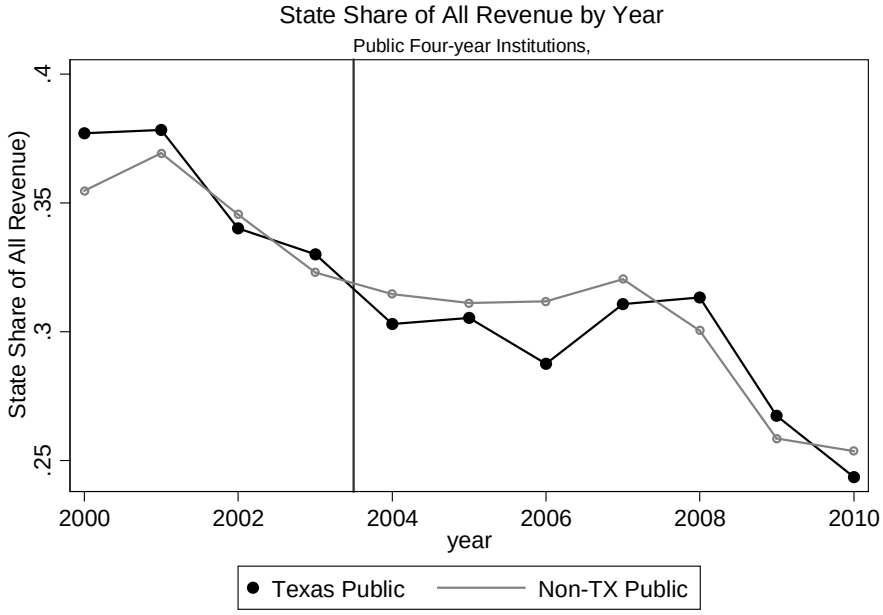
Figure 1. Average Tuition and Fees, Texas Public Universities vs. Non-Texas Public Universities



Note: The vertical line refers to 2003 when the bill targeting tuition deregulation was passed. Averages are weighted by total undergraduate enrollment. Non-weighted graphs look similar. Sample includes all public four-year institutions in the U.S. Sources: Authors' analysis of data from IPEDS.

Figure 2. Share of Revenue from Tuition and State Appropriations

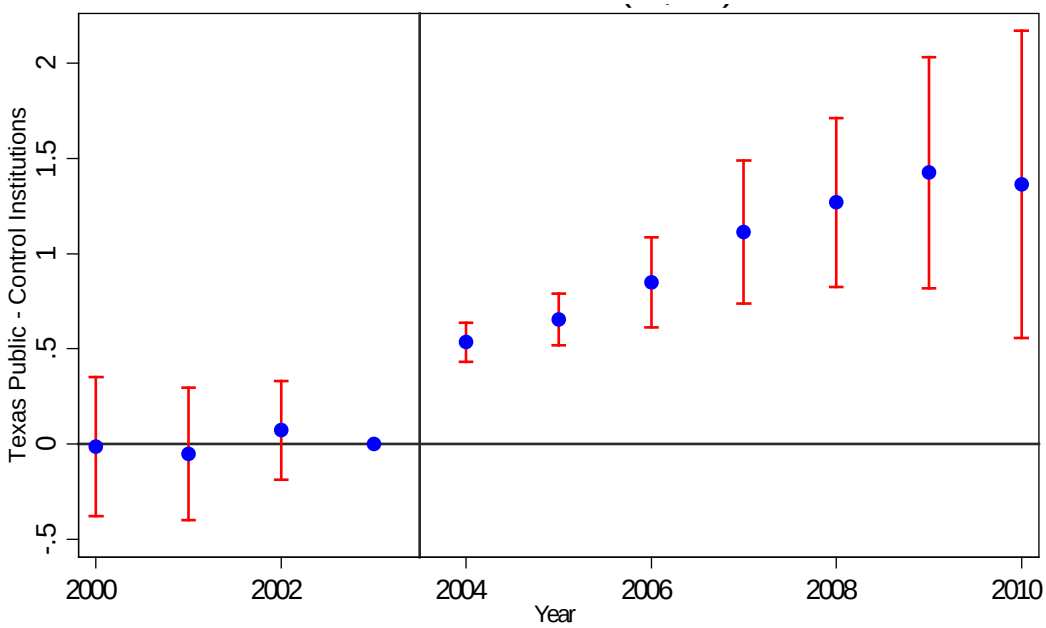




Notes: The vertical line refers to 2003 when the bill targeting tuition deregulation was passed. Averages are weighted by total undergraduate enrollment. Non-weighted graphs look similar. Sample includes all public four-year institutions in the U.S. (public universities in Texas vs. public universities in all other states). Sources: Authors' analysis of data from IPEDS.

