The Effects of Institutional Inputs on Time to Degree for Traditional and Nontraditional College Students[1]

Jenna Cullinane
University of Texas at Austin
jenna.cullinane@austin.utexas.edu

Jane Arnold Lincove*
University of Texas at Austin and
Tulane University
janelincove@austin.utexas.edu

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* corresponding author

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Abstract

Time to degree is a key factor in institutional productivity and managing the costs of college for students and families. While there is a robust body of empirical and theoretical work addressing baccalaureate degree completion and persistence, much less is known about the factors that drive time to degree. Most importantly, the institutional factors that affect time to degree have been largely unexamined, with a primary focus on the characteristics of students. As a result, it is unclear if students or institutions should be the target of policy interventions. This study examines student-level and institutional-level factors that contribute to timely—or not so timely—completion. The study uses a discrete-time hazard model to analyze statewide longitudinal student-level data from Texas along with institutional data from the Integrated Postsecondary Education Data System (IPEDS). Results suggest time to degree is a complex phenomenon, and both student and institutional factors are significantly associated with time to degree. We find differential effects of institutional factors on the probability of graduating on time, graduating late, and dropping out of college, which suggest that policy changes designed to reduce time to degree may have perverse effects on overall graduation rates.

National and state trends indicate many graduates do not complete their bachelor's degrees in a timely fashion. Forty-four percent of students in the 2008–09 cohort of the Baccalaureate and Beyond Longitudinal Study graduated in four years, 23 percent in five years, and 9 percent in six years. Median time to degree in 2008, was 52 months, seven months longer than a traditional four-year program (U.S. Department of Education, NCES, 2011). The phenomenon of untimely degree completion is present across higher education, from community colleges to highly selective four-year institutions. Approximately one in three students at selective flagship institutions graduates in four years. At less selective colleges, only one in four graduates on time (Bowen, 2009). Importantly, extended time to graduation has occurred during a time of significant expansion in access to higher education coupled with increasing public and private costs. It is unclear if extended time to degree is a positive reflection of new opportunities to earn a degree while balancing work and family demands, or a negative reflection of resource inefficiency. The answer to this question requires empirical evidence about why students take more than four years to graduate. This paper attempts to fill this gap by examining the influence of institutional inputs on time to degree for students from different backgrounds, including nontraditional college pathways.

Increasing scrutiny to higher education budgets has induced states to experiment with ways to cut costs by accelerating graduation time. At the state level, new policies incentivize universities by linking funding to four-year graduation rates. Universities have responded by incentivizing students to finish faster with strategies such as charging higher tuition to extenders, reducing required credits, and providing tuition incentives for on-time completion (Volkwein &

Lorang, 1996; THECB, 1996). These policy approaches could have unintended consequence of reducing overall graduation rates by eliminating or taxing flexibility for students who progress at a slower pace. If students who graduate more slowing are also more likely to be first-generation college students, minorities, or low-income, efforts to reduce time to degree might also reduce opportunities for social mobility through higher education. It is important to examine both the distributional equity and efficiency of punitive policies, such as charging higher tuition to extenders, in the context of goals to promote increased access for historically underrepresented groups.

There is little empirical evidence about the relationship between policy levers and student choices regarding pace of completion for policymakers to draw upon. Past research suggests that characteristics of both student demand and institutional supply are responsible. In this paper, we contribute to academic understanding of relationships between demand, supply, and time to degree by estimating the effects of students characteristics and institutional inputs on the probability that a student will graduate on-time, graduate late, dropout, or continue undergraduate enrollment longer than six years. Our empirical objective is to identify whether institutional factors that positively influence on-time graduation have similar effects on late graduation and dropout.

Our empirical analysis makes several important contributions that build on prior research. First, we employ a statewide, longitudinal dataset that includes multiple four-year institutions of varying quality and inputs. Second, we employ a competing-risk model that accommodates

multiple student outcomes other than on-time graduation. And third, we examine differential effects on populations that are less likely to obtain a degree, including minorities, students from low-income families, and students who pursue nontraditional college pathways. We find that different institutional inputs influence four-year graduation, late graduation, and dropout across different student populations. Our results suggests that policies designed to increase on-time graduation for some students may have perverse effects of promoting dropout or extending time to degree for others.

Theoretical Influences on Time to Degree

The study is built upon an integrated theoretical framework that incorporates human capital, social capital, and neo-institutional theory to explain individual and institutional action. Human capital theory hypothesizes that educational investments depend on perceived future labor market returns and nonmonetary benefits to schooling compared to costs (Becker, 1975; Clotfelter, 1991). Empirical studies suggest that increasing labor market returns to a degree partially explain rising enrollment and completion (Freeman, 1975; Kane and Rouse, 1995; Long, 2010), but high rates of returns are unable to explain some student outcomes, such as low enrollment of black males (Perna, 2000). However, human capital theory provides little explanation for observed differences in price response across ethnic groups and socio-economic status (Heller, 1997). Detailed information about labor market returns is not well understood by students, especially underclassmen and minority students (Betts, 1996), therefore it is unlikely that this is the only driver of student decision-making.

Sociological and organizational perspectives, including social capital theory and neo-institutional theory, offer additional explanations of college outcomes. Social capital theory argues that connections between peers, students and faculty, students and advisors, students and parents, as well as the social environments of education institutions facilitate positive postsecondary outcomes through the communication of expectations (Coleman 1988; Bourdieu, 1986). Empirical research supports the hypothesis that higher levels of parent education, income, involvement, and academic counseling and advising are predictive of positive education outcomes (Hossler, Braxton, & Coopersmith, 1989; Perna, 2000; Perna et al., 2008). Social capital theory also provides an explanation for why outcomes and price-sensitivity might vary across subpopulations of students as expectations and values about higher education vary also across communities (Perna & Titus, 2005; Institute for Higher Education Policy and Excelencia in Education, 2008).

In addition to norms projected by their communities, students may also respond to norms and incentives specific to their universities. Organizations influence patterns of human behavior by limiting choices, reducing uncertainty, and creating stability (Boin & Kuipers, 2008; Thoenig, 2003; Campbell, 2005). Institutions shape both the options available to individuals and preferences among options (Ostrom, 2007). In the case of higher education, universities seek to maximize their public legitimacy through multiple outcomes including graduation rates and the quality of graduates (Suchman, 1995). Universities can send a message that slower progress to degree is preferable if funding is linked to outcomes such as admission to graduate school or

student satisfaction. Universities are incentivized to instill in students a strong motivation to graduate quickly when public funding is linked to time to degree. In practice, an institutional response to a political push to increase time to degree may be purely symbolic, and internally, universities continue create obstacles to graduation (Meyer & Rowan, 1977). It is common for students to face internal obstacles to completion such a difficulty registering for required courses or a lack of clarity regarding degree requirements.

An integrated theoretical model of influences on time to degree requires attention to individual, community, and institutional level factors. This study expands upon a foundational study from DesJardins, Ahlburg, and, McCall (2002), which identified and tested many individual factors hypothesized to influence time to degree using a discrete time hazard methodology. Their study models the likelihood of graduation and the likelihood of on-time graduation compared to stopout in a competing-risks approach. These authors find that some groups who appear to have a disadvantage in graduation rates catch up by graduating late or remaining enrolled, rather than dropping out. This provides initial insight into delayed graduation as a strategy for students who encounter obstacles to a traditional four-year pathway. However, the study does not address the effects of institutional factors on the probability of graduation, as the sample includes students from a single university.

If individual student characteristics influence time to degree, increases in time to degree over time may be associated with a changing population of college students, including expanded opportunities for first generation college entry. In a very different empirical approach, Bound,

Lovenheim, and Turner (2012) compare national demographic changes in the college-going population and changes in resources for higher education, using a Oaxaca decomposition method to identify influences on long-term increases in time to degree. These authors find that decreases in higher education resources, rather than changing demographics, explain most of the increase in time to degree between the 1970s and 1990s.

In this study, we incorporate the supply-side factors identified by Bound et al. in the discrete time hazard approach used by Desjardins et al., while attempting to improve upon prior studies in three ways. First, we use a statewide dataset from Texas, which provides a large, diverse sample of students who attended 34 public four-year universities. This enables us to examine the effects of institutional inputs, as well as student characteristics. Second, we include both traditional and nontraditional college pathways to capture a greater range of student choices that influence time to degree. Finally, our dataset is sufficiently robust to test differential effects of institutional inputs on college outcomes for students by race, income, and college pathways.

Empirical Evidence on Time to Degree

Time to degree generally refers to the length of time students spend working towards completion of postsecondary requirements and earning a credential. Our focus is on time to complete a bachelor's degree. For the purposes of this study, time to degree will begin at college entry and include "stopout" time when students are not actively making progress toward a

bachelor's degree[2]. While research on time to degree is nascent, previous empirical research on determinants of graduation provides insight into individual and institutional variables that might also influence the likelihood of graduating on time.

