Pricing and University Autonomy: Tuition Deregulation in Texas

JEONGEUN KIM AND KEVIN STANGE

This paper investigates changes in tuition policies in the wake of tuition deregulation in Texas, which in 2003 transferred tuition-setting authority from the state legislature to institutions. We find that price increases accelerated, 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, nursing, and architecture. Price increases were particularly large for institutions with the highest initial costs and for programs with a high earnings premium within institutions, though lower for institutions with more low-income students. These distinctions suggest that public postsecondary institutions respond to microeconomic incentives when given greater autonomy to set price, and take 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, differential tuition, college pricing

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 policymakers 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 explored the possibility of 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, John Bound, Michael Lovenheim, and Sarah Turner (2010) find 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 because many institutions have responded by raising tuition. Although shifting costs to students via tuition increases would be one way to compensate for lost state revenue, this option is limited for many public colleges and universities that have limited flexibility to set prices. The responsibility for setting tuition is left to individual institutions in only ten states; state legislatures or other broad government boards have primary authority in the others (Carlson 2011). This pattern is changing, however, as a

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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 (Camou and Patton 2012; Deaton 2006; Marley and Herzog 2015; McBain 2010).

Despite the policy relevance and potential impacts on access and affordability, evidence is scant on how public institutions alter their tuition levels or policies when given more autonomy over tuition-setting. Much research on university pricing has focused on private, particularly elite, institutions (Clotfelter 1996; Ehrenberg 2001; Epple, Romano, and Sieg 2006) and generally not on tuition-setting structures. Findings are mixed in the limited analysis of the public sector that has examined tuition-setting and governance structures. Robert Lowry (2001) finds that tuition at public universities is higher when a state has multiple governing boards, Michael Rizzo and Ronald Ehrenberg (2004) find no relationship, and Michael McLendon, James Hearn, and Robert Hammond (2013) find that tuition is lower in states with more governing boards. Because 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] Stella Flores and Justin Shepard (2014) examine the effect of tuition deregulation at seven Texas institutions and find that institution-level price has accelerated but effects on enrollment of underrepresented minority students is mixed. The behavior of private universities is unlikely to provide a clear model of how public institutions will respond to greater pricing authority, as public institutions have a formal responsibility for educating their in-state residents that private institutions do not (Weisbrod, Ballou, and Asch 2008). Furthermore, if state lawmakers internalized institutional objectives before deregulation, shifts in the nominal responsibility for setting prices could have minimal impact. For all these reasons, an empirical examination of whether and how public institutions alter prices when given more authority to do so is essential.

To answer these questions, this study describes 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 is a particularly good setting to examine the topic of deregulation in light of its institutional diversity and the scope of the policy changes. We make three contributions to prior work. First, we focus on a sharp change in the financial independence of public universities specifically as it relates to tuition-setting authority, rather than 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, we also examine program-specific prices within institutions. Prior research on price-setting has focused on overall institution-level price with no systematic analysis of price differences across programs within institutions. The program-specific analysis in this study is enabled by novel data about pricing practices at a program level within institutions, which we assembled from numerous historical and archival sources. Within-institution analysis is important because many institutions have turned to or are considering differential tuition to maintain program quality in the face of diminished state appropriations. 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 ma-

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 and his colleagues (2013) incorporate several measures of governance structure (including number of governing boards) in longitudinal analysis that includes institution fixed effects, but do not explicitly assess the extent to which governing board measures actually change over time, which is necessary for identification.

jority of college students attend public four-year colleges outside the flagships.

In our analysis, we first 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 lucrative and selective programs within institutions. Institutions with many low-income students experienced lower price growth and additional grant aid also offset some of the price growth for low-income students. One implication is that deregulation resulted in much greater differentiation within the public higher education system in Texas.

These results suggest that public institutions respond to microeconomic incentives when setting prices but take measures to mitigate impacts on low-income students. Although it may not be surprising that institutions altered prices following deregulation, the specific patterns of these changes were unknown beforehand and are potentially informative about the differing objectives of institutions and state lawmakers. State lawmakers appear to place relatively more value on broad-based affordability, having maintained low and uniform sticker prices prior to deregulation. Institutions, on the other hand, appear to place relatively more weight on program quality and desire greater differentiation, both across programs and institutions. Whether these patterns reflect different objectives (such as a different conception of social welfare on the part of institutions) or differences in information (institutions may have better information about the appropriate level of differentiation), we cannot tell. Regardless, the balance struck between affordability and quality objectives clearly depends on the nominal price-setter, which numerous states have recently altered (or considered altering). The equity and efficiency consequences of these price changes ultimately hinges on how they affected the sorting of students into programs, changed institutional capacity, and impacted program quality. A necessary first step to addressing these normative issues is to document and understand how public institutions change their pricing practices when given full autonomy to do so.

BACKGROUND

Texas has a large and diverse public higher education system that includes thirty-nine 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 percent of the revenue at four-year institutions, and tuition for 18 percent (South Regional Education Board 2013), though appropriations have been declining in Texas for last five years (Palmer 2013).[2]

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, which vary across five academic levels and twenty discipline areas, are determined by cost differences.[3] Importantly,

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

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

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 because this spending would not be reimbursed by the state.

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 appropriate and necessary. Designated tuition, previously known as a building use fee, 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 associated with services or activities. Mandatory fees are charged to a student on 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.

Tuition Deregulation

In response to the economic downturn, the state decreased revenue appropriations in 2002 (Hernandez 2009). With leadership from the state's research-intensive universities, particularly the University of Texas (UT) and Texas A&M systems, 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 enough 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 (University of Texas 2008), claiming that a "deregulated environment is a more efficient environment" (Hall 2003). The argument was that tuition flexibility would not only permit maintenance of existing levels of service, but also increase institutional agility to anticipate and meet statewide 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 would 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 legislature 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. The amount can also 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 the deregulation came with a requirement that 20 percent of the proceeds from Texas resident undergraduate rates greater than $46 per school credit hour be set aside to

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).

provide financial assistance to students.[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).

Review of Literature

Most 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 (Hearn, Griswold, and Marine 1996; Kane 1999; Paulsen 2000; Toutkoushian and Hollis 1998). Declines in state support are followed by increases in in-state tuition in subsequent years (Koshal and Koshal 2000) and higher net tuition revenue (Lowry 2001). Rizzo and Ehrenberg (2004) also find 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 also be mediated by institutional characteristics. Michael McLendon, James Hearn, and Robert Hammond (2013) find that as state appropriation increases, tuition at public flagships grows more slowly. Factors such as proportion of out-of-state students also influence tuition levels. Rizzo and Ehrenberg (2004) also show 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 and Stone 2007; Turner 2012). Bridget Long (2004) finds that the Georgia HOPE scholarship decreased tuition at public institutions by 3 percent but increased it at private institutions by about 5 percent. 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) find 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

Caroline 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 find significant differences between public and private institutions in response to market changes: the increase in tuition and subsidizes were most significant at elite private institutions (Clotfel-

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

5. A long literature on the effects of tuition increases on student enrollment and success is indirectly relevant here in that students' enrollment responses should influence institutions' pricing decisions (for a recent overview of this literature, see Kane 1999; for program-specific enrollment responses to price, see Shin and Milton 2008; Stange 2015).

ter 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. Although 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) finds 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) find no evidence for the relationship between autonomous governance structures and higher tuition. This finding is echoed by McLendon, Hearn, and Hammond (2013), who find that having a weak governing board (a measure of institutional autonomy) has 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 focuses on factors that determine overall institution-level price and offers no analysis of price differences across programs within institutions. This is surprising, because 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 (Ehrenberg 2007; Heller 2006; Mortenson 2004; Ward and Douglass 2005). Only recently have these practices been documented on a national scale. In a broad survey of 165 public research universities, Glen Nelson (2008) finds that 45 percent 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 more rare, but still present at some institutions (Ehrenberg 2012; Simone 2010). A recent survey found a continuation of this trend: Ehrenberg (2012) reports that 42 percent of all public doctoral institutions had some form of tuition differential in 2010–2011, as did many public master's-level (18 percent) and bachelor's-level (30 percent) public institutions, and that growth has been steady 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), particularly that of minority students (Ravenscroft and Enyeart 2009). Incremental tuition revenue is allocated to colleges or departments in most cases, and the central administration keeps part of differential tuition revenue at some institutions. The tuition revenue is spent on teaching expenditure (reduction of faculty-student ratio, increases in faculty salaries), equipment and technology support, and financial aid (Ravenscroft and Enyeart 2009).