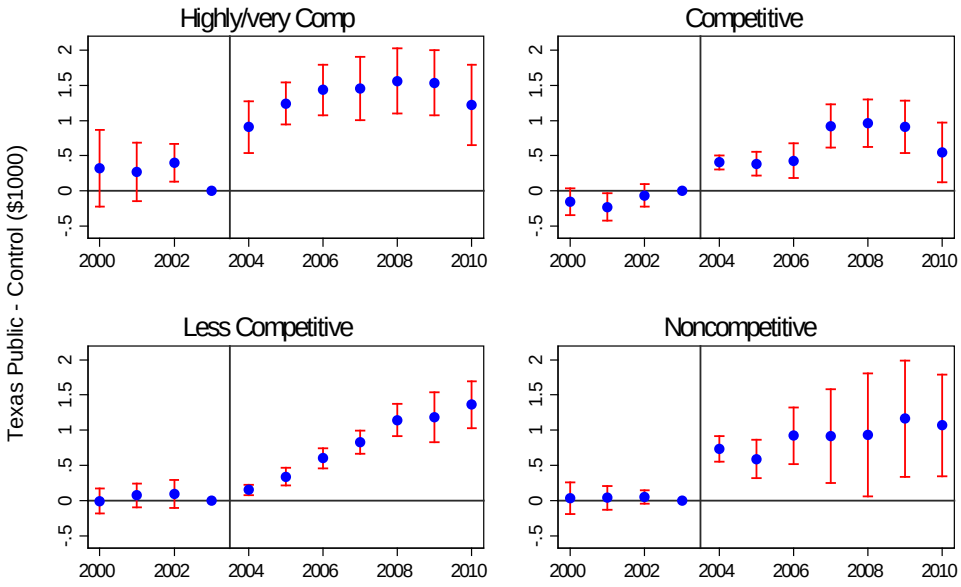
Figure 3. Estimates of In-State Tuition and Fee Changes ($1,000) post Deregulation

Public Institutions in Southwest and Southeast States as Controls



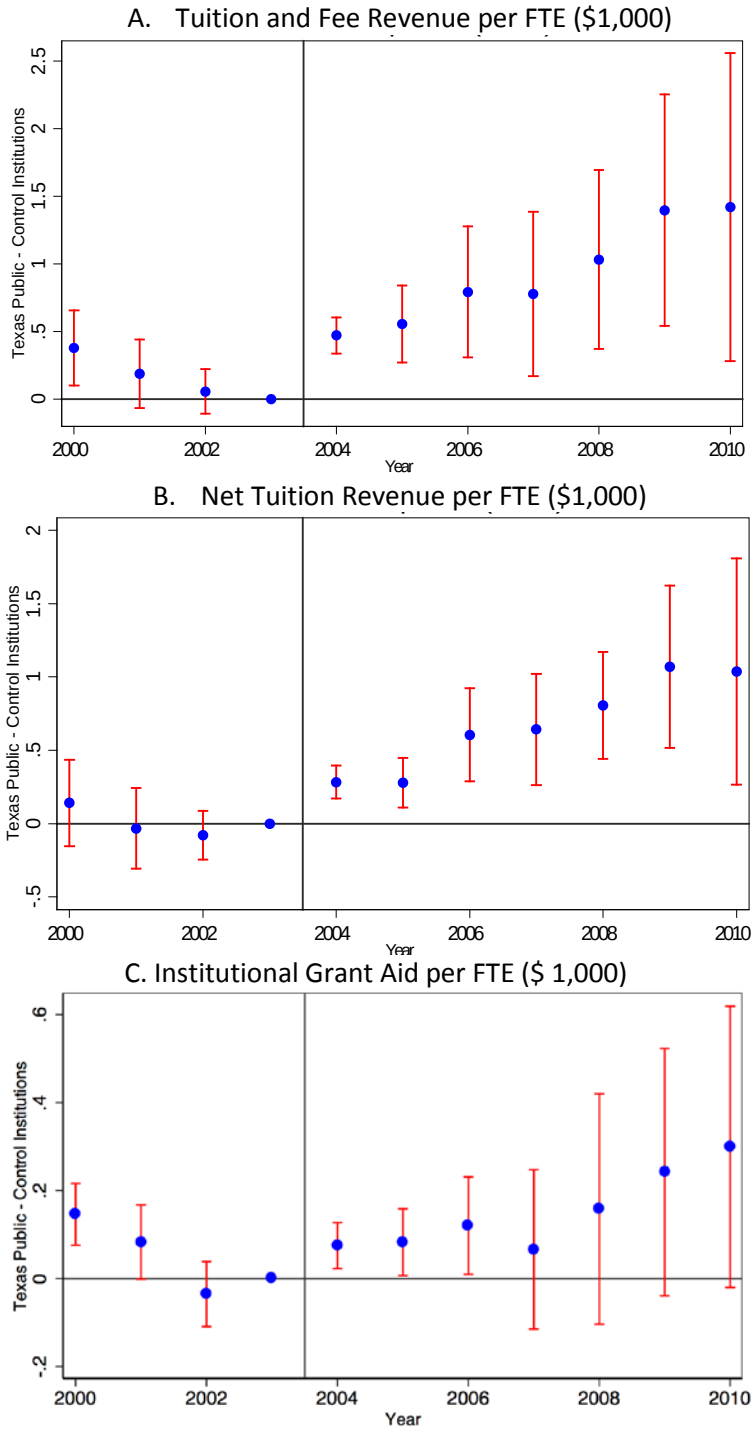
Notes: Graph reports event-study point estimate and 95% confidence interval. Control group includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment. Sources: Authors' analysis of data from IPEDS.