Demographic Factors

Student factors which may affect time to degree include: demographic characteristics; high school preparation; student preferences for majors, college transfers, and changing majors; time spent on work or leisure; and future returns to education. Nationally, minority students tend to graduate less frequently than white students (for example, Adelman, 2006). In Texas, Black and Hispanic students have significantly lower rates of degree completion (52.7% and 65.9% respectively) than white and Asian peers (76.6% and 83.8% respectively) (Texas Higher Education Coordinating Board, 2012a, 2012b). Research suggests that racial gaps in college graduation are often attributable to complex structural inequalities such as poverty and high school quality (Light & Strayer, 2000; Adelman, 2006; Fletcher & Tienda, 2010; Massey, 2006). Desjardins et al. (2002) find significant racial differences in on-time graduation, controlling for socio-economic status and other structural variables.

[2] Time to degree has been operationalized in a variety of ways including the time between high school graduation and college graduation, inclusive of any delay before matriculation (i.e. Bound, Lovenheim, and Turner). Others have defined it as the time spent between first college entry and completion, either inclusive or exclusive of any stop-out periods where students are continuously enrolled but not taking classes (i.e. Garibaldi, Giavazzi, Ichino, & Rettore, 2012; Glocker, 2009; Lam, 1999). Stop-out time tends to be included in analyses from the student and state perspectives, but excluded from studies of institutional resource use, which tend to focus on actual time students spend enrolled more narrowly (i.e. Lam, 1999). Time to degree may also be described by its mediating outcomes like attempting fewer than 15 credits in a semester, accumulating excess credits, or time spent on academic probation (Volkwein & Lorang, 1996).

Age at college entry can influence college outcomes in different ways. Older students who delay entry into postsecondary education face different costs and benefits and societal expectations. Older college entrants exhibit higher levels of academic motivation (Cantwell, Archer, and Burke, 2001; Calcagno, Crosta, Bailey & Jenkins, 2007), but also higher opportunity costs. (Cleveland-Innes, 1994; Calcagno, Crosta, Bailey & Jenkins, 2007). They may be less integrated into university life and therefore less easily influenced by internal university pressures (Cleveland-Innes, 1994).

Finally, the economic status of students and their families is a significant factor influencing participation and success in higher education (Rouse, 1994; Manski, 1992) and time to degree (Bound, Lovenheim, and Turner, 2012). Low-income students and those with unmet financial need are more likely to stop or drop out due to financial constraints or to the simultaneous demands of work and school (Desjardins et al, 2002; Herzog, 2005).

High School Preparation

Success in high school coursework, especially in mathematics, is predictive of later educational outcomes including higher GPAs, higher likelihood of graduation, and lower likelihood of dropout. Students who graduate in four years typically have better high school grades, higher mathematics achievement, and better grades in college courses than other college students (Parker, 2005; Allen & Robbins, 2010; Deming, Hastings, Kane & Staiger, 2011). Very low levels of academic preparation are associated with low graduation rates and longer times to degree, due in part to requirements for additional remedial coursework (Horn & Nevill, 2006;

Attewell, Lavin, Domina & Levey, 2006). However, DesJardins et al. find that neither ACT score nor high school class rank are significantly associated with time to degree or stop out. An alternative hypothesis is that prior preparation is associated with socialization toward the goal of overall academic success, which may be better measured by grades than time to degree. Two studies find that higher freshman year grades are associated with longer times to degree, which is attributed to student desire to protect GPAs by taking fewer classes per semester (Adelman, 2006; Volkein and Lorang, 1996).

College Pathways

Students also make many choices during college that can influence the rate of completion, including the intensity of enrollment and credit completion. Students enroll part-time for a variety of reasons, including protecting GPAs, confusion over registration, inability to get a slot in a required course, competing family or financial commitments, or a preference for more leisure time. On average, students who enroll full-time are more likely to complete on time (Adelman, 2006). Prior studies find that when work crowds out studying, degree completion can be slowed or stopped (Ehrenberg and Sherman, 1987; Singell, 2004, Stinebrickner and Stinebrickner, 2003). Students with unmet financial need or who have high labor market participation (in excess of 20 hours a week) have lower GPAs (Stinebrickner & Stinebrickner, 2003) and longer time to degree (Volkwein and Lorang, 1996; Gleason, 1993; Lam, 1999).

Students' choice of a program of study can also affect time to degree (Adelman, 2006). Different majors lead to different professions with different rates of return (Desjardins et al., 2002; Thomas & Zhang, 2005; Berger, 1988). Fields with higher rates of return are associated

with higher graduation rates (Desjardins et al, 2002), but many high-return fields, such as engineering or health sciences, also have more specific and numerous course requirements (University of Texas at Austin, 2012; Adelman, 2006). In this case, extended time to degree is a positive labor market strategy rather than a disappointing outcome. Double majoring is another potential extender of time to degree, although studies find that double majors are rare and unlikely to be driving significant and widespread increases in time to degree (Bound, Lovenheim & Turner, 2012; University of Texas at Austin, 2012; Sugarman & Kelly, 1994).

Students also accumulate useful credits more slowly when they change majors or transfer to new institutions (Lam, 1999; University of Florida, 1995). Transfer from two-year institutions or across four-year institutions generally has a negative effect on time to degree (Hilmer, 1999, Lam, 1999), often through loss of credits that are not accepted by the receiving institution (Monaghan & Attewell, 2014). An alternative to permanent transfer is "swirling" across multiple two-year and four-year institutions simultaneously to improve access to courses (Adelman, 2006; Herzog, 2005; McCormick, 2003). Many students, including 78 percent of all bachelor's degree completers in Texas, take at least one course at a community college, often while enrolled full-time at another institution of higher education (National Student Clearinghouse Research Center, 2013).

Institutional Factors

Institutional factors can influence time to degree indirectly, through shaping student preferences, and directly, by creating obstacles to graduation. One influence occurs through

university expenditures on instruction and support services (Webber & Ehrenberg, 2010). Insufficient institutional resources negatively impact degree completion when required courses are unavailable, poor quality of advising leads to inefficient progress through college, class sizes grow, or instructional quality declines (Volkwein & Lorang, 1996; Bound et al., 2012).[3] Increases in the student-faculty ratio explain a significant proportion of the increase in time to degree between the 1970s and 1990s and 75 percent of the reduction in degree completion (Bound, Lovenheim & Turner, 2012).

Another factor is institutional quality. Higher quality universities exhibit higher graduation rates and shorter times to degree, often through selection of higher quality students (Dale and Krueger, 2002). Long (2008) finds that average SATs, tuition, and faculty-student ratio are all positively associated with the probability of graduation. Bound et al. (2010, 2012) find that the national decrease in the rate of degree completion and increase in time to degree can be largely explained by growing enrollment at lower-resourced institutions with high faculty-student ratios, including community colleges and non-selective four-year universities.

Importantly, student pathways and institutional characteristics described above are endogenous to student demographics and prior preparation in ambiguous directions. In this study, we include a rich set of independent variables to control for student selection into campuses, majors, and pathways through college. We also conduct disaggregated analysis of

[3] In two more specific examples, an analysis of time to degree at the University of Texas at Austin found that differences in the requirements, sequencing, and availability of courses across programs of study contributed to long times to degree for engineers and other STEM majors (The University of Texas at Austin, 2012). A survey of University of California Davis students found that 50 percent of extenders cite a lack of required course availability as a factor in their delayed completion (Lehman, 2002).

time to degree to identify differential effects of institutional variables on different types of students based on demographics, preparation, and pathways.

Estimating the Effects of Institutions on Time to Degree

It is typical to model the probability of graduating as an OLS or logistic function where graduation is predicted with observed student characteristics at a single point in time. Similarly, time to degree can be modeled as a regression of years enrolled prior to graduation on observed characteristics. These strategies have two disadvantages. First, observing a student at a single point in time does not accommodate time-varying independent variables. In the case of institutional variables, which are the focus on this study, students face time-varying inputs as they transfer institutions or as institutions adjust inputs in response to policy and economic conditions. Second, these strategies limit the scope of observable student outcomes. Modeling the probability of graduation as a simple dichotomous outcome ignores the possibility that students who do not graduate fall into two very different categories – those who drop out and those who are continuing to pursue a degree. Similarly, modeling time to degree as continuous outcome requires the analyst to drop students who do not graduate within the period of observation (Singer & Willet, 1993), introducing an important selection bias.

Following DesJardin et al (2002), we estimate the effects of institutional and student characteristics on time to degree using a discrete time hazard model. Hazard models predict the likelihood of an event occurring across multiple longitudinal observations of individuals. The

method is appropriate when estimating not only the probability of an outcome, but the timing of the outcome as well, so it is well-suited to examine a culminating educational event such as graduation (Singer & Willet, 1993; Singer 2003). In this case, the discrete-time period in which graduation can occur is an academic trimester, and the probability of graduation will increase with each additional trimester of enrollment.