THEORETICAL FRAMEWORK

To structure our empirical work, we briefly sketch several prominent economic factors potentially influencing public institutions' pricing behavior in the wake of tuition deregulation.[6] We pay particular attention to factors that explain why institutions may increase prices for particular programs rather than at the same rate across the board. Our starting point is a model of price-setting where univer-

6. This discussion glosses over the fact that the changes we document empirically result from a shift in price-setting autonomy from state lawmakers to institutions themselves. If lawmakers were completely internalizing the objectives of the institutions prior to deregulation, we would see little change in price following deregulation and would thus be unable to quantify the importance of the factors described.

sities 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 (such as prestige, surplus, diversity, or student success) subject to a budget constraint that educational spending must be covered by tuition and state revenue.[7]

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 and Turner 2009; Thornton 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 because of private-sector competition, and this may force institutions to generate more revenue to retain them (Deaton 2006). Before deregulation, institutions did not have the flexibility to align price very closely with inherent costs, thus some programs were underpriced relative to cost. This resulted in cross-subsidization across academic disciplines, from low-cost—such as the humanities and social sciences—to high-cost—such as fine arts, agriculture, business, and engineering (James 1978; Zemsky, Wegner, and Massy 2005). From this perspective, differential pricing alleviates undue expense on students in less expensive majors (Harwell 2013). Given pricing flexibility, universities will likely increase prices for costly majors and moderate increases for lower-cost ones (Berg and Hoenack 1987; Hoenack and Weiler 1975; Yanikoski and Wilson 1984). Although differential tuition could benefit low-income students who enter low-cost fields (Little, O'Toole, and Wetzel 1997), it may also hamper access to high-cost ones. Institutions concerned about access may thus allocate part of the incremental revenue to financial aid.

An observably similar, though conceptually distinct, prediction is that price increases should be greatest for those programs already making the largest educational investments before deregulation. Vertical differentiation across institutions arises from heterogeneous demand for college quality and complementarity between student ability and college quality (Hoxby 2009; Rothschild and White 1995). Price regulation constrains the extent of quality differentiation because students with 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). When proposing higher tuition, institutions emphasize the need to enhance quality through additional resources, which can be used for faculty hiring and salary increase, smaller classes, better facilities, and more student supports.[8] Departments' quest for quality and reputation are further driven by schools' desire to obtain resource parity with peer institutions (for example, Texas A&M University 2010), which may be most salient for the most well-resourced institutions at baseline.

A second prediction is that institutions and programs facing more elastic demand should be more reluctant to raise price. This is a basic tenet of monopolistic pricing and has been examined in the context of university pricing (Ehrenberg and Sherman 1987; 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 (such as business) or if the degree is required for entry to

7. 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.

8. Texas A&M and the University of Houston report that additional revenue, beyond the 20 percent set aside for financial aid, is largely retained by the colleges and spent at the discretion of the dean of the colleges (Ravenscroft and Enyeart 2009).

the related occupation (such as nursing). Although 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 2006). For example, institutions may not want to increase price for certain majors deemed critical to the local workforce. We do not investigate this factor directly.

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 the Integrated Postsecondary Education Data System (IPEDS), we assemble data on in-state tuition and fees, revenues by category, and total enrollment for each public four-year university in the country from 2000 to 2010.[9] To this data we merge on information about Barron's selectivity in 2004 and the state unemployment rate in each year. The full sample includes a total of 6,599 observations, corresponding to thirty-two 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. Although both groups of institutions have been raising prices over this period, the price jump at Texas universities in 2004 is notable. 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 depend more on tuition in the postderegulation period (figure 2). The share of revenue coming from state appropriations also dropped in Texas relative to other institutions following deregulation, though it recovered eventually (figure 3).

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 (such as 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.

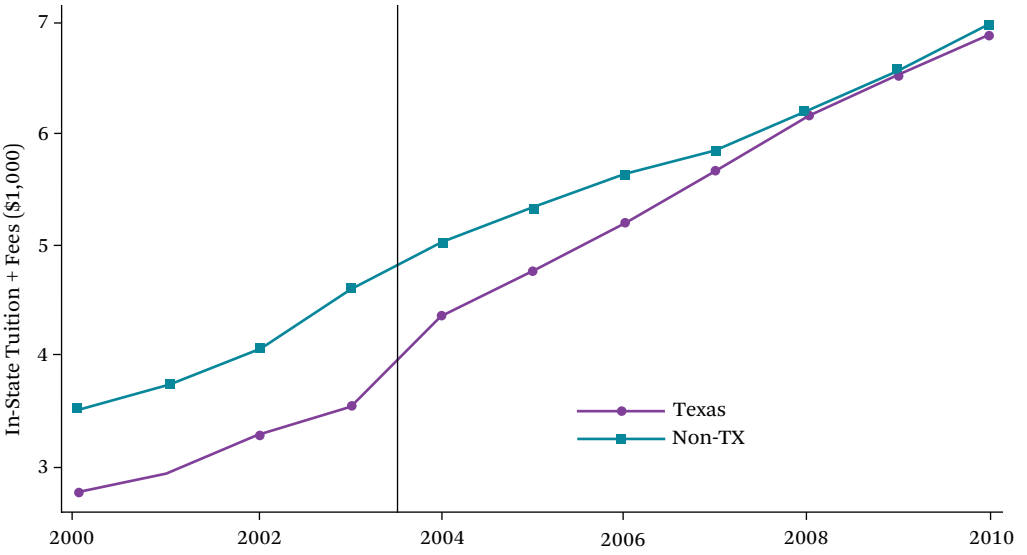
$$Y_{jt} = \beta_0 \cdot Texas\ Public_j + \sum_{s=2000}^{2010} \gamma_t 1(year_t = s) + \beta_t 1(year_t = s) \cdot Texas\ Public_j + e_{jt}$$

We omit the interaction term for 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 indicating 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 before deregulation. In most of our analysis, we restrict our sample to institutions in sixteen southeastern and southwestern states,[10] though we also examine other sets of institutions as potential control groups.

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

10. These states include Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia in the Southeast and Arizona, New Mexico, Oklahama, and Texas in the Southwest.