Figure 4. Estimates of In-State Tuition and Fee Changes ($1,000) post Deregulation, by Selectivity



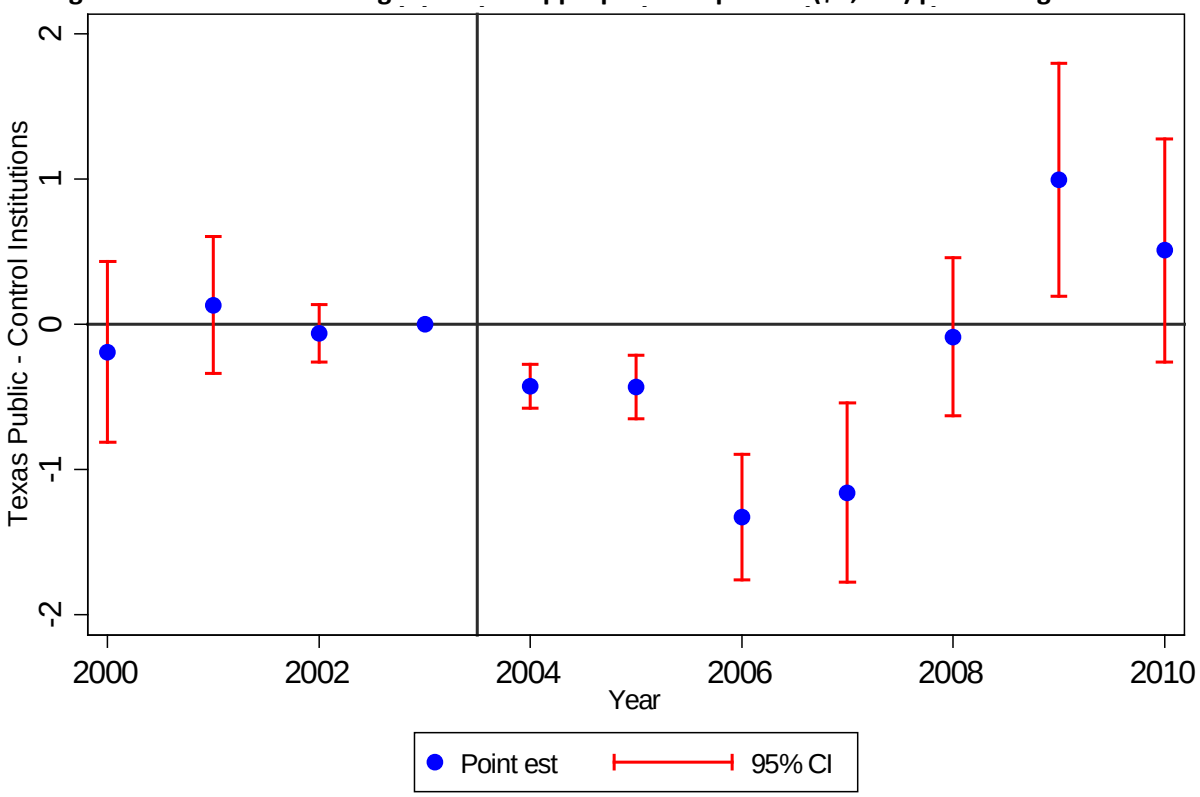
Notes: Graph reports event-study point estimate and 95% confidence interval, separately by selectivity group. Control group includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment. Sources: Authors' analysis of data from IPEDS.

Figure 5. Estimates of Changes in Net Tuition Revenue and Institutional Grant Aid Post Deregulation



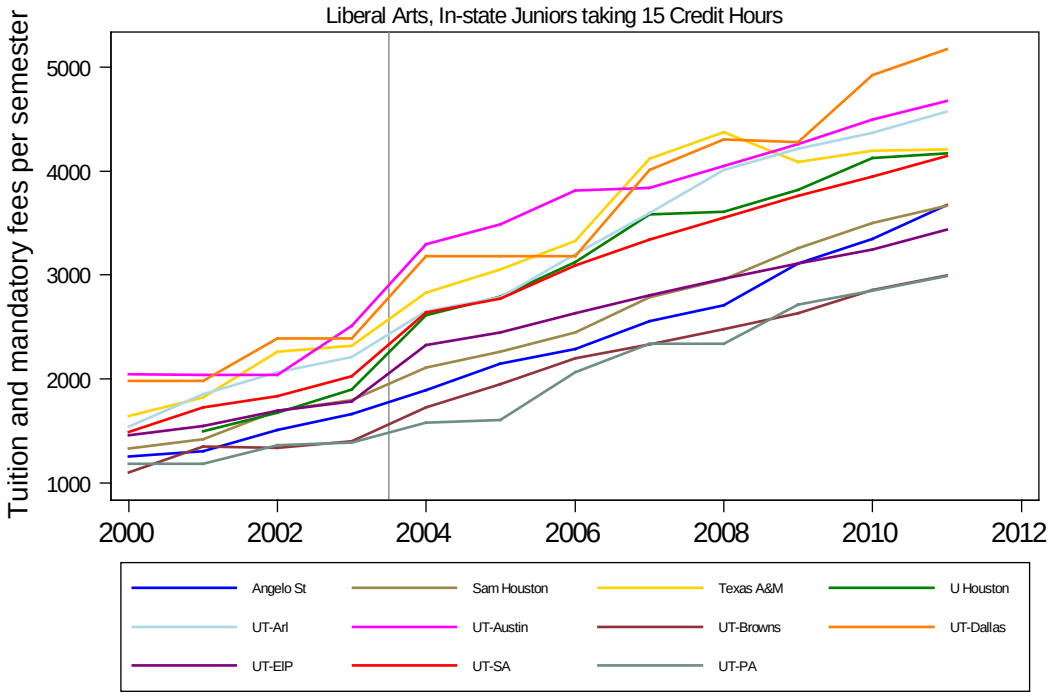
Notes: Graph reports event-study point estimate and 95% confidence interval. Tuition and fee revenue and FTE includes students from all levels, not exclusively undergraduate. Net tuition revenue equals tuition revenue minus institutional grant expenditure. Control group includes all public four-year institutions in Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment. Sources: Authors' analysis of data from IPEDS.