The hazard model requires multiple observations of students over time, with each student remaining in the longitudinal data until she either graduates from college or drops out. This allows for estimation of the effects of other time-varying factors including institutional inputs. Students who remain enrolled at the end of the study period provide an appropriate comparison groups for other outcomes. The hazard model can be estimated as a logistic model of a dichotomous outcome (i.e. graduating vs. not graduating), or more appropriately, as a multinomial logistic model of multiple outcomes (i.e. graduating on time, graduating late, or dropping out) compared to the alternative of remaining enrolled at the end of the study period. In this case, we are able to follow students for up to six years after initial college enrollment to get a fuller picture of pathways to graduation. The discrete-time hazard is modeled as:

$$(1)\ h(t_{ij}) = Pr_j[y_{i=}j \mid y_i \geq j, X_i(t), \varepsilon_i)$$

Where student *i* is observed in the dataset for every trimester *j* in which he is enrolled in college. $X_i(t)$ is the vector of individual and institutional characteristics for student at time *t*. Our empirical model predicts the likelihood of graduating (y) conditional on *X* and the number of trimesters of prior enrollment. The likelihood of graduation increases with each additional

semester of college but is also influenced by fixed and changing characteristics of students and their universities. Our basic model (single risk) considers only two possible outcomes: graduating and not graduating. We use a maximum likelihood estimation of a logistic regression to predict the probability of graduation conditioned on prior enrollment, individual characteristics, and institutional inputs where $\alpha_j(D)$ is the baseline hazard for each trimester of observation in the sample:

$$(2)\ \text{Logit}\ h(t_{ij}) = [\alpha_1 D_{1ij} + \alpha_2 D_{2ij} + \ldots + \alpha_J D_{Jij}] + [\beta_1 X_{1ij} + \beta_2 X_{2ij} + \ldots + \beta_N X_{Nij}] + \varepsilon_i$$

To estimate more nuanced effects on time to degree, we estimate a second model (competing risks) with multiple possible outcomes. In this case we include four possible outcomes: 1) graduating on time (i.e. in four years or less), 2) graduating in more than four years, 3) dropping out without a degree, and 4) remaining enrolled after six years of observation. We estimate this model in a multinomial logistic regression where the three outcomes that conclude enrollment (on-time graduation, late graduation, or dropout) are compared to remaining enrolled. Again, this model controls for prior trimesters of enrollment and estimates the influence of student and institutional variables on the probability of each outcome occurring.

Our empirical focus is the influence of institutional inputs on timely graduation, with concern for perverse effects on overall graduation rates and equity in higher education access. Our final empirical strategy disaggregates students by demographics and college pathways to identify differential effects of institutional inputs on time to degree for different types of

students. This allows us to determine if policies to promote timely graduation among certain groups of students will have negative effects on populations with lower average college attainment.

Data

This study uses administrative data from the Texas Higher Education Coordinating Board (THECB) provided through the University of Texas Education Research Center (UT ERC). The data set includes college application, enrollment, and graduation records for all students who applied to or attended public colleges and universities in Texas from 2004-2011. To allow sufficient time to measure late graduation, we follow two cohorts of students who began college in 2004 and 2005 through 2011. Student-level data is merged with IPEDS institutional data for all public two-year and four-year institutions in the state over the same period.[4] This dataset allows us to improve upon previous studies of single-campus outcomes by including students who attended 34 public four-year universities and 65 public community and technical colleges within a single state.

This dataset meets the demands of the hazard model by providing observations of students each trimester for up to six years following initial enrollment in college. We observe both initial conditions of demographics and high school performance, and changing conditions of college enrollment and institutional inputs. Compared to other studies of graduation, we are also

[4] The data we use were originally collected as part of the Integrated Postsecondary Education Data System (IPEDS) and later compiled, edited for consistency, and made publicly available by the Delta Cost Project (www.deltacostproject.com). Institution data from 2003 to 2010 are matched to students enrolled between 2004 and 2011 with a one-year lag.

able to place relatively few restrictions on inclusion in the dataset. We identify students who expressed intent to obtain a four-year degree by including all eventual college entrants who applied for admission to a four-year public university during 2004 or 2005. We include students who enrolled directly from high school, students who transferred from two-year colleges, and students who took time off between high school and college.

The data also identify flexible and changing pathways through undergraduate programs. Students may be enrolled full- or part-time, may be simultaneously enrolled at two public institutions, and may transfer across institutions in the dataset during their time in college. Because these choices are also associated with the probability of graduation, we control for both time-invariant and time-varying differences in higher education pathways, as suggested by theory. Time-invariant characteristics include age at entry into higher education, a dummy variable indicating the student started at a two-year college, an indicator of simultaneous enrollment at two institutions, and the number of developmental education credits acquired[5]. Unlike prior studies, which fix enrollment intensity and major at single point in time, we include time-varying indicators of the number of credits a student is enrolled in each semester and indicators of the student's current major.

Data on student demographics, family background, high school performance, and enrollment history were obtained from administrative records of the students' responses on Apply Texas, a central application used by all Texas public universities. We include indicators

[5] Developmental education courses remediate pre-college skills in reading, writing, and mathematics. Developmental credits do not count towards a degree.

of gender, race, parent's educational attainment, and family income bracket. Prior preparation is measured by high school outcomes. We include SAT composite score and indicators for graduating in the top 10 percent, top 11-25 percent, or bottom 75 percent of the high school class[6].

We link each student to her institution's inputs at time *t* focusing on the theoretical effects of instruction, research, peers, and student supports. We measure the quantity and quality of instructional supports through the number of full-time faculty per 100 students, the percent of faculty who are part-time, and instructional expenditures per student. Expectations set by the social setting are measured by the percent minority enrollment. Minority enrollment is expected to be negatively associated with expectations regarding graduation and on-time graduation based on historically low minority graduation rates in Texas. This is, admittedly, a weak proxy for social capital within an institution, but IPEDS offers no better direct measure. Non-instructional student support services to promote graduation (such as counseling, mentoring, etc.) are measured in expenditures per student for student services. All institutional variables are time varying and will change with changes in university inputs, as well as if a student transfers to a different university. For students simultaneously enrolled in two institutions, we selected institutional variables for the institution where the student attempted the most credits.

We use complete data for more than 200,000 students across up to 21 trimesters, resulting in over 1.8 million student-trimester observations. Only 13 percent of students in the dataset

[6] The Top 10% Rule, passed in 1997, grants automatic admission to Texas public universities to all students who graduate from a Texas public high school ranked in the top 10% of their class.

graduated on time (i.e. within four years of enrollment). An additional 34 percent graduated in five to six years. Thirty percent of the dataset dropped out without a degree, and the remaining 23 percent were still enrolled in college in 2011. Graduation rates in the sample are lower than prior studies because we retain students on nontraditional pathways. Figure 1 illustrates the probability of graduation over a six-year year period. The likelihood of graduation in the first four years of enrollment is close to zero. Beginning in the eleventh trimester, the likelihood of graduation begins to increase. As expected, we see sharp declines in the proportion of the sample that is still enrolled as students graduate in the periods just prior to four years, five years, and six years of enrollment.

Time to degree varies by bachelor's degree-granting institution, as presented in Figure 2. At institutions with the lowest average times to degree, students complete in approximately 12.5 terms, while at institutions with the highest average times to degree, students graduate in close to 18 terms.

Summary statistics for students by college outcome (graduated on-time, graduated late, still enrolled, and dropped out) are displayed in Table 1. As expected, students who graduated on time are younger and more likely to be white, female, high income, and have parents with college degrees. Minorities are particularly underrepresented as on-time graduates. Minorities, males, and those in lower income brackets are more likely to graduate late. However, both Hispanics and Blacks are overrepresented in the still enrolled group, and Blacks are overrepresented among dropouts.

Summary statistics for high school outcomes, college majors, and college experiences are displayed in Table 2. On-time graduates have the highest average SAT scores and class rank, followed by late graduates. Over 40 percent of on-time graduates and 22 percent of late graduates were in the top 10 percent of their high school class, compared to only 8 percent of those still enrolled and dropouts. Non-traditional paths through college are very common. Forty-five percent of students started at a two-year college, and students average 4.7 part-time semesters. Thirty-percent of students were, at some time, enrolled in multiple institutions. Those who begin at two-year colleges are underrepresented as on-time graduates and overrepresented as still enrolled. Those who simultaneously enroll are overrepresented in on-time graduation and late graduation.

Variables measuring average institutional inputs over time are displayed in Table 3. The dataset includes 65 two-year colleges, 23 four-year non-research universities, and 11 research universities. To capture the mix of instructional, support, and research resources, we include measures of per student expenditures on instruction and student services[7] and a dummy variable equal to one if the institution has zero research expenditures. Importantly, there is a large variance in institutional inputs within these three types. For example, instructional expenditures per student ranged from $5,200 to over $12,000 at research universities and from $1,400 to over $14,000 at two-year colleges.