Figure 1. Average Tuition and Fees

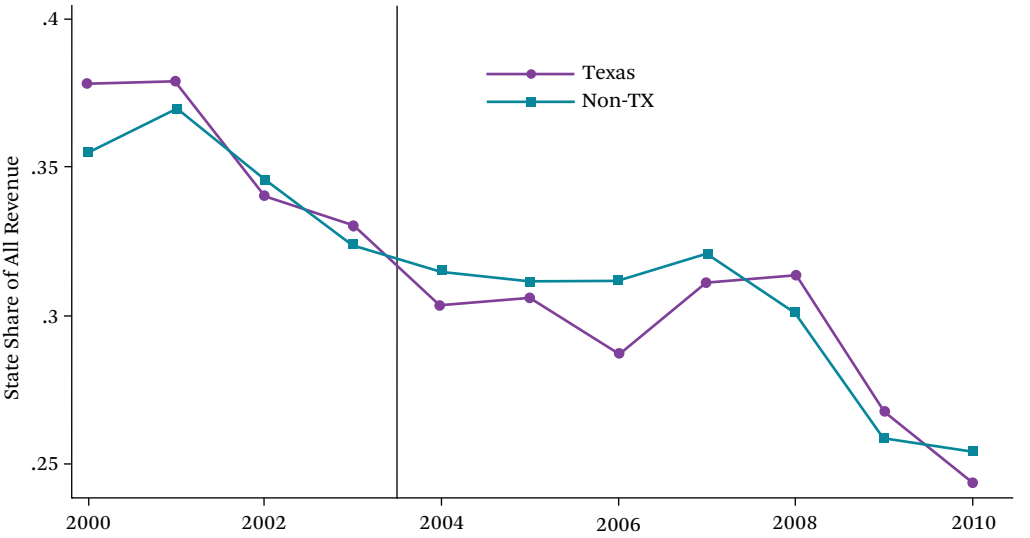


Sources: Authors' calculations based on IPEDS.
Note: The vertical line refers to 2003 when the bill targeting tuition deregulation was passed. Averages are weighted by total undergraduate enrollment. Nonweighted graphs look similar. Sample includes all public four-year institutions in the United States (public universities in Texas versus public universities in all other states).

Figure 2. Share of Revenue from Tuition

Sources: Authors' calculations.
Notes: The vertical line refers to 2003 when the bill targeting tuition deregulation was passed. Averages are weighted by total undergraduate enrollment. Nonweighted graphs look similar. Sample includes all public four-year institutions in the United States (public universities in Texas versus public universities in all other states).

Figure 3. Share of Revenue from State Appropriations



Sources: Authors' calculations based on IPEDS.

Notes: The vertical line refers to 2003 when the bill targeting tuition deregulation was passed. Averages are weighted by total undergraduate enrollment. Nonweighted graphs look similar. Sample includes all public four-year institutions in the United States (public universities in Texas versus public universities in all other states).

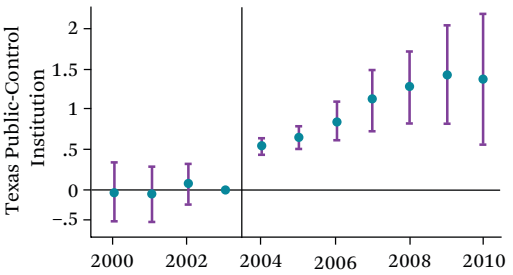
This restricted sample includes approximately 184 non-Texas institutions per year and a total of 2,096 non-Texas observations (for summary statistics, see table A1). Our analysis weights each observation according to its total undergraduate enrollment, though unweighted results are quite similar for all the outcomes we examine. As a robustness check, we also control for the state unemployment rate in some specifications, because 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 4 plots the point estimates and 95 percent confidence interval of the β_ts for in-state tuition and required fees, estimated using all public institutions in the Southeast or Southwest as controls. Although no trend difference is discernable between Texas and other states before 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.[11] A lack of trend prior to deregulation suggests that Texas and non-Texas institutions had similar price trajectories prior to deregulation and might have been expected to continue this pattern in the absence of deregulation.[12]

11. 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 institutions do not provide a good control group as their tuition rates have been rising relative to Texas public institutions even before deregulation.

12. Tables A2 and A3 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.

Figure 4. Estimates of Tuition and Fee Changes ($1,000) After Deregulation

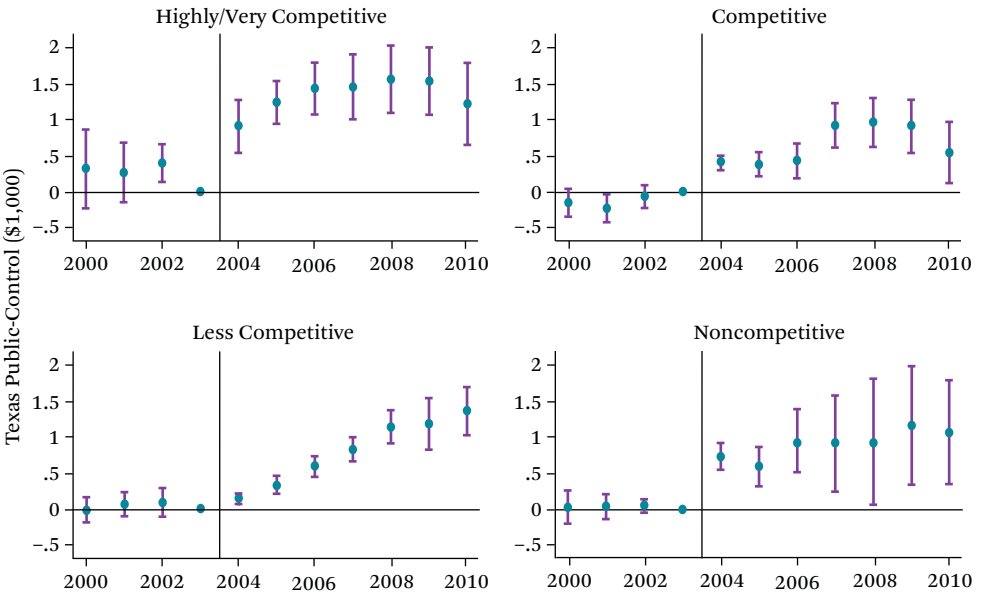


Source: Authors' calculation based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. Control group includes all public four-year institutions in either the Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment.

Figure 5 separates institutions by selectivity. The steepest price increase is seen at the five institutions that Barron's deemed highly competitive or very competitive (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.[13]

Figures 6, 7, and 8 examine two alternative, revenue-based, measures of price. In figure 6, estimates for tuition and fee revenue per full-time-equivalent 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 percent of the incremental proceeds from resident undergraduate tuition be set aside to fund need-based institutional aid and loan programs. Figure 7 pre-

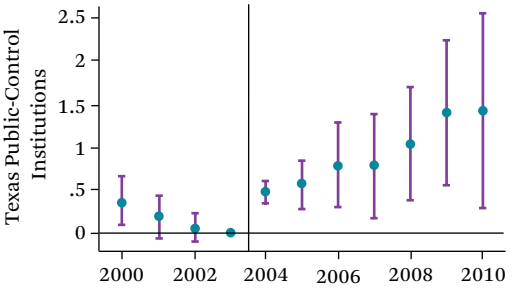
Figure 5. Estimates of Tuition and Fee Changes ($1,000) After Deregulation, by Selectivity



Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent 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.

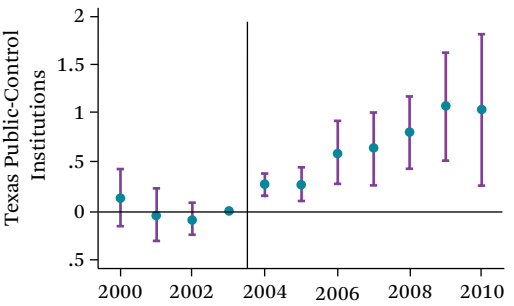
13. We do see large price increases in the noncompetitive sector as well, but given the few institutions in this sector in Texas (six), these results are quite imprecise, especially for later years.