Figure 6. Estimates of Changes in State Appropriations per FTE ($1,000) post Deregulation



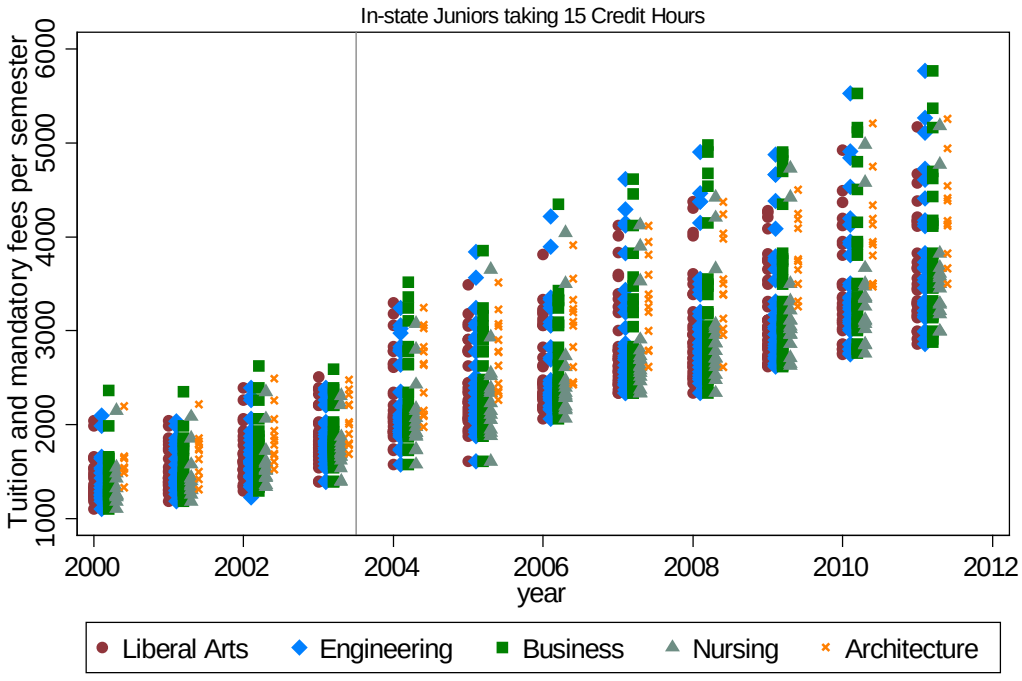
Notes: Graph reports event-study point estimate and 95% confidence interval. State appropriations revenue and number of full-time-equivalent students includes students from all levels, not exclusively undergraduate. Control group includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment. Sources: Authors' analysis of data from IPEDS.

Figure 7. Tuition and Fees by Institution, 2000 to 2011



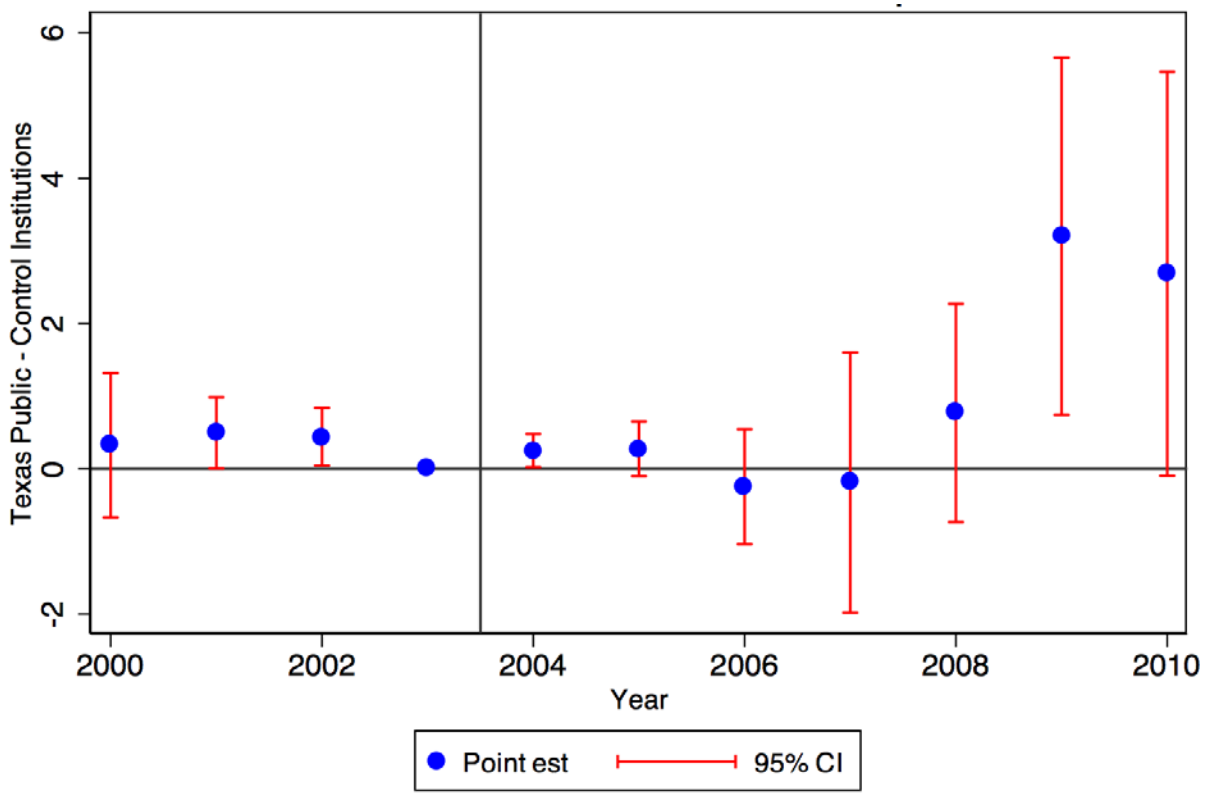
Sources: Authors' analysis of data from IPEDS.