Institutional variables also changed due to policy changes during the study period. Figure 3 illustrates the annual percent change in the average values of faculty and expenditure variables.

[7] Expenditures are adjusted to constant 2010 dollars.

We see annual increases in inputs from 2005 to 2008, with a large spike in inputs in 2006. In 2009, all inputs were suddenly reduced after many years of annual increases due to statewide budget cuts in response to the financial crisis. The faculty-student ratio is the most sensitive input with spikes of 15 percent growth in 2006, followed by a 10 percent decline in 2009.

Empirical Findings on Influences on Graduation and Time to Degree in Texas

We estimate both a binomial logistic single-risk model comparing graduation to other outcomes, and a multinomial competing-risk model comparing graduation in graduating on-time, graduating late, and dropping out to remaining enrolled. All results are displayed as log odds effects on the probability out an outcome occurring. Log odds greater than 1.0 indicate a positive relationship with the outcome variable, while log odds less than 1.0 indicate a negative relationship. Given the large dataset, most estimates are statistically significant, so we report only those with large and interesting effect sizes. We first compare the binomial and multinomial models in estimates using the full analytic dataset. Results are displayed in Table 4.

Individual Factors

Our individual control variables are statistically significant and in the expected directions.[8] The probability of graduating versus not graduating is higher for highly-ranked high school graduates who are white, female, and children of college graduates. STEM and social science majors are most likely to graduate. Students who begin at two-year colleges or required development education credits are less likely to graduate.

[8] The reference group for each specification is a white male who graduated in the bottom 75 percent of his high school class, with parents who did not graduate from high school, family income less than $40,000, and a liberal or fine arts major.

Comparing these results to the multinomial results provides more information about the nuances of these relationships. Females are more likely to graduate on-time, compared to remaining enrolled, than males, but females and males have similar probability of dropping out compared to remaining enrolled. Male graduation rates catch up with female rates through late graduation. Similarly, Hispanics are less likely to graduate on-time compared to remaining enrolled than Whites, but equally likely to graduate late or dropout. Blacks are less likely than Whites to graduate on-time or late, but are equally likely to dropout. Similar to Desjardin et al., we find that racial and gender differences in graduation are largely due to staying enrolled longer, rather than an increased propensity to dropout. High school performance is a strong predictor of on-time graduation. Top 10 percent graduates are more than twice as likely to graduate on-time and only half as likely to dropout compared to those in the bottom 75 percent. The odds of on-time completion are positively associated with increases in SAT score as well, but the effects are more modest.

The multinomial results also provide greater insight into the role of college pathways. Starting at a two-year college has a large, negative effect on graduating on-time, but only a small negative effect on graduating late and very little effect on dropping out, compared to remaining enrolled. Enrolling part-time also increases the likelihood of remaining enrolled, compared to all other outcomes. Beginning at a two-year college and part-time enrollment are not paths to timely graduation, but they are strategies to stay enrolled instead of dropping out. Simultaneous enrollment to gain extra credits slightly increases the likelihood of graduating on-time or late,

and also significantly reduces the likelihood of dropping out. It is likely that students who enroll at two schools at once are highly motivated to graduate and may be more price-sensitive.

Institutional Factors

We turn now to the question of whether institutional inputs also influence time to degree. Importantly, our estimation strategy cannot assess causality. While institutional variables can be controlled by policymakers, we cannot determine whether deliberate changes in inputs cause changes in graduation. We can only identify associations in an attempt to understand how students at different types of institutions behave towards graduation. Our models control for student sorting into institutions through observable variables, but not through unobservables such as motivation, career objectives, or opportunity costs. Through disaggregated models, we can observe the interaction of demographics and college pathways and institutional inputs. We acknowledge that students select in to institutional pathways for numerous reasons that are not accounted for in these models.

Table 5 displays binomial and multinomial results for institutional variables for the same specifications as Table 4. In the binomial model, instructional expenditures have a large, positive effect on the probability of graduating versus not graduating, and faculty-student ratios have a small positive effect. Part-time faculty and minority enrollment have a negative association with graduation. The multinomial model provides greater insight into time to degree. Compared to remaining enrolled, full-time faculty-student ratio is positively associated with on-time graduation. However, this ratio is also negatively associated with graduating late, compared

to remaining enrolled. Part-time faculty are positively associated with on-time graduation and negatively associated with late graduation. Part-time faculty are also positively associated with dropping out. Instructional expenditures are positively associated with graduation but only through late graduation. Instructional expenditures, holding faculty ratios constant, are not associated with an increased probability of graduating on time. Student services expenditures are likely to be higher on campuses with a high probability of dropout. Although we find no effect on the probability of overall graduation, there is a positive association with graduating late.

Effects by Student Characteristics

We next examine the importance of institutional inputs for students from different backgrounds by estimating effects separately by race, family income, and high school class rank. Each estimation controls for student characteristics, high school outcomes, college major, and college pathways, excluding only the variables that identify selection into the subgroup.

Table 6 displays log odds estimates for the probability of graduating on time compared to the reference outcome of continued enrollment. We estimate effects for three income groups (under $40k or missing, $40-80k, or above $80k), three racial groups (white, Hispanic, or Black), and three bins of class rank (top 10%, top 11-25%, or bottom 75%).

In the aggregated results, we estimated a positive effect of full-time faculty on the probability of graduating on time. This result holds for all subgroups in Table 6, with the largest effects for Blacks and students in the top 11-25%. The effects of part-time faculty vary by

group. Part-time faculty have a positive effect on the probability of on-time graduation only for students in higher income brackets, whites, and those in the bottom bins for class rank. Part-time faculty have a large, negative effect on the probability of on time graduation for Hispanic students and no effect on Blacks or low-income students.

Instructional expenditures have a positive association with on-time graduation for Hispanics and those in the bottom bin for class rank, and a negative association for Blacks. Student services expenditures have a small negative association for all student groups, and percent minority has a large negative association for all students. Overall, these disaggregated results suggest that full-time faculty are positively associated with graduating on-time for all students and student services expenditures are negatively associated for all students, while part-time faculty and instructional expenditures have mixed effects.

Table 7 displays results from the same disaggregated estimation for the log-odds of graduating late, compared to remaining enrolled, and Table 8 presents the same estimation for the log-odds of dropout compared to remaining enrolled. Here we explore whether any of the factors that are positively or negatively associated with on-time graduation have the opposite effect on other outcomes. Contrary to the findings for graduating on-time, both instructional expenditures and student services expenditures are positively associated with graduating late, compared to remaining enrolled. The effects of instructional expenditures are particularly large across all groups, including Blacks, Hispanics, and lower bins of high school class rank. High-income students, whites, Hispanics, and high-ranking students are less likely to dropout as

instructional expenditures increase, but Black students are approximately 50 percent more likely to dropout. Student services expenditures are associated with an increased likelihood of dropout for some groups, but the effect is large only for Hispanics.

Effects by College Pathways

We next examine the differential effects of institutional inputs by college pathways by running regressions on subgroups by six pathways. The first three pathways describe how students entered higher education. Based on their first enrollment at Texas public institution, we identify students who first enrolled at a two-year college, four-year non-research university, or four-year research university[9]. In our dataset, 45.1 percent began at a two-year, 27.6 percent at a non-research four-year, and 28.3 percent at a research four-year. We also test three non-mutually exclusive pathways that describe how students navigated higher education. The first group, which includes 33.5 percent of students, followed a traditional undergraduate pathway that includes enrolling immediately after high school graduation in a four-year university, taking all courses on a single campus, and enrolling part-time for fewer than two semesters[10]. The second group, which includes 30.1 percent of students, engaged in simultaneous enrollment on two campuses during one or more trimesters, often through part-time enrollment at a two-year institution. The final group includes 27.4 percent of students who engaged in frequent part-time enrollment, defined as 5 or more part-time semesters.

[9] Institutions are categorized according to 2005 Carnegie sector classification as documented in IPEDS. Carnegie classifications for *public research institutions* correspond to this paper's four-year research university category. Non-research universities correspond to the Carnegie classifications for *public masters and public bachelors institutions*. Two-year colleges correspond to the Carnegie *public associates institutions*.

[10] Here, we exclude summer sessions in the count of terms enrolled part-time.

The results for on-time graduation by pathway are displayed in Table 9. Full-time faculty-student ratio is positively associated with graduating on time for all six pathways. Part-time faculty have large positive effects for students who begin at two-year colleges or engage in frequent part-time enrollment. Part-time faculty have a large negative association with graduating on time for students who began at a non-research university and no effect for students who began at a research university. This suggests that institutions with high transfer rates employ more part-time faculty, and that full-time faculty primarily contribute to on-time graduation at four-year universities.