Figure 6. Estimates of Changes in Tuition and Fee Revenue (per FTE, $1,000) After Deregulation



Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. Tuition and fee revenue per FTE includes students from all levels, not exclusively undergraduate. Control group includes all public four-year institutions in Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment.

Figure 7. Estimates of Changes in Net Tuition Revenue (per FTE, $1,000) After Deregulation

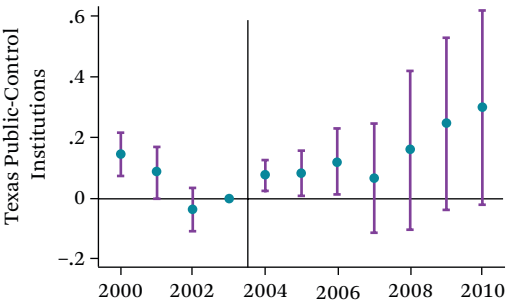


Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. Tuition and fee revenue per FTE includes students from all levels, not exclusively undergraduate. Net tuition revenue equals tuition revenue minus institutional grant expenditure.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

sents estimates of changes in net tuition revenue (tuition revenue minus institutional grants) following deregulation. Although 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. Figure 8 indicates that Texas public institutions have increased institutional grant aid after deregulation, compared with their counterparts in the Southeast and Southwest.

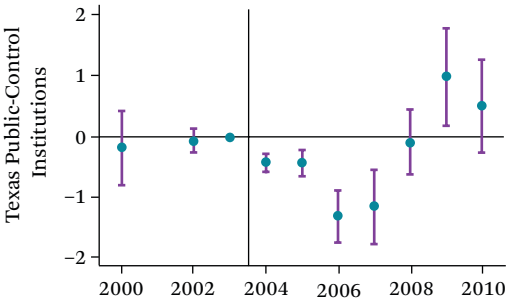
Figure 9 examines changes in state appropriations per student following deregulation using the same difference-in-differences model. Texas institutions had a similar path of state support in the years leading up to deregulation, though a sizable drop in state support in the four years following. The decline, which was partially enabled by deregulation through political compromise, is thus an alternative explanation for the steep tuition increases immediately after deregulation. Interestingly, Texas institutions continued to expand their prices relative to peer institution through 2008 and 2009, despite state appropriations having returned to parity.

Figure 8. Estimates of Changes in Institutional Grant Aid (per FTE, $1,000) After Deregulation



Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. Institutional grant aid per FTE includes students from all levels, not exclusively undergraduate. Control group includes all public four-year institutions in Southwest or Southeast. Standard errors clustered by state. Estimates are weighted by total undergraduate enrollment.

Figure 9. Estimates of Changes in State Appropriations per FTE ($1,000) After Deregulation



Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. State appropriations revenue per FTE 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.

WITHIN TEXAS COMPARISONS

Data and Measures

Although information on average or typical tuition and fees are available for institutions from a number of standard sources, no systematic data exist 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, credit load, entering cohort, residency, and undergraduate level. This level of granularity is critical because 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 include only 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 before deregulation legislation passed 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). These micro data contain 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.[14]

We constructed two proxies for demand

14. 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 that 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

elasticity at the program level. First, we created 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. Second, we estimate the average ten-year log earnings difference between enrollees of each program and Texas high school graduates who do not enroll in a Texas public postsecondary institution from the high school cohort of 2000 from student earnings micro data.[15] These data were obtained from merged student records obtained from the Texas Education Agency, Texas Higher Education Coordinating Board, and the Texas Workforce Commission, housed at the UT-Dallas Education Research Center as part of the Texas Schools Project. As a robustness check, we also use log earnings estimates adjusted to control for sex, race-ethnicity, free-lunch status, and high school exit exam scores. We interpret higher selectivity and higher earnings potential as markers for programs facing less elastic demand. Finally, we calculated the freshman acceptance rate from THECB data to characterize overall institutional selectively. The proportion of students receiving federal grant aid (a proxy for low-income) for the institution overall was drawn from IPEDS.

Although we collected price data on all academic programs, in the analysis 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).

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 nonstandard 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.

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.

$$\Delta Price_{j,k} = \beta_0 + \beta_1 \left(\frac{Exp}{SCH}\right)_{jk,2002} + \beta_2(Selective_{jk}) + \beta_3(LnEarnings_{jk}) + \delta_k + \beta_z Z_j + \varepsilon_{jk} \quad (1)$$

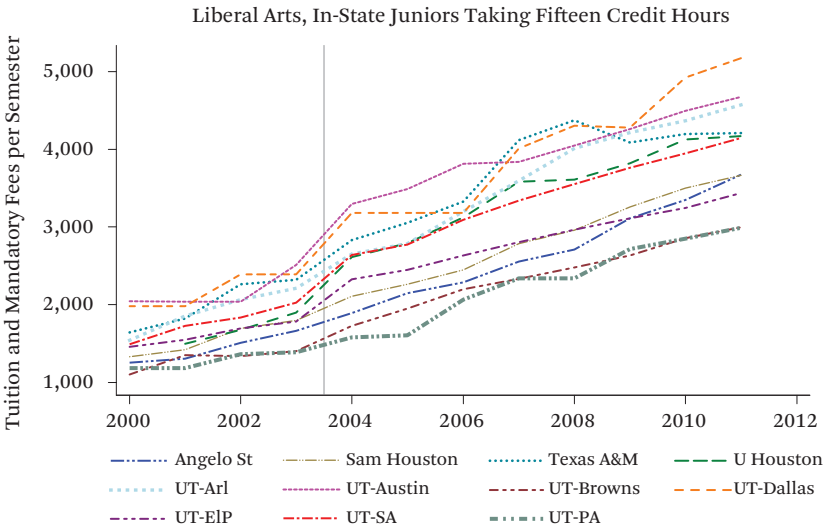
Our main outcome, $\Delta Price_{j,k}$, is the change in price for program k at institution j between Fall 2003 (the last term before deregulation took effect) and Fall 2011.[16] We investigate sev-

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.

15. Specifically, for all Texas high school graduates from the class of 2000 we regress log quarterly earnings measured ten or more years after graduation on indicators for first enrollment in one of about three hundred institution-major programs (plus community college). The estimated coefficients on these indicators provide the log earnings difference between enrollees in these programs and high school graduates who did not enroll in a Texas public postsecondary institution within two years of high school. These measures come from ongoing work in which one of the authors is examining the impact of price deregulation in Texas on the sorting of students to different programs.

16. Results are substantively very similar if 2002 is used as the base year. Pooling multiple years of price data and including many interactions between time, postderegulation, and our covariates does not improve precision since our main variables of interest are time-invariant.

Figure 10. Tuition and Fees by Institution



Source: Authors' calculations.

eral 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. Because 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 $\left(\frac{\text{Exp}}{\text{SCH}}\right)_{jk,2002}$ captures whether programs that are more costly to provide experienced larger increases in price following deregulation. This cost variation is both across 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 or ACT scores than other majors. We use this variable as a proxy for a program having excess demand. Third, $LnEarnings_{jk}$ measures the earnings premium that students enrolled in program k at institution j have relative to high school graduates that do not enroll in a Texas postsecondary institution. Programs (within institutions) having excess demand or higher earnings premiums should face a less elastic demand and thus could raise prices without curtailing enrollment. Fourth, we examine a small set of institutional characteristics, Z_j, such as overall selectivity and demographic composition (percentage eligible for Pell). Finally, in some specifications we include program or institution fixed effects (replacing institutional characteristics) to examine cross-program price changes after netting out overall price increases at institutions.