Figure 8. Price Spread Across Institution and Program, 2000 to 2011



Sources: Authors' analysis of data from IPEDS.

Figure 9. Estimates of Changes in Educational and General Expenses per FTE ($1,000) post Deregulation



Notes: Graph reports event-study point estimate and 95% confidence interval. Total educational and general expenses and number of full-time-equivalent students includes students from all levels, not exclusively undergraduate. Control group includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment. Non-weighted graphs look very similar. Sources: Authors' analysis of data from IPEDS.

Table 1. Summary of Pricing Polices Adopted by Texas Public Universities Since 2003

	Differential Pricing by Level?	Differential Pricing by Field? (Which fields?)	Flat pricing?	Guaranteed tuition?
University of Texas at Arlington	Yes (upper)	engineering, nursing, business, architecture, liberal arts, visual and performing arts, sciences, education	Yes	N/A
University of Texas at Austin	N/A	architecture, business, commuication, education, engineering, fine arts, liberal arts, natural sciences, nursing, pharmacy, social work, geosciences	Yes	N/A
University of Texas at Brownsville	N/A	N/A	Yes	N/A
University of Texas at Dallas	Yes (lower)	engineering and computer sciences, business, natural sciences and math	Yes	Yes
University of Texas at El Paso	N/A	engineering, nursing, business		
University of Texas at San Antonio	N/A	N/A	N/A	N/A
University of Texas at Tyler	N/A	N/A	N/A	N/A
University of Texas-Pan American	N/A	N/A	N/A	N/A
University of Texas of the Permian Basin	N/A	N/A	N/A	N/A
Texas A&M University	Yes (upper)	business; architecture, engineering, bio & agricultural engineering	Yes	N/A
Texas A&M International University	N/A	N/A	N/A	N/A
Texas A&M University- Commerce	N/A	N/A	N/A	N/A
Texas A&M University- Corpus Christi	N/A	N/A	N/A	N/A
Texas A&M University- San Antonio	No Data	No Data	No Data	No Data
Texas A&M University-Kingsville	N/A	N/A	N/A	N/A
Prairie View A&M University	N/A	business, nursing, engineering	N/A	N/A
Tarleton State University	N/A	business, nursing & health professions, engineering and technology (*2013)	N/A	N/A
Texas A&M University- Texakana	No Data	No Data	No Data	No Data
West Texas A&M University	N/A	N/A	N/A	N/A
Texas A&M University- Central Texas	No Data	No Data	No Data	No Data
University of Houston	N/A	architecture, business, education, engineering, hotel & restaurant business, liberal arts & social sciences, social work, technology	N/A	N/A
University of Houston -Clear Lake	N/A	business	N/A	N/A
University of Houston- Downtown	N/A	business	N/A	N/A
University of Houston- Victoria	N/A	N/A	N/A	N/A
University of North Texas	N/A	N/A	Yes	N/A
University of North Texas at Dallas	N/A	N/A	N/A	N/A
Lamar University	N/A	N/A	N/A	N/A
Sam Houston State University	N/A	N/A	N/A	N/A
Sul Ross State University	N/A	N/A	N/A	N/A
Texas State University	N/A	N/A	N/A	N/A
Angelo State University	N/A	N/A	N/A	N/A
Texas Tech University	N/A	agriculture, business, engineering	N/A	N/A
Midwestern State University	N/A	N/A	N/A	N/A
Stephen F. Austin State University	N/A	N/A	N/A	N/A
Texas Southern University	N/A	business, education, science & tech, humanities, fine a	N/A	N/A
Texas Woman's University	N/A	nursing	N/A	N/A

Sources: Historical tuition and fee documents and course catelogs compiled by authors.