Larger instructional expenditures are positively associated with graduating on time for students with simultaneous enrollment and students who started at a two-year college. Instructional expenditures are negatively associated with graduating on time for traditional pathway students and students at both types of four-year universities. Thus greater instructional expenditures not associated with increases in full-time faculty are associated with extended time to degree at four-year universities, but extra instructional expenditures at two-year colleges may facilitate on-time graduation for transfer students. Expenditures for student services have a similar small to moderate negative association with on-time graduation for students from all pathways. Minority enrollment has a large negative association with graduating on time for all pathways.

Results by pathway for graduating late and dropping out are displayed in Tables 10 and 11 respectively. We focus here on associations that differ from main effects described above.

Unlike on-time graduation, there is no positive effect of full-time faculty on the probability of graduating late. Compared to the mixed results for graduating on time, instructional expenditures have a large, positive effect on the probability of graduating late for all student pathways – an effect that is largest for traditional students and students who began at a research university. Student services expenditures have smaller positive effects for all student pathways that are largest for those who began at four-year universities. Compared to larger negative effects for graduating on time, percent minority has only small negative effects on the probability of graduating late.

Instructional expenditures have mixed results for dropout, with large positive effects for the traditional pathway and a small positive effect for frequent part-time enrollers. For all other pathways, instructional expenditures are associated with a reduced probability of dropout. Student support expenditures are associated with an increased probability of dropout for students on nontraditional pathways including simultaneous enrollment, frequent part-time, and starting at a two-year institutions.

Implications for Policies to Promote Graduation and Accelerate Time to Degree

Using a large, statewide dataset, we provide a more nuanced examination of time to degree than previous studies. Detailed institutional characteristics related to expenditures, peers, and faculty quantity offer new insights into the operations of institutions and how institutional actions shape the options available to individuals and influence patterns of student behavior. Our results confirm theoretical predictions that both student characteristics and institutional inputs are

independently associated with time to degree. We find considerable evidence of institutional tradeoffs between higher graduation rates and reduced time to completion. Efforts to shift resources toward areas positively associated with four-year graduation may inadvertently decrease overall graduation by limiting opportunities to graduate at a slower pace, with the largest impact on campuses with high minority enrollment. This is particularly true for the use of part-time faculty and additional instructional resources while keeping full-time faculty-student ratios constant.

A second contribution is that we find that nontraditional pathways through undergraduate education are quite common and are associated with time to degree. Only one-third of students in the sample have a traditional enrollment pathway that begins in a four-year institution and does not involve simultaneous enrollment or transfer. Two-thirds of our sample formally transferred, earned credits multiple institutions, or frequently enroll part-time. It is likely that graduation is often extended because low-income or first-generation college students are unable to sustain full-time enrollment. Other students may spend more time exploring options before choosing a degree program. Our results provide some new insight into these mechanisms. Students in Texas appear to use simultaneous enrollment to accelerate graduation. Enrolling part-time and beginning at a two-year college are not pathways to graduating in four years, but they allow students to graduate eventually and avoid dropout. These new findings suggest that studies that focus only on traditional students or college graduates provide a limited picture of obstacles to graduation. Policy should consider the context of nontraditional students, despite a research focus on more traditional pathways.

While our models cannot illustrate causality of institutional inputs, our estimates of the effects of institutional inputs on time to degree reveal institution-level factors that contribute to graduating on time, while also identifying obstacles to eventual graduation for those who do not complete on time. Our results suggest that full-time faculty are positively associated with the probability of on-time graduation with no significant negative effect on graduating late or dropping out. The relationship between part-time faculty and graduation is more complex. Part-time faculty reduce the likelihood of on-time graduation for minority students but may facilitate graduation for students on some nontraditional college pathways. At the same time, part-time faculty decrease the likelihood of graduating late and increase the likelihood of dropping out for many groups. Reliance on part-time instructors is a growing trend in higher education, and greater focus on the positive and negative uses of part-time faculty across institutional settings is warranted.

Instructional expenditures have mixed effects on time to degree. In general, increased instructional expenditures, controlling for faculty quantity, are associated with a reduced likelihood of graduating on time, particularly at four-year universities. However, instructional expenditures are positively associated with graduating late and do not increase the likelihood of dropout. This result could reflect the higher costs of students who delay graduation while accruing more credits or an ineffectiveness of instructional funds used for resources other than full-time faculty.

The association between student services expenses and time to degree is also complex, as institutions will expand programs in response to problems with degree completion and dropout. What is apparent in our results is that student services expenditures are negatively associated with time to degree. More interesting is the finding of similar effects of student services on time to degree across pathways. There is some indication that student services increase the probability of eventually graduating for students, but only for those who begin at four-year universities. This result suggests that two-year colleges could benefit from better alignment of both instruction and support services for students with a long-term goal of obtaining a four-year degree.

Finally, our results highlight racial inequalities in access to timely graduation. Hispanics are less likely to graduate on time than whites, and Blacks are less likely to graduate on time or late. Added to this disparity are the negative effects of attending a university with high minority enrollment. Percent minority is negatively associated with on-time and late graduation, and positively associate with dropout for all types of students on all types of pathways. Importantly, we find that whites, Blacks, and Hispanics respond differently to institutional inputs. All this suggests that policymakers should target graduation interventions for high minority campuses, using caution to ensure that policies that increase time to degree for one group do not have perverse effects on another group.

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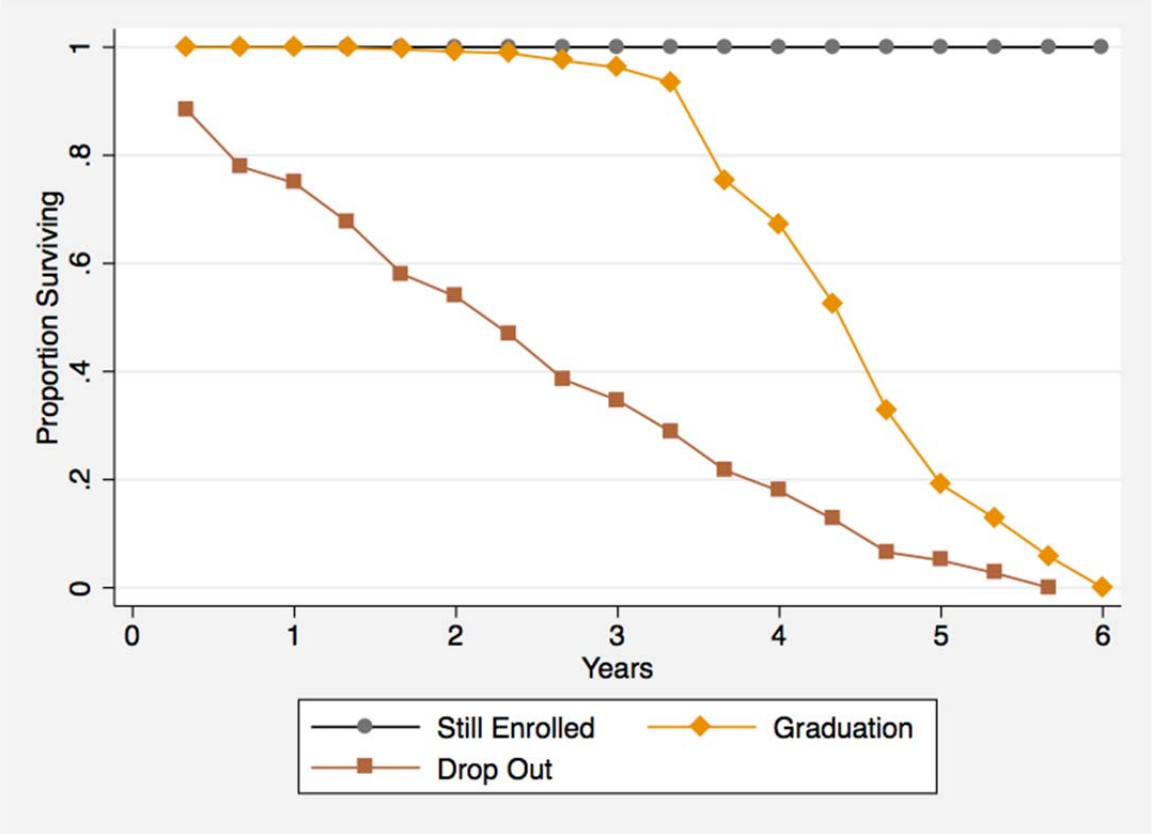
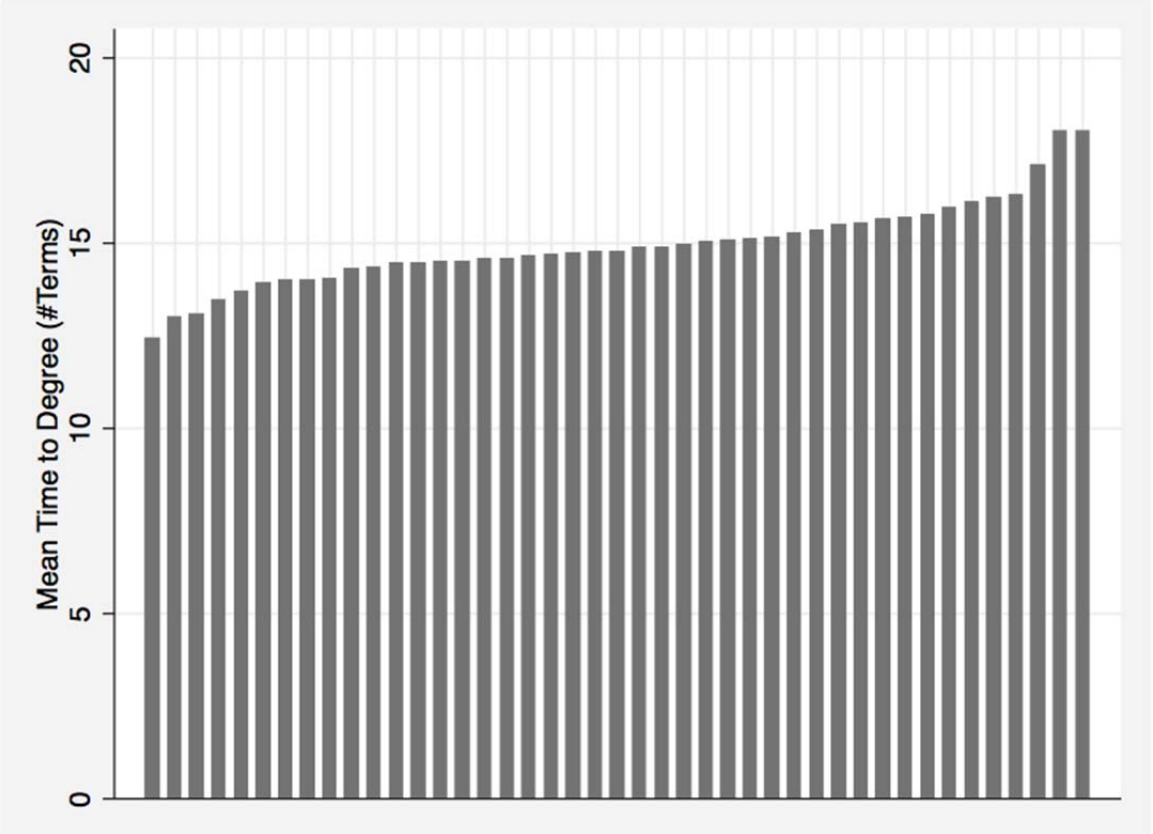
Figure 1: Survival graph for graduation and dropout, compared to still enrolled 2004/2005 through 2011