Descriptive Evidence

Figure 10 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 fifteen credit hours. The tuition and fees for each institution increased considerably following deregulation, a notable jump occurring in the first year institutions had tuition-setting authority. On average, tuition is increased by $1,782 (95 percent) from 2003 to 2011.[17] However, variation around this average is fairly sig-

17. THECB (2010b) reported that between the fall of 2003 and the fall of 2009 the statewide average of total academic charges for a student taking fifteen semester credit hours increased by 72 percent, some $1,389.

nificant, UT-Dallas raising prices by $2,783 (117 percent) and the University of Houston-Victoria by $1,084 (59 percent).

In addition, three forms of new pricing structures emerged: differential, flat-rate, and guaranteed. Institutions' use of these practices following deregulation is summarized in table 1. More than one-third (thirteen) of the universities began differentiating tuition by major or program or assigned program-specific fees that had the same effect, referred to as *differential tuition*. The programs typically affected are engineering (ten), business (twelve), nursing (six), and architecture (four). Many of these were ad-

Table 1. Summary of Pricing Policies 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	no
University of Texas at Austin	no	architecture, business, communication, education, engineering, fine arts, liberal arts, natural sciences, nursing, pharmacy, social work, geosciences	yes	no
University of Texas at Brownsville	no	no	yes	no
University of Texas at Dallas	yes (lower)	engineering and computer sciences, business, natural sciences and math	yes	yes
University of Texas at El Paso	no	engineering, nursing, business		no
University of Texas at San Antonio	no	no	no	no
University of Texas at Tyler	no	no	no	no
University of Texas-Pan American	no	no	no	no
University of Texas of the Permian Basin	no	no	no	no
Texas A&M University	yes (upper)	business; architecture, engineering, bio & agricultural engineering	yes	no
Texas A&M International University	no	no	no	no
Texas A&M University-Commerce	no	no	no	no
Texas A&M University-Corpus Christi	no	no	no	no
Texas A&M University-San Antonio	no data	no data	no data	no data
Texas A&M University-Kingsville	no	no	no	no
Prairie View A&M University	no	business, nursing, engineering	no	no

Table 1. (*cont.*)

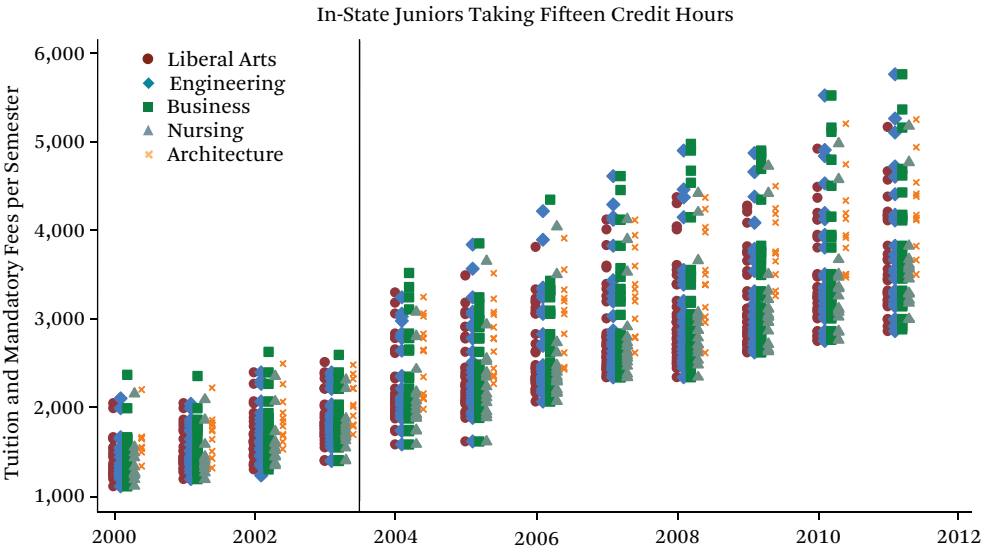
	Differential Pricing by Level?	Differential Pricing by Field? (Which Fields?)	Flat Pricing?	Guaranteed Tuition?
Tarleton State University	no	business, nursing & health professions, engineering and technology (*2013)	no	no
Texas A&M University-Texakana	no data	no data	no data	no data
West Texas A&M University	no	no	no	no
Texas A&M University-Central Texas	no data	no data	no data	no data
University of Houston	no	architecture, business, education, engineering, hotel & restaurant business, liberal arts & social sciences, social work, technology	no	no
University of Houston-Clear Lake	no	business	no	no
University of Houston-Downtown	no	business	no	no
University of Houston-Victoria	no	no	no	no
University of North Texas	no	no	yes	no
University of North Texas at Dallas	no	no	no	no
Lamar University	no	no	no	no
Sam Houston State University	no	no	no	no
Sul Ross State University	no	no	no	no
Texas State University	no	no	no	no
Angelo State University	no	no	no	no
Texas Tech University	no	agriculture, business, engineering	no	no
Midwestern State University	no	no	no	no
Stephen F. Austin State University	no	no	no	no
Texas Southern University	no	business, education, science & tech, humanities, fine arts, & social sciences	no	no
Texas Woman's University	no	nursing	no	no

Sources: Authors' compilation.

opted in 2004. Cost varied across institutions and programs even before deregulation, given variation in fees and that some institutions were not hitting the cap on designated tuition. However, the increase in the dispersion of prices across institutions and programs from 2004 onward is quite clear (figure 11).

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. Ronald Ehrenberg (2012), Glen Nelson (2008), and Kevin Stange (2015) each find that many public universities have ad-

Figure 11. Price Spread Across Institution and Program



Source: Authors' calculations.

opted 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*. Steven Hemelt and Kevin Stange (2014) find modest to no effect of flat (versus per credit) pricing on the average number 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).

Difference Regressions

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 measures of program cost and excess demand, separately by program. Across all institutions, colleges spend $208 per undergraduate student credit hour in liberal arts, ranging from $108 to $390 across institutions. The other four programs we examine are all significantly more expensive, including $397 for engineering, $267 for business, $511 for nursing, and $341 for architecture. Because these programs are much more expensive than liberal arts, it is not surprising that these are targeted for differential pricing. Interestingly, variation is considerable 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. Finally, enrollees in engineering, business, and architecture experience higher earnings premiums than students in liberal arts, even after adjusting for student achievement and demographic characteristics.