Table 2. Characteristics of Five Programs at Texas Public Universities, 2002

	Liberal Arts	Engineering	Business	Nursing	Architecture
Number of programs	26	14	26	12	10
Program is selective	0.00	0.57	0.31	0.17	0.30
Acceptance rate (institution)	0.83	0.83	0.83	0.87	0.80
Fraction Pell (institution)	37.3	31.4	37.3	40.2	22.9
Undergraduate Expenditure per Student Credit Hour					
Mean	207	401	267	525	341
Std Dev	68	176	83	168	169
Min	108	174	177	345	132
Max	390	737	456	869	690
Tuition and fees per semester, 2002					
Mean	1,672	1,855	1,694	1,620	1,913
Std Dev	283	303	332	298	291
Min	1,295	1,359	1,295	1,337	1,522
Max	2,387	2,387	2,622	2,345	2,494
Change in tuition and fees per semester, 2002 to 2011					
Mean	1,997	2,332	2,087	1,974	2,400
Std Dev	397	631	546	407	456
Min	1,459	1,594	1,459	1,594	1,973
Max	2,783	3,593	3,487	2,836	3,585
Grant aid (need-eligible students), 2003					
Total grant aid	4,193	4,997	4,337	4,685	4,454
Pell grant aid	2,383	2,404	2,342	2,357	2,083
Non-Pell grant aid	1,809	2,592	1,995	2,328	2,371
Net tuition and fees per semester (need-eligible students), 2003					
Mean	-224	-479	-293	-578	-94
Std Dev	416	637	478	450	610
Min	-1,355	-1,780	-1,369	-1,463	-1,453
Max	505	240	696	12	470
Change in net tuition and fees per semester (need-eligible students), 2003 to 2011					
Mean	385	264	460	407	577
Std Dev	675	956	575	484	625
Min	-967	-966	-467	-342	-67
Max	1,796	2,613	2,199	1,158	1,739
Change in grant aid (need-eligible students), 2003 to 2011					
Total grant aid	1,409	2,003	1,447	1,478	1,731
Pell grant aid	1,000	902	980	927	859
Non-Pell grant aid	410	1,102	467	551	871

Sources: Undergraduate expenditure per student credit hour and accpetance rate comes from THECB. Whether a program is selective and sticker price information was collected by the authors from various archival sources. Average grant aid and net tuition estimated from student-level data contained in the Financial Aid Databse compiled by THECB. See text for details.

Table 3. Predictors of Price Changes - Liberal Arts

	Price change from 2002 to 2011 (mean = $2019)						Change from 2003 to 2011			
							Net price ($450)	Total grants ($1356)	Pell grant ($969)	Other grant ($387)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure per SCH in liberal arts	0.376			2.261**			-2.767	4.972***	1.337***	3.635***
(lower and upper division ugrad)	(1.449)			(0.934)			(1.706)	(1.207)	(0.441)	(1.226)
Acceptance rate		-730.7		-103.1	-144.0	-129.0	-591.7	747.4	1,010**	-262.3
(institution)		(588.1)		(362.2)	(374.7)	(321.5)	(541.0)	(768.9)	(429.2)	(1,120)
% Students w Federal grant aid			-11.04***	-12.36***	-12.78**	-10.34***	-13.31**	-1.554	5.064*	-6.617
(institution)			(3.800)	(4.100)	(4.575)	(2.439)	(5.838)	(6.071)	(2.581)	(6.253)
Expenditure per SCH					1.244					
(lower division ugrad)					(0.845)					
Expenditure per SCH						3.723***				
(upper division ugrad)						(0.555)				
Constant	1,920***	2,627***	2,431***	2,111***	2,390***	1,477***	1,967***	-193.0	-302.3	109.3
	(276.2)	(517.1)	(155.8)	(343.2)	(309.7)	(289.4)	(559.5)	(716.3)	(352.6)	(970.1)
Observations	26	25	25	25	25	25	25	25	25	25
R-squared	0.004	0.083	0.268	0.393	0.331	0.716	0.293	0.312	0.517	0.180

Notes: SCH refers to School Credit Hours. Sample includes all "Liberal Arts" programs at Texas public universities for which sticker price (tuition plus mandatory fees) was available in both 2002 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking 15 credits in the Fall. Average grant aid and net price is calculated for all full-time in-state juniors with a declared major in liberal arts or English that received one of the main need-based aid programs (Pell, SEOG, Texas Grant, TPEG, HB3015). Grant aid amounts are annual, but are divided in half when calculating net price. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Source: Authors' calculations.

Table 4. Predictors of Price Changes by Program, Four Programs Pooled

	Price change from 2002 to 2011 (mean = $2171)					Change from 2003 to 2011			
						Net price ($426)	Total grants ($1589)	Pell grant ($932)	Other grant ($656)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure per SCH in program	0.247	-0.0424	0.0962	-0.435	0.0358	-0.152	-0.157	-0.0127	-0.144
(lower and upper division ugrad)	(0.393)	(0.382)	(0.623)	(0.731)	(0.652)	(0.760)	(0.513)	(0.321)	(0.601)
Selective program		346.2**	289.7	299.7	92.71	-152.1	356.8**	-155.3**	512.1***
		(154.8)	(188.1)	(184.7)	(184.8)	(217.4)	(151.4)	(72.33)	(158.9)
Expenditure per SCH in liberal arts				1.930	2.735**	0.853	1.490	0.431	1.058
(lower and upper division ugrad)				(1.882)	(1.190)	(1.696)	(1.349)	(0.960)	(1.297)
Acceptance rate					-490.6				
(institution)					(408.0)				
% Students w Federal grant aid					-12.24***				
(institution)					(4.002)				
Engineering			252.1	168.1	180.7	-90.46	306.0	49.89	256.2
			(263.1)	(245.8)	(208.7)	(314.9)	(244.1)	(113.4)	(219.2)
Business			97.00	-60.21	71.10	16.77	-136.7	57.16	-193.9
			(252.3)	(253.0)	(208.4)	(224.2)	(228.5)	(111.0)	(204.1)
Architecture			405.4	315.8	186.6	170.0	168.3	-42.48	210.8
			(259.4)	(277.9)	(270.3)	(274.8)	(232.7)	(116.8)	(222.0)
Nursing (reference)									
Constant	2,082***	2,069***	1,875***	1,771***	2,317***	351.8	1,191***	878.4***	312.6
	-140.9	-122.2	-336.8	-350	-393.3	(395.1)	(330.7)	(179.0)	(306.5)
Observations	62	62	62	62	61	58	58	58	58
R-squared	0.006	0.091	0.151	0.181	0.385	0.037	0.279	0.115	0.378