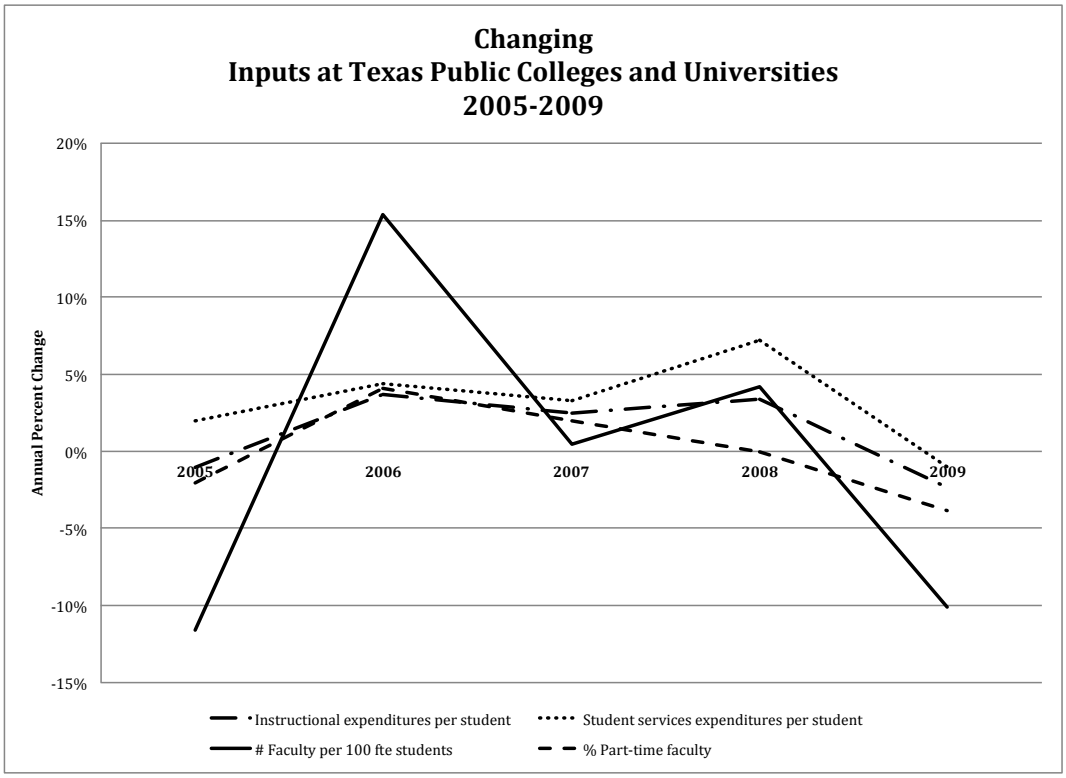
Note: Based on author's calculations using THECB administrative data. Sample includes all Texas public higher education students who enrolled in 2004 and 2005.

Figure 2: Mean time to bachelor's degree at public bachelor's degree-granting institutions 2004/2005 through 2011



Note: Based on author's calculations using THECB administrative data. Sample includes all Texas public institutions of higher education.

Figure 3: Changing inputs at Texas public colleges and universities 2005 through 2009



Note: Based on author's calculations using THECB administrative data. Sample includes all Texas public institutions of higher education.

Table 1: Mean students characteristics (sd) by graduation outcome

	Graduated On Time	Graduated Late	Still Enrolled	Dropped Out	All Students
Student demographics					
Age of entry	18.33	18.12	19.30	20.79	19.22
	(2.45)	(2.63)	(5.03)	(6.96)	(4.98)
Female	0.64	0.56	0.55	0.52	0.55
	(0.48)	(0.50)	(0.50)	(0.50)	(0.50)
Hispanic	0.18	0.25	0.34	0.30	0.28
	(0.38)	(0.43)	(0.47)	(0.46)	(0.45)
Black	0.06	0.10	0.18	0.18	0.14
	(0.25)	(0.30)	(0.39)	(0.38)	(0.35)
White	0.69	0.63	0.49	0.50	0.56
	(0.46)	(0.48)	(0.50)	(0.50)	(0.50)
Other race	0.11	0.13	0.14	0.07	0.11
	(0.31)	(0.34)	(0.35)	(0.25)	(0.31)
Father's educational attainment					
College degree	0.51	0.37	0.22	0.18	0.30
	(0.50)	(0.48)	(0.42)	(0.38)	(0.46)
High school diploma	0.30	0.34	0.32	0.26	0.30
	(0.46)	(0.47)	(0.46)	(0.44)	(0.46)
No high school diploma	0.04	0.06	0.09	0.06	0.07
	(0.21)	(0.24)	(0.28)	(0.24)	(0.25)
Mother's educational attainment					
College degree	0.47	0.35	0.22	0.17	0.28
	(0.50)	(0.48)	(0.41)	(0.37)	(0.45)
High school diploma	0.35	0.37	0.34	0.29	0.34
	(0.48)	(0.48)	(0.47)	(0.45)	(0.47)
No high school diploma	0.04	0.06	0.08	0.05	0.06
	(0.20)	(0.23)	(0.27)	(0.22)	(0.23)
Family income					
>$80,000	0.43	0.33	0.17	0.15	0.25
	(0.50)	(0.47)	(0.38)	(0.36)	(0.44)
$40,000 to 80,000	0.24	0.23	0.19	0.15	0.20
	(0.43)	(0.42)	(0.39)	(0.36)	(0.40)
<$40,000	0.15	0.18	0.25	0.18	0.19
	(0.35)	(0.39)	(0.43)	(0.38)	(0.39)
Missing	0.18	0.26	0.39	0.52	0.36
	(0.39)	(0.44)	(0.49)	(0.50)	(0.48)
Number of students	25,843	68,413	46,101	60,458	200,815
% of sample	13%	34%	23%	30%	100%

Note: Based on author's calculations using THECB administrative data. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 2: Mean (sd) high school outcomes and college pathways by outcome