As our primary outcome, we calculate the per-semester price change from 2003 to 2011 for each program at each institution. Table 2 also summarizes the variation in price of these five programs across institutions. Because price data is available for only some years and

Table 2. Characteristics of Five Programs, 2003

	Liberal Arts	Engineering	Business	Nursing	Architecture
Number of programs	27	14	27	13	10
Program is selective	0.00	0.57	0.30	0.23	0.30
Acceptance rate (institution)	0.82	0.84	0.82	0.84	0.80
Fraction Pell (institution)	37.3	32.4	37.3	40.0	22.9
Log earnings difference	0.241	0.839	0.517	0.169	0.532
Adjusted log earnings difference	0.151	0.478	0.313	0.120	0.345
Undergraduate expenditure per student credit hour, 2002					
Mean	208	397	267	511	341
Min	108	174	177	333	132
Max	390	737	456	869	690
Tuition and fees per semester, 2003					
Mean	1,870	1,985	1,873	1,740	2,099
Min	1,389	1,389	1,389	1,389	1,687
Max	2,508	2,387	2,590	2,308	2,474
Change in tuition and fees per semester, 2003 to 2011					
Mean	1,782	2,129	1,887	1,854	2,214
Min	1,084	1,330	1,084	1,423	1,812
Max	2,783	3,383	3,383	2,873	3,360
Grant aid (need-eligible students), 2003					
Total grant aid	4,243	4,997	4,380	4,663	4,454
Pell Grant aid	2,390	2,404	2,366	2,374	2,083
Non-Pell Grant aid	1,852	2,592	2,014	2,289	2,371
Net tuition and fees per semester (need-eligible students), 2003					
Mean	−251	−479	−317	−563	−94
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	408	264	460	397	577
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	1,371	2,003	1,427	1,478	1,731
Pell Grant aid	1,009	902	976	912	859
Non-Pell Grant aid	362	1,102	452	565	871

Sources: Authors' compilation. Undergraduate expenditure per student credit hour and acceptance rate from THECB. Whether a program is selective and sticker price information from various archival sources. Log earnings difference is for 2000 enrollees in each program measured ten years after enrollment, relative to earnings for high school graduates who did not enroll in a Texas public institution. Adjusted log earnings estimates control for student race, sex, free-lunch status, and high school exit exam scores. Average grant aid and net tuition estimated from student-level data contained in the Financial Aid Database compiled by THECB. See text for details.

not all institutions have nursing and architecture programs, this table and our subsequent analysis relies on ninety-one observations: twenty-seven liberal arts programs, fourteen engineering programs, twenty-seven business programs, thirteen nursing programs, and ten architecture programs. As in the earlier figures, average price and range of prices was similar across all five programs prior to deregulation in 2003. The third panel depicts changes in price from 2003 to 2011. Average price nearly doubled, increasing by $1,782 for liberal arts programs, about $70 more for nursing programs, $100 more for business programs, $350 more for engineering, and $430 more for architecture programs. However, these averages mask quite a bit of heterogeneity in price response. The standard deviation and range (maximum-minimum) 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 show the same variation across programs in part because 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. Expenditure per student (combining lower and upper division courses) has no relationship with the price change following deregulation, though the estimate is imprecise.[18] Specifications (2) through (4) examine the correlation with three other economic factors: the institutional acceptance rate, the proportion of students receiving federal grant aid (a marker for the proportion who are low income), and log earnings premium. Institutions with a low acceptance rate and greater earnings premiums see 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 proportion of students receiving federal grant aid) have more restrained increases. When these variables are examined together (specification 5), we find that institutions with the greatest price increases following tuition deregulation have higher expenditure per student credit hour and fewer low-income students than before deregulation. Selectivity and earnings premiums do not have a consistent relationship with price increases of liberal arts programs. Finally, specifications (6) through (9) examine the correlates of changes in 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 examines price changes for four particular programs which 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. Earnings premiums, program selectivity, and overall institution characteristics (such as 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 higher earnings premiums or separate admissions processes (a marker for excess demand), yet did not for more expensive programs regardless of which other characteristics are controlled for. Although selective programs see larger price increases than nonselective ones, they also provide more grant aid, particularly grants other than Pell. This suggests that the net tuition for selective programs did not rise as fast for needy students as sticker price did. Programs with high earnings premiums see an increase in net price, as additional grant aid

18. Figures A1 and A2 plot the price changes against baseline expenditure in 2002 (figure A1) and earnings premiums (figure A2), separately by program. It is clear that the price increase is greatest in engineering and architecture programs with the greatest expenditure at baseline, but not so for business, liberal arts, or nursing. Price increases are strongly positively correlated with earnings premiums for all majors other than architecture.

Table 3. Predictors of Price Changes, Liberal Arts

	Price Change from 2003 to 2011 (mean = $1,782)					Change from 2003 to 2011 (Students with Need Aid)			
						Net Price ($442)	Total Grants ($1,387)	Pell Grant ($985)	Other Grant ($402)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure per SCH in liberal arts (lower and upper division ugrad)	0.0642				2.231*	−1.515	3.408*	0.165	3.243
	(1.554)				(1.241)	(2.380)	(1.903)	(0.683)	(2.009)
Acceptance rate (institution)		−379.1			86.19	−341.5	442.8	900.1	−457.2
		(523.0)			(585.9)	(765.6)	(1,189)	(625.4)	(1,797)
% Students with federal grant aid (institution)			−10.96***		−13.29**	−20.53***	7.441	11.39**	−3.947
			(2.957)		(4.799)	(7.155)	(8.477)	(4.823)	(10.95)
Log earnings difference (relative to non-enrollees)				900.7**	−106.1	−653.1	821.8	700.3**	121.5
				(374.7)	(312.8)	(1,021)	(920.4)	(312.6)	(966.0)
Constant	1,769***	2,120***	2,218***	1,585***	1,817***	1,930***	−153.4	−382.4	229.0
	(291.9)	(467.4)	(135.2)	(106.1)	(458.0)	(661.5)	(990.0)	(518.4)	(1,467)
Observations	27	26	26	26	25	24	24	24	24
R^2	0.000	0.030	0.296	0.254	0.376	0.316	0.314	0.574	0.172

Source: Authors' calculations.

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 2003 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 who 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. Log earnings difference is for 2000 enrollees in humanities measured ten years after enrollment, relative to earnings for high school graduates who did not enroll in a Texas public institution. Robust standard errors in parentheses.

*$p < .1$, **$p < .05$, ***$p < .01$

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

	Price Change from 2003 to 2011 (mean = $1,984)						Change from 2003 to 2011 (Students with Need Aid)			
							Net Price ($432)	Total Grants ($1,595)	Pell Grant ($932)	Other Grant ($664)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure per SCH in program (lower and upper division ugrad)	0.510 (0.406)			0.700 (0.471)	0.802 (0.658)	0.482 (0.566)	0.0467 (0.711)	0.206 (0.474)	0.0606 (0.214)	0.145 (0.449)
Selective program		350.4** (140.9)		111.5 (183.9)	115.6 (198.9)	−11.29 (178.5)	−242.2 (225.7)	268.5* (157.2)	−75.35 (70.99)	343.8** (144.2)
Log earnings difference (relative to non-enrollees)			506.1*** (178.6)	552.1*** (203.7)	559.2** (232.8)	337.1* (200.2)	457.7 (368.9)	521.4** (252.5)	−392.1*** (78.50)	913.5*** (251.9)
Expenditure per SCH in liberal arts (lower and upper division ugrad)						2.906** (1.236)				
Acceptance rate (institution)						−231.9 (469.6)				
% Students with federal grant aid (institution)						−10.86** (4.771)				
Engineering					−3.450 (241.8)	58.13 (220.1)	−240.5 (302.2)	147.7 (242.5)	218.8** (101.5)	−71.13 (191.5)

Table 4. *(cont.)*

	Price Change from 2003 to 2011 (mean = $1,984)						Change from 2003 to 2011 (Students with Need Aid)			
							Net Price ($432)	Total Grants ($1595)	Pell Grant ($932)	Other Grant ($664)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Business					46.23	44.61	1.055	−129.4	166.2	−295.5*
					(211.6)	(183.9)	(242.2)	(218.1)	(105.6)	(174.2)
Architecture					284.8	142.2	130.6	143.1	33.36	109.7
					(223.4)	(246.5)	(285.2)	(222.4)	(110.5)	(189.3)
Nursing (reference)										
Constant	1,802***	1,864***	1,746***	1,429***	1,323***	1,604***	298.9	1,157***	1,019***	138.0
	(143.5)	(82.42)	(95.33)	(182.5)	(337.3)	(453.5)	(363.6)	(292.6)	(129.5)	(244.3)
Observations	64	64	62	62	62	61	57	57	57	57
R^2	0.023	0.091	0.127	0.191	0.223	0.403	0.060	0.299	0.232	0.484

Source: Authors' calculations.