Notes: SCH refers to School Credit Hours. Sample includes all engineering, business, architecture, and nursing programs at Texas public universities for which sticker price (tuition plus mandatory fees) was available in both 2002 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking 15 credits in the Fall. Average grant aid and net price is calculated for all full-time in-state juniors with a declared major in one of these four programs that received one of the main need-based aid programs (Pell, SEOG, Texas Grant, TPEG, HB3015). Grant aid amounts are annual, but are divided in half when calculating net price. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations.

Table A1. IPEDS Sample Characteristics

	Full Sample		Non-Texas Public in SE/SW		Texas Public	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
In-state tuition + fees ($1,000)	4.18	1.78	4.17	1.81	4.24	1.60
Tuition and fee revenue per FTE ($1,000)	6.73	2.97	6.62	3.00	7.39	2.64
Net tuition revenue per FTE ($1,000)	5.57	2.56	5.47	2.58	6.20	2.31
State appropriations per FTE ($1,000)	9.38	8.40	9.58	8.95	8.26	3.65
Share of revenue state appropriations	0.35	0.11	0.35	0.11	0.37	0.10
Share of revenue from tuition	0.29	0.12	0.28	0.12	0.33	0.10
Institutional grant/tuition revenue	0.16	0.12	0.16	0.12	0.15	0.09
Undergraduate enrollment	9,583	8,807	9,143	8,558	12,203	9,777
Number of observations	2,448		2,096		352	
Number of institutions in 2003	216		184		32	
Number of states	16		15		1	

Source: IPEDS and authors' calculations.

Table A2. Texas vs. Non-Texas Sticker Price Estimates, Robustness

	Dependent variable: In-State Tuition and Fee Changes ($1,000)						
	Control group: SE/SW Public			Control group:			
	Base model	Unweighted	Control for unemp. Rate	All public	SE Public	SE no FL	SW public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2000	-0.013	0.083	-0.051	0.293***	-0.053	0.157	0.206
	(0.187)	(0.139)	(0.309)	(0.109)	(0.211)	(0.162)	(0.159)
2001	-0.051	0.062	-0.103	0.248**	-0.100	0.108	0.244
	(0.178)	(0.133)	(0.341)	(0.101)	(0.199)	(0.139)	(0.167)
2002	0.074	0.084	0.059	0.264***	0.017	0.166	0.416
	(0.132)	(0.096)	(0.165)	(0.086)	(0.140)	(0.099)	(0.197)
2004	0.535***	0.365***	0.520***	0.403***	0.545***	0.529***	0.461***
	(0.053)	(0.038)	(0.108)	(0.076)	(0.060)	(0.074)	(0.069)
2005	0.654***	0.442***	0.611**	0.490***	0.670***	0.624***	0.545***
	(0.069)	(0.048)	(0.239)	(0.094)	(0.078)	(0.089)	(0.092)
2006	0.848***	0.628***	0.814***	0.638***	0.871***	0.752***	0.694***
	(0.120)	(0.093)	(0.221)	(0.129)	(0.137)	(0.131)	(0.077)
2007	1.114***	0.888***	1.048**	0.874***	1.147***	0.914***	0.899***
	(0.192)	(0.134)	(0.382)	(0.146)	(0.219)	(0.168)	(0.092)
2008	1.268***	1.010***	1.144	1.025***	1.326***	1.066***	0.885**
	(0.226)	(0.175)	(0.655)	(0.175)	(0.248)	(0.208)	(0.174)
2009	1.424***	1.169***	1.231	1.017***	1.518***	1.104***	0.779
	(0.309)	(0.209)	(0.984)	(0.228)	(0.323)	(0.205)	(0.531)
2010	1.364***	1.145***	1.185	0.968***	1.480***	0.894***	0.549
	(0.411)	(0.281)	(0.945)	(0.286)	(0.428)	(0.219)	(0.765)
Observations	2,411	2,412	2,411	6,293	2,110	1,921	652
R-squared	0.327	0.269	0.328	0.220	0.305	0.413	0.638

Notes: Model includes indicator for Texas public institution, year fixed effects, and interactions between year fixed effects and indicator for Texas public institution. Table reports coefficients on these interactions. Interaction term for 2003 is omitted group so point estimates represent price differences over-and-above the difference that prevailed in 2003. All models (except 2) are weighted by undergraduate enrollment. Control group for base model includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.1 Source: Authors' calculations.