	Graduated On Time	Graduated Late	Still Enrolled	Dropped Out	All Students
High school outcomes					
SAT composite score	1124.92	1036.90	963.80	954.52	1006.64
	(173.97)	(163.31)	(147.00)	(152.36)	(168.17)
Graduated in top 10%	0.40	0.22	0.08	0.08	0.17
	(0.49)	(0.41)	(0.28)	(0.27)	(0.37)
Graduated in top 11-25%	0.17	0.17	0.11	0.11	0.14
	(0.38)	(0.37)	(0.31)	(0.31)	(0.34)
College major (time varying)					
Undeclared	0.25	0.35	0.35	0.13	0.31
	(0.43)	(0.48)	(0.48)	(0.34)	(0.46)
STEM	0.28	0.31	0.26	0.18	0.25
	(0.45)	(0.46)	(0.44)	(0.38)	(0.43)
Agriculture/Health	0.14	0.19	0.24	0.16	0.19
	(0.34)	(0.39)	(0.43)	(0.36)	(0.39)
Social Science/Business	0.55	0.59	0.47	0.42	0.50
	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)
Liberal Arts/Fine Arts	0.59	0.69	0.67	0.50	0.61
	(0.49)	(0.46)	(0.47)	(0.50)	(0.49)
College pathways					
Started at two-year college	0.17	0.47	0.61	0.43	0.45
	(0.38)	(0.50)	(0.49)	(0.50)	(0.50)
Ever enrolled part-time	0.90	0.97	0.95	0.78	0.90
	(0.29)	(0.18)	(0.23)	(0.41)	(0.30)
Semesters enrolled part-time	4.31	5.23	6.85	2.74	4.74
	(3.02)	(2.93)	(3.82)	(2.58)	(3.43)
Ever simultaneously enrolled	0.37	0.40	0.35	0.12	0.30
	(0.48)	(0.49)	(0.48)	(0.32)	(0.46)
Development education credits	0.38	1.24	2.32	1.94	1.59
	(1.12)	(2.01)	(2.62)	(2.61)	(2.36)
Number of students	25,843	68,413	46,101	60,458	200,815
% of sample	13%	34%	23%	30%	100%

Note: Based on author's calculations using THECB administrative data. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 3: Mean (sd) institutional inputs by type

	2- year colleges	4-year non-research universities	4-year research universities
Full-time faculty per 100 fte students	3.78	4.33	4.07
	(1.46)	(1.23)	(1.36)
% Part-time faculty	0.54	0.41	0.54
	(0.19)	(0.11)	(0.14)
% Minority students	0.4	0.44	0.31
	(0.20)	(0.28)	(0.20)
Instructional expenditures per student	4638	5736	7238
	(1,491.45)	(1,323.75)	(1,884.15)
Student services expenditures per student	979	998	1134
	(462.98)	(413.68)	(319.87)
Number of institutions	65	23	11

Note: Based on author's calculations using IPEDS Delta Cost Project's publicly released data. Sample includes all Texas public higher education institutions between 2003-2010.

Table 4: Log-odds regression results (se) for student variables

	Single Risk	Competing Risk		
	Graduated (vs. not graduated)	Graduated On-time	Graduate Late	Dropout
		(vs. still enrolled)		
Student demographics				
Age of Entry	1.02***	1.05***	0.99***	1.09***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	1.56***	1.94***	1.17***	0.96***
	(0.02)	(0.03)	(0.01)	(0.01)
Hispanic	0.86***	0.79***	0.98***	1.04***
	(0.01)	(0.02)	(0.01)	(0.01)
Black	0.67***	0.58***	0.85***	0.97*
	(0.01)	(0.02)	(0.01)	(0.01)
Other race	0.93***	0.91***	1.34***	0.94***
	(0.02)	(0.02)	(0.02)	(0.02)
Father's educational attainment				
College degree	1.19***	1.24***	1.09***	0.77***
	(0.03)	(0.05)	(0.02)	(0.02)
High school diploma	1.05**	1.08**	1.07***	0.90***
	(0.02)	(0.04)	(0.01)	(0.02)
Mother's educational attainment				
College degree	1.12***	1.23***	1.04***	0.79***
	(0.03)	(0.05)	(0.01)	(0.02)
High school diploma	1.04*	1.10**	1.02	0.89***
	(0.03)	(0.04)	(0.01)	(0.02)
Family income				
>$80,000	1.22***	1.18***	1.18***	0.92***
	(0.02)	(0.03)	(0.01)	(0.02)
$40,000-80,000	1.16***	1.16***	1.11***	1.03*
	(0.02)	(0.03)	(0.01)	(0.02)
Missing	1.14***	1.18***	1.12***	1.31***
	(0.02)	(0.04)	(0.01)	(0.02)

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(Table 4: continued)

High school outcomes				
SAT composite	1.17***	1.24***	1.04***	0.89***
	(0.00)	(0.01)	(0.00)	(0.00)
Graduated in top 10%	1.94***	2.24***	1.37***	0.58***
	(0.02)	(0.04)	(0.01)	(0.01)
Graduate in 11-25%	1.32***	1.33***	1.20***	0.75***
	(0.02)	(0.03)	(0.01)	(0.01)
College major				
Undeclared	0.22***	0.20***	0.53***	1.53***
	(0.01)	(0.02)	(0.01)	(0.02)
STEM	1.15***	1.11***	1.03***	0.82***
	(0.02)	(0.02)	(0.01)	(0.01)
Agriculture/Health	0.93***	0.94**	0.88***	1.04**
	(0.02)	(0.03)	(0.01)	(0.02)
Social Sciences/Business	1.49***	1.52***	1.26***	0.80***
	(0.02)	(0.03)	(0.01)	(0.01)
College experiences				
Started at two-year college	0.44***	0.25***	0.87***	1.08***
	(0.01)	(0.00)	(0.01)	(0.01)
# Semesters enrolled part-time	0.87***	0.84***	0.90***	0.64***
	(0.00)	(0.00)	(0.00)	(0.00)
Simultaneously enrolled at two schools	1.09***	1.11***	1.08***	0.33***
	(0.01)	(0.02)	(0.01)	(0.00)
# Development education credits	0.34***	0.34***	0.48***	1.08***
	(0.02)	(0.03)	(0.01)	(0.00)
Number of person-periods	1,818,863		1,818,863	
Number of students	200,815		200,815	
Pseudo R-squared	0.37		0.28	

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of binomial and multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 5: Log-odds regression results for institutional variables

	Single Risk	Competing Risk		
	Graduated (vs. not graduated)	Graduated On-time	Graduate Late	Dropout
		(vs. still enrolled)		
Full-time faculty per 100 fte students	1.07***	1.15***	0.93***	0.89***
	(0.01)	(0.01)	(0.00)	(0.00)
% part-time faculty	0.62***	1.38***	0.27***	1.68***
	(0.03)	(0.09)	(0.01)	(0.05)
% minority students	0.50***	0.28***	0.92***	1.95***
	(0.02)	(0.02)	(0.02)	(0.05)
Instructional expeditures per student (log)	1.44***	1.03	1.59***	0.86***
	(0.03)	(0.03)	(0.02)	(0.02)
Student services expenditures per student (log)	0.99	0.85***	1.14***	1.11***
	(0.01)	(0.02)	(0.01)	(0.02)
No research expenditure	0.16***	0.16***	0.34***	2.30***
	(0.00)	(0.01)	(0.01)	(0.03)
Number of person-periods	1,818,863		1,818,863	
Number of students	200,815		200,815	
Pseudo R-squared	0.40		0.30	

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of binomial and multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 6: Log-odds estimates for graduating on time by student characteristics

Outcome: graduate on-time vs. still enrolled	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	By Income			By Race			By High School Class Rank		
	<$40k	$40-80k	>$80k	White	Hispanic	Black	Top 10	Top 11-25	Bottom 75
Full-time faculty per 100 fte students	1.21***	1.14***	1.10***	1.11***	1.15***	1.36***	1.11***	1.30***	1.15***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.04)	(0.02)	(0.03)	(0.01)
% Part-time faculty	0.87	1.97***	2.45***	2.81***	0.40***	1.00	1.04	1.30***	2.39***
	(0.09)	(0.28)	(0.30)	(0.23)	(0.05)	(0.24)	(0.13)	(0.20)	(0.23)
% Minority students	0.43***	0.21***	0.05***	0.05***	0.53***	0.44***	0.48***	0.31***	0.23***
	(0.03)	(0.04)	(0.01)	(0.01)	(0.05)	(0.06)	(0.06)	(0.04)	(0.02)
Instructional expeditures per student (log)	0.97	1.09	1.10*	0.96	1.29***	0.74**	1.12*	0.92	1.26***
	(0.05)	(0.07)	(0.06)	(0.04)	(0.10)	(0.09)	(0.07)	(0.07)	(0.06)
Student services expenditures per student (log	0.85***	0.84***	0.83***	0.80***	0.89**	0.83**	0.83***	0.96***	0.81***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.05)	(0.06)	(0.04)	(0.04)	(0.02)
Number of observations	924,999	382,067	511,797	1,131,469	477,070	210,324	337,472	263,174	1,218,217
Number of students	110,044	39,613	51,158	126,831	55,682	27,798	33,974	27,312	139,529
Pseudo R-squared	0.28	0.31	0.33	0.30	0.30	0.28	0.28	0.31	0.33