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 2003 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking fifteen credits in the fall semester. 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. Log earnings difference is for 2000 enrollees in each program measured ten years after enrollment, relative to earnings for high school graduates who did not enroll in a Texas public institution. Robust standard errors in parentheses.

*$p < .1$, **$p < .05$, ***$p < .01$

was not sufficient to offset tuition increases.[19] Results are qualitatively similar regardless of whether earnings premiums are adjusted for student covariates or whether lower or upper division undergraduate courses are used to construct the expenditure measure.[20]

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 change 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 because they believed the change would make them flexible to market demands and faculty hiring, which in turn would enhance their prestige and quality of education (University of Texas 2008). The assumption is that the quality of their educational offerings was held artificially low when prices were set by the legislature. Meanwhile, other 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.

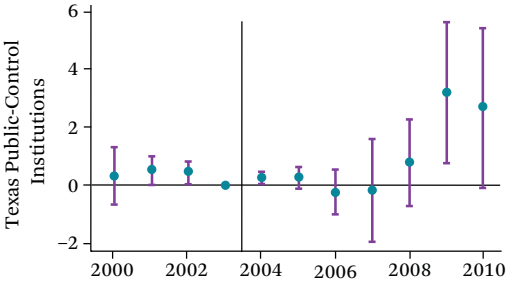
Our findings are broadly consistent with these economic rationales. We find that overall price increases (for students in the liberal arts) were greatest at institutions that were already spending more per student and that had fewer low-income students. Program-specific price is largely influenced by earnings premiums, selectivity, and overall spending at the institution. Because the state funding formula does not consider cross-institution differences in spending within fields, this behavior can be explained by the desire of more resource-intensive institutions to pay for their additional spending via price increases. The importance of alumni earnings and student income suggests that institutions also consider the demand and access consequences of the price changes, as institutions with less elastic demand and higher-income students are more able to increase price without harming enrollment. Finally, lucrative programs also increased grant aid for low-income students, somewhat offsetting the increase in sticker price faced by these students. Thus demand and cost may function as important contingencies for public universities in setting prices (Morphew and Eckel 2009; Yanikoski and Wilson 1984).

These results may shed light on the objectives of public universities, particularly in comparison with state lawmakers. State lawmakers set low and uniform sticker prices prior to deregulation, suggesting value placed on broad-based affordability. Institutions, on the other hand, appear to desire a greater level of differentiation (between and within institutions) and a higher level of program quality. The balance struck between the dual objectives of affordability and quality clearly depends on the nominal price-setter, though whether this reflects differences in objectives or information between institutions and lawmakers remains unclear. 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 and Womack 2003). Figure 12 suggests that the increase in tuition and fees in the post-

19. Table A4 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 but programs with greater earnings premiums did. This general pattern mostly holds after controlling for expenditure in liberal arts 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 postderegulation price changes but earnings premiums unpredictive.

20. These robustness results are reported in appendix tables A5 and A6.

Figure 12. Estimates of Changes in Educational and General Expenses per FTE ($1,000) After Deregulation



Source: Authors' calculations based on IPEDS.
Notes: Graph reports event-study point estimate and 95 percent confidence interval. Total educational and general expenses per FTE 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. Nonweighted graphs look very similar.

deregulation period ultimately enabled higher levels of education and related activities at an institutional level. Yet how differential tuition shifted the revenues and expenses for different activities across academic programs within institutions is not well understood, in part because revenue allocation is at the discretion of the dean of the college at some universities in the state (Ravenscroft and Enyeart 2009).

Although our analysis is intended to be entirely positive, the normative implications of greater differentiation can be framed around a potential trade-off 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 (Hoxby 2009; Rothschild and White 1995). In fact, efficiency concerns were the primary justification for tuition deregulation (University of Texas 2008).

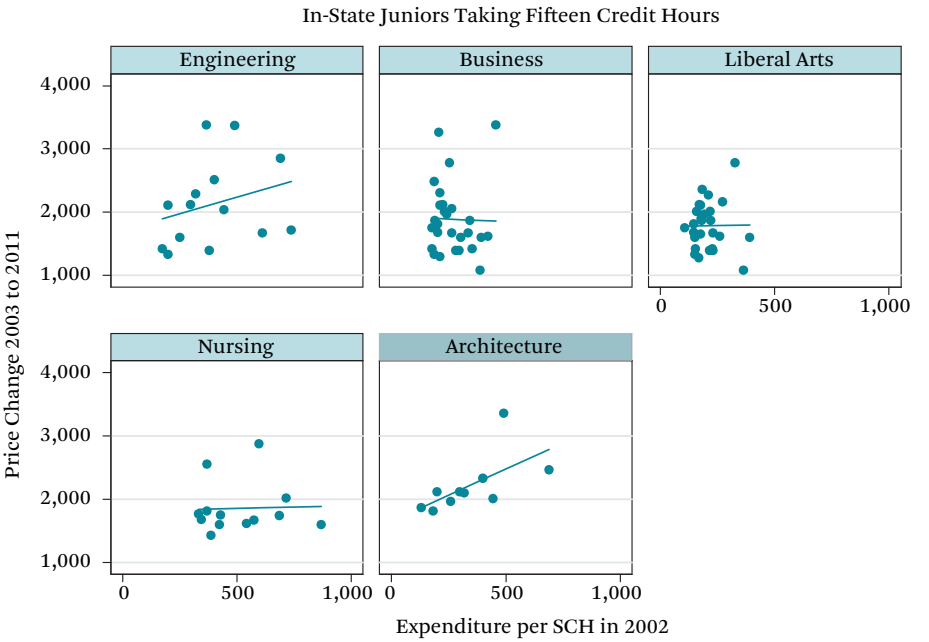
On the other hand, differential pricing and greater price dispersion could also widen socioeconomic gaps, as price increased overall and most dramatically at the most selective and best-resourced programs. These changes could price lower-income students out of desirable programs or make completion more 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. This increase in institutional grant aid for students who are eligible for need-based might reflect the requirement that came with the deregulation to allocate 20 percent of the incremental to institution's need-based financial aid. 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 12 does suggest that institutions 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 (for example, Totzke, 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 nonpoor students remains unclear. Across many universities nationally, Stange (2015) finds 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.[21] 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.

21. One of the authors (Stange) is currently investigating these issues in collaboration with Rodney Andrews from University of Texas at Dallas.