Table A3. Texas vs. Non-Texas Net Price Estimates, Robustness

	Dependent variable: Net Tuition Revenue per FTE ($1,000)						
	Control group: SE/SW Public			Control group:			
	Base model (1)	Unweighted (2)	Control for unemp. Rate (3)	All public (4)	SE Public (5)	SE no FL (6)	SW public (7)
2000	0.140	0.227	0.135	0.322***	0.141	0.225	0.132
	(0.150)	(0.212)	(0.291)	(0.115)	(0.174)	(0.215)	(0.146)
2001	-0.032	0.040	-0.038	0.129	-0.074	0.050	0.213
	(0.140)	(0.146)	(0.315)	(0.080)	(0.156)	(0.157)	(0.179)
2002	-0.079	-0.006	-0.081	0.051	-0.128	-0.051	0.216
	(0.085)	(0.111)	(0.124)	(0.072)	(0.084)	(0.086)	(0.159)
2004	0.283***	0.169**	0.281***	0.203***	0.275***	0.220***	0.328***
	(0.057)	(0.076)	(0.076)	(0.048)	(0.068)	(0.068)	(0.051)
2005	0.279***	0.321***	0.274	0.185**	0.284**	0.214*	0.239
	(0.086)	(0.106)	(0.216)	(0.083)	(0.098)	(0.104)	(0.152)
2006	0.606***	0.541***	0.602**	0.496***	0.676***	0.540***	0.152
	(0.161)	(0.118)	(0.209)	(0.125)	(0.159)	(0.156)	(0.443)
2007	0.642***	0.910***	0.634	0.517***	0.727***	0.568**	0.066
	(0.193)	(0.108)	(0.362)	(0.157)	(0.188)	(0.203)	(0.549)
2008	0.806***	0.982***	0.792	0.608***	0.870***	0.738**	0.381
	(0.186)	(0.124)	(0.633)	(0.161)	(0.197)	(0.244)	(0.288)
2009	1.069***	1.142***	1.046	0.820***	1.158***	0.845**	0.444
	(0.282)	(0.142)	(0.978)	(0.210)	(0.295)	(0.301)	(0.439)
2010	1.037**	0.955***	1.016	0.710**	1.147**	0.621*	0.261
	(0.394)	(0.171)	(0.934)	(0.285)	(0.410)	(0.294)	(0.768)
Observations	2,386	2,400	2,386	6,227	2,104	1,915	631
R-squared	0.319	0.230	0.319	0.218	0.313	0.342	0.518

Notes: Model includes indicator for Texas public institution, year fixed effects, and interactions between year fixed effects and indicator for Texas public institution. Table reports coefficients on these interactions. Interaction term for 2003 is omitted group so point estimates represent price differences over-and-above the difference that prevailed in 2003. All models (except 2) are weighted by undergraduate enrollment. Control group for base model includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.1 Source: Authors' calculations.

Table A4. Predictors of Price Changes by Program, Separately by Program

	Dept variable: Price change from 2002 to 2011															
	Engineering				Business				Nursing				Architecture			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Expenditure per SCH in program	0.515	0.514	-0.757	-0.0832	-0.0651	-0.0962	-0.842	1.141	-0.0850	-0.714	-1.457	-0.595	1.526	2.506*	2.788	4.218**
(lower and upper division ugrad)	(0.969)	(1.465)	(1.201)	(1.083)	(1.835)	(1.976)	(2.456)	(2.516)	(0.653)	(0.518)	(1.077)	(1.259)	(0.984)	(1.185)	(1.444)	(1.265)
Selective program		0.430	183.8	79.18		451.2*	415.8*	350.7		742.7**	817.3***	778.5		-585.8	-569.4	-527.8
		(524.0)	(460.4)	(479.2)		(233.9)	(235.0)	(235.4)		(247.2)	(179.8)	(485.7)		(359.0)	(368.5)	(333.0)
Expenditure per SCH in liberal arts			8.116***	4.034			1.119	1.334			2.053	1.539			-1.733	-12.86
(lower and upper division ugrad)			(2.080)	(2.925)			(2.942)	(2.733)			(1.627)	(2.058)			(5.770)	(6.966)
Acceptance rate				-2,289				-364.7				768.3				-4,470**
(institution)				(2,615)				(417.3)				(1,284)				(1,285)
% Students w Federal grant aid				-0.702				-15.86**				-9.730				44.10**
(institution)				(16.74)				(5.800)				(7.531)				(13.89)
Constant	2,125***	2,125***	867.0**	3,424	2,104***	1,974***	1,952***	2,328***	2,019***	2,225***	2,198***	1,576	1,879***	1,721***	1,954*	6,142**
	(374.8)	(399.1)	(362.8)	(2,097)	(471.0)	(467.2)	(498.7)	(388.1)	(377.4)	(352.8)	(346.8)	(1,376)	(242.1)	(257.8)	(931.8)	(1,729)
Observations	14	14	14	14	26	26	26	25	12	12	12	12	10	10	10	10
R-squared	0.021	0.021	0.336	0.482	0.000	0.152	0.157	0.454	0.001	0.439	0.511	0.604	0.320	0.573	0.576	0.849

Notes: SCH refers to School Credit Hours. Sample includes all engineering, business, architecture, and nursing programs at Texas public universities for which sticker price (tuition plus mandatory fees) was available in both 2002 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking 15 credits in the Fall. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations.

Figure A1. Price Change and Initial Instructional Expenditure, by Program