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 7: Log-odds estimates for graduating late by student characteristics

Outcome: graduate late vs. still enrolled	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		By Income			By Race			High School Rank	
	<$40k	$40-80k	>$80k	White	Hispanic	Black	Top 10	Top 11-25	Bottom 75
Full-time faculty per 100 fte students	0.92***	0.93***	0.97***	0.94***	0.94***	0.89***	0.98**	0.91***	0.93***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
% Part-time faculty	0.30***	0.28***	0.21***	0.24***	0.38***	0.30***	0.25***	0.24***	0.30***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.01)
% Minority students	0.85***	1.03	1.29***	1.39***	0.89***	0.89**	1.11**	0.95	.89***
	(0.02)	(0.05)	(0.07)	(0.05)	(0.03)	(0.04)	(0.05)	(0.04)	(0.02)
Instructional expeditures per student (log)	1.57***	1.69***	1.78***	1.76***	1.67***	1.77***	1.47***	1.87***	1.67***
	(0.03)	(0.05)	(0.04)	(0.03)	(0.05)	(0.08)	(0.05)	(0.06)	(0.03)
Student services expenditures per student (log)	1.23***	1.09***	1.09***	1.12***	1.09***	1.25***	1.24***	1.27***	1.10***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.04)	(0.03)	(0.03)	(0.01)
Number of observations	924,999	382,067	511,797	1,131,469	477,070	210,324	337,472	263,174	1,218,217
Number of students	110,044	39,613	51,158	126,831	55,682	27,798	33,974	27,312	139,529
Pseudo R-squared	0.28	0.31	0.33	0.30	0.30	0.28	0.28	0.31	0.33

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 8: Log-odds estimates for dropping out by student characteristics

Outcome: dropout vs. still enrolled	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		By Income			By Race			High School Rank	
	<$40k	$40-80k	>$80k	White	Hispanic	Black	Top 10	Top 11-25	Bottom 75
Full-time faculty per 100 fte students	0.91***	0.87***	0.88***	0.90***	0.92***	0.85***	0.89***	0.89***	0.89***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
% Part-time faculty	2.15***	1.17**	1.39***	1.48***	1.92***	1.91***	1.39***	1.55**	1.91***
	(0.08)	(0.09)	(0.11)	(0.07)	(0.11)	(0.17)	(0.15)	(0.14)	(0.07)
% Minority students	1.70***	2.69***	4.65***	2.41***	2.04***	1.54***	2.08***	2.32***	1.86***
	(0.05)	(0.22)	(0.43)	(0.12)	(0.09)	(0.09)	(0.20)	(0.18)	(0.06)
Instructional expeditures per student (log)	1.05*	0.92	0.58***	0.88***	0.78***	1.46***	.53***	0.77***	1.04
	(0.03)	(0.05)	(0.03)	(0.03)	(0.04)	(0.10)	(0.04)	(0.05)	(0.03)
Student services expenditures per student (log	1.15***	1.07*	1.11***	1.08***	1.27***	1.03	0.98	0.92***	1.13***
	(0.02)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.05)	(0.04)	(0.02)
Number of observations	924,999	382,067	511,797	1,131,469	477,070	210,324	337,472	263,174	1,218,217
Number of students	110,044	39,613	51,158	126,831	55,682	27,798	33,974	27,312	139,529
Pseudo R-squared	0.28	0.31	0.33	0.30	0.30	0.28	0.28	0.31	0.33

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 9: Log-odds estimates for graduating on time by student characteristics

	(1)	(2)	(3)	(4)	(5)	(5)
	first enrollment			navigating higher education		
Outcome: graduate on-time vs. still enrolled	2-year college	4-year non-research university	4-year research university	Traditional 4-year enrollment	Simultaneous enrollment	Frequent part-time enrollment
Full-time faculty per 100 fte students	1.11***	1.46***	1.36***	1.23***	1.09***	1.12**
	(0.02)	(0.03)	(0.04)	(0.02)	(0.01)	(0.06)
% Part-time faculty	2.58***	0.39***	1.00	1.26**	1.34***	4.13***
	(0.35)	(0.06)	(0.24)	(0.13)	(0.14)	(1.83)
% Minority students	0.49***	0.45***	0.44***	0.29***	0.24***	0.27***
	(0.06)	(0.04)	(0.06)	(0.03)	(0.03)	(0.08)
Instructional expeditures per student (log)	1.44***	0.54***	0.74**	0.87***	1.37***	0.87
	(0.09)	(0.04)	(0.09)	(0.04)	(0.07)	(0.18)
Student services expenditures per student (log)	0.78***	0.72***	0.83**	0.89***	0.80***	0.86
	(0.04)	(0.03)	(0.06)	(0.03)	(0.03)	(0.13)
Number of observations	833,007	463,597	534,380	548,139	658,945	571,265
Number of students	90,608	55,329	56,842	67,371	60,443	54,974
Pseudo R-squared	0.29	0.30	0.34	0.33	0.29	0.31
% of all students	45%	28%	28%	34%	30%	27%

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 10: Log-odds estimates for graduating late by student characteristics

	(1)	(2)	(3)	(4)	(5)	(5)
		first enrollment			navigating higher education	
Outcome: graduate late vs. still enrolled	2-year college	4-year non-research university	4-year research university	Traditional 4-year enrollment	Simultaneous enrollment	Frequent part-time enrollment
Full-time faculty per 100 fte students	0.94***	0.88***	0.89***	0.91***	0.96***	0.93***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% Part-time faculty	0.26***	0.40***	0.30***	0.30***	0.23***	0.22***
	(0.01)	(0.03)	(0.03)	(0.02)	(0.01)	(0.01)
% Minority students	0.92***	0.86***	0.89**	0.85***	0.96	0.88***
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Instructional expeditures per student (log)	1.61***	1.44***	1.77***	1.70***	1.60***	1.61***
	(0.03)	(0.04)	(0.08)	(0.04)	(0.03)	(0.04)
Student services expenditures per student (log)	1.11***	1.25***	1.25***	1.23***	1.12***	1.09***
	(0.01)	(0.02)	(0.04)	(0.02)	(0.02)	(0.02)
Number of observations	833,007	463,597	534,380	548,139	658,945	571,265
Number of students	90,608	55,329	56,842	67,371	60,443	54,974
Pseudo R-squared	0.29	0.30	0.34	0.33	0.29	0.31
% of all students	45%	28%	28%	34%	30%	27%

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.

Table 11: Log-odds estimates for dropping out by student characteristics

	(1)	(2)	(3)	(4)	(5)	(5)
	first enrollment			navigating higher education		
Outcome: dropout vs. still enrolled	2-year college transfer	4-year non-research university	4-year research university	Traditional 4-year enrollment	Simultaneous enrollment	Frequent part-time enrollment
Full-time faculty per 100 fte students	0.86***	0.95***	0.85***	0.94***	0.90***	0.89***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% Part-time faculty	2.28***	1.73***	1.91***	1.20***	1.52***	1.55***
	(0.11)	(0.10)	(0.17)	(0.07)	(0.14)	(0.09)
% Minority students	4.04***	1.71***	1.54***	1.48***	2.05***	1.18***
	(0.16)	(0.07)	(0.09)	(0.07)	(0.16)	(0.06)
Instructional expeditures per student (log)	0.90***	0.91**	1.46***	0.78***	0.82***	1.19***
	(0.03)	(0.04)	(0.10)	(0.03)	(0.05)	(0.06)
Student services expenditures per student (log)	1.19***	1.02	1.03	1.01	1.17***	1.21***
	(0.03)	(0.02)	(0.04)	(0.02)	(0.06)	(0.04)
Number of observations	833,007	463,597	534,380	548,139	658,945	571,265
Number of students	90,608	55,329	56,842	67,371	60,443	54,974
Pseudo R-squared	0.29	0.30	0.34	0.33	0.29	0.31
% of all students	45%	28%	28%	34%	30%	27%

Note: Based on author's calculations using THECB administrative data and IPEDS Delta Cost Project's publicly released data. Significance indicated by --*: P<0.10, --**: P<0.05, --***: P<0.01. Table displays results of multinomial logistic regression. Sample includes all Texas public higher education students who first enrolled in 2004 and 2005. Includes observations for all trimesters enrolled from 2004-2011.