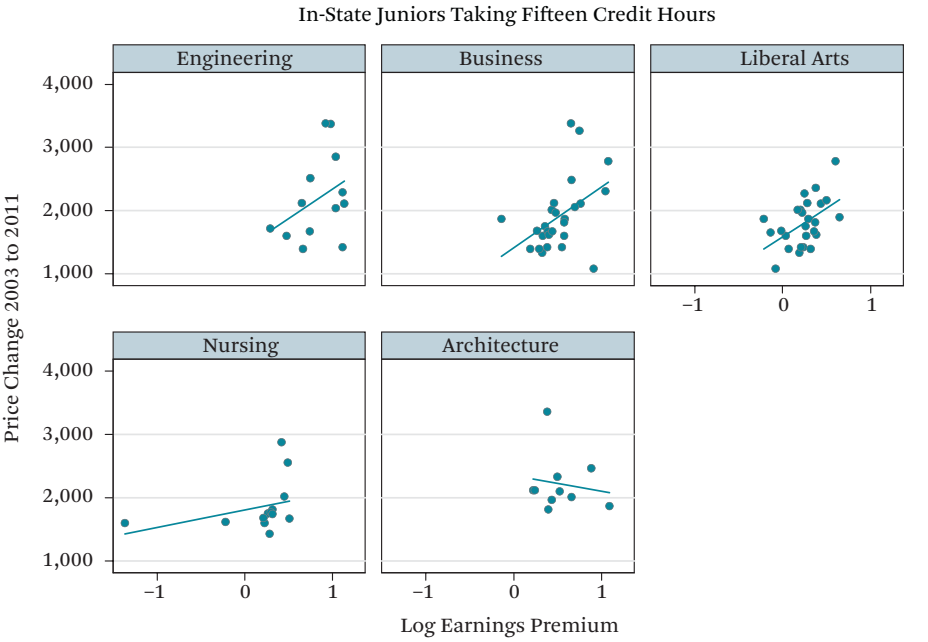
APPENDIX

Figure A1. Price Change and Initial Instructional Expenditure



Source: Authors' calculations.

Figure A2. Price Change and Log Earnings Premium



Source: Authors' calculations.

Table A1. IPEDS Sample Characteristics

	Full Sample		Non-Texas Public in SE/SW		Texas Public	
	Mean	SD	Mean	SD	Mean	SD
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 or 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: Authors' calculations based on IPEDS.

Table A2. Texas Versus 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	Un-weighted	Control for Unemploy-ment Rate	All Public	SE Public	SE without 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^2	0.327	0.269	0.328	0.220	0.305	0.413	0.638

Source: Authors' calculations.

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.

*$p < .1$, **$p < .05$, ***$p < .01$

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

	Dependent Variable: Net Tuition Revenue per FTE ($1,000)						
	Control Group: SE/SW Public			Control Group			
	Base model	Un-weighted	Control for unemploy-ment rate	All public	SE Public	SE without FL	SW public
	(1)	(2)	(3)	(4)	(5)	(6)	(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^2	0.319	0.230	0.319	0.218	0.313	0.342	0.518

Source: Authors' calculations.

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.

*$p < .1$, **$p < .05$, ***$p < .01$

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

	Dept variable: Price change from 2003 to 2011							
	Engineering		Business		Nursing		Architecture	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expenditure per SCH in program	2.313	0.145	−0.0633	1.708	0.398	0.297	2.575*	4.097**
(lower and upper division ugrad)	(1.294)	(1.699)	(2.210)	(2.757)	(0.688)	(0.598)	(1.092)	(0.900)
Selective program	−433.1	−67.36	280.1	239.0	375.7	1,013	−516.1	−463.0*
	(564.0)	(502.6)	(261.3)	(242.1)	(334.2)	(691.7)	(375.0)	(162.0)
Log earnings difference	1,411**	−458.1	797.8	630.9	271.4	184.5	−198.4	−263.1
(relative to non-enrollees)	(547.6)	(1,985)	(492.6)	(530.6)	(199.7)	(473.2)	(292.6)	(252.2)
Expenditure per SCH in liberal arts		3.631		0.528		1.319		−11.86*
(lower and upper division ugrad)		(3.355)		(2.478)		(3.188)		(4.925)
Acceptance rate		−3,035		−79.56		2,146		−4,842***
(institution)		(2,158)		(567.1)		(1,121)		(311.8)
% Students w Federal grant aid		−3.081		−12.70		−12.61**		47.37**
(institution)		(27.47)		(9.978)		(4.567)		(8.735)
	319.4	4,456	1,428**	1,520**	1,518***	−125.0	1,595***	6,146***
Constant	(550.2)	(3,774)	(676.4)	(569.2)	(392.3)	(935.4)	(278.6)	(647.3)
Observations	13	13	26	25	13	13	10	10
R^2	0.298	0.526	0.257	0.475	0.319	0.646	0.641	0.968

Source: Authors' calculations.

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 2003 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking fifteen credits in the fall semester. Robust standard errors in parentheses.

*$p < .1$, **$p < .05$, ***$p < .01$

Table A5. Robustness of Price Change Results, Liberal Arts Programs

	Price Change from 2003 to 2011 (mean = $1,782)			
	(1)	(2)	(3)	(4)
Expenditure per SCH in liberal arts (lower and upper division ugrad)	2.231*	2.446*		
	(1.241)	(1.245)		
Acceptance rate (institution)	86.19	57.96	18.96	210.8
	(585.9)	(541.9)	(548.5)	(688.2)
% Students with federal grant aid (institution)	−13.29**	−13.54**	−12.31**	−10.57**
	(4.799)	(4.866)	(4.378)	(3.726)
Log earnings difference (relative to non–enrollees)	−106.1		48.12	127.9
	(312.8)		(321.3)	(263.9)
Adjusted log earnings difference (relative to non–enrollees)		−370.6		
		(319.1)		
Expenditure per SCH (lower division ugrad)			1.215	
			(0.817)	
Expenditure per SCH (upper division ugrad)				2.538***
				(0.800)
Constant	1,817***	1,835***	2,029***	1,292*
	(458.0)	(415.1)	(397.5)	(627.0)
Observations	25	25	25	25
R^2	0.376	0.392	0.330	0.509

Source: Authors' calculations.

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 2003 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking fifteen credits in the fall semester. Log earnings difference is for 2000 enrollees in each program measured ten years after enrollment, relative to earnings for high school graduates who did not enroll in a Texas public institution. Adjusted log earnings estimates control for student race, sex, free-lunch status, and high school exit exam scores. Robust standard errors in parentheses.

*$p < .1$, **$p < .05$, ***$p < .01$

Table A6. Robustness of Price Change Results, Four Programs Pooled

	Price change from 2003 to 2011 (mean = $1,782)			
	(1)	(2)	(3)	(4)
Expenditure per SCH in program (lower and upper division ugrad)	0.802	0.783		
	(0.658)	(0.678)		
Selective program	115.6	136.8	202.8	95.71
	(198.9)	(203.5)	(191.5)	(201.2)
Log earnings difference (relative to non-enrollees)	559.2**		459.2*	566.2**
	(232.8)		(245.7)	(230.7)
Adjusted log earnings difference (relative to non-enrollees)		496.5*		
		(248.8)		
Expenditure per SCH (lower division ugrad)			0.140	
			(0.625)	
Expenditure per SCH (upper division ugrad)				0.851
				(0.644)
Major fixed effects	Yes	Yes	Yes	Yes
Constant	1,323***	1,363***	1,670***	1,289***
	(337.3)	(346.6)	(290.6)	(336.3)
Observations	62	62	62	62
R^2	0.223	0.192	0.194	0.228

Source: Authors' calculations.

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 2003 and 2011. Price includes tuition plus mandatory fees for in-state juniors taking fifteen credits in the fall semester. Log earnings difference is for 2000 enrollees in each program measured ten years after enrollment, relative to earnings for high school graduates who did not enroll in a Texas public institution. Adjusted log earnings estimates control for student race, sex, free-lunch status, and high school exit exam scores. Robust standard errors in parentheses.

*$p < .1$, **$p < .05$, ***$p < .01$

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