RAISING THE COST OF AFFORDABILITY:

GUARANTEED TUITION PROGRAMS

AND THE ECONOMIC VALUE OF CERTAINTY

by

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The issues of affordability and access to higher education are widespread among college campuses and throughout the national political debate. As institutions attempt to combat rising tuition, many schools have implemented guaranteed, or fixed rate, tuition programs (GTP). These programs serve as a promise to students, pledging their tuition will not rise throughout their degree path, and participating institutions assert that these programs are successful at providing an affordable education. I investigated these claims by analyzing what the factors are to implement a guaranteed program, and the impact of these programs on outcome variables such as completion.

Through available institution and student information, I compiled a list of the 140 public and private institutions that have implemented a guaranteed program. With this base list, I presented details and criteria of each unique program through data available on college websites and surveying enrollment and finance offices of participating universities. I relied on university data derived from the College Scorecard Report, including but not limited to enrollment rates, retention rates, state appropriation, student identifiers, and net price. Using a variation on a time series regression, and data

spanning a period of eleven years, I analyzed patterns leading up to and following the start of these programs. I found there were some patterns indicating small effects of GTPs and other factors both before and after the implementation of a program. However, while some effects were statistically significant, the effects were very small in magnitude. None of the quantified effects analyzed in the empirical model were found to have a dramatic enough impact to credit the GTPs I reviewed as causing the size of effects the educational institutions generally intended, as represented in the communications of institutions to students and their families.

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Chapter 1: Background

1.1 Introduction to Guaranteed Tuition Proposals

Two of the most pressing issues present in higher education in the United States are affordability and access (US DOE). As the cost of higher education rises and state appropriations dwindle, universities become more tuition dependent. To combat this, public and private universities across the nation have developed and are marketing alternative tuition programs that strive to provide educational opportunities and maintain academic excellence while avoiding budget shortfalls. One new program that has gained in popularity is a fixed-rate or guaranteed tuition program (GTP). By 2011, 267 institutions in 44 different states had adopted a fixed-rate or GTP plan (IPEDS).

Each campus that adopts a GTP implements a different set of specific policies, but the core of the programs remain the same: the college fixes the tuition rate for a set period of time for students, in order to prevent increases in tuition year by year. Each year, the incoming class is considered a cohort, and they are given a set tuition amount to pay for a determined period of time, usually between four and five years. This fixed amount is advertised as a promise and is aimed to provide financial certainty to prospective students and their families by addressing the issues of unpredictability in college tuition.

While there are similarities across the programs, GTPs vary in five main ways. The first is whether students have the option to choose the program, or whether it is mandatory for all students. If it is optional, it will either be an opt-in or opt-out program, which have different rates of participation. Second, the eligibility of the student changes with different programs. Depending on the campus, resident, non-

resident, or all undergraduate students are eligible for GTPs. Third, campuses vary on how many years the program is guaranteed, and what happens if a student does not graduate during the guaranteed time. Most programs guarantee the tuition rates for four to five years, and at the completion of the fixed time students either pay a non-guaranteed rate, the rate of the incoming cohort, or the rate of the cohort following them, the next class. Fourth, transfer students are treated differently depending on the program. For some, transfer students are not eligible for the fixed tuition rate. For others, transfer students are eligible for the full time allotted or a select number of years depending on the amount of credits they have when admitted to the college. Lastly, some institutions include all tuition and fees in the guaranteed rate, others include some fees with the tuition, and still others only guarantee the tuition rate.

To keep the guarantee program revenue neutral, the student pays an amount higher than their cost of education during their first two years of study, and it only becomes a financial incentive the last two years of a student's time enrolled (Morphew, 39). This system of overpaying in the early period manifests itself in decision-making behavior in two principal ways. First, prospective students and families suffer from sticker-shock because the first year's guaranteed rate is significantly higher than the comparable rate of a year-by-year program. Second, rational behavior predicts future discounting, meaning that people give more weight to decisions and utility received or loss in the present than the future. Therefore, the high initial price will be perceived with more weight than the cost savings three and four years through the course of study. To overcome these initial responses to the program, GTPs require an eloquent, targeted

marketing strategy for universities to ensure that prospective students are not discouraged to attend universities with GTPs (Nicoolescu, 38).

Universities that have implemented these programs claim the programs have increased enrollment, provided a more affordable education, and increased graduation rates (Delaney, 360). Despite these claims and the subsequent rise in popularity of GTPs, there are still questions and concerns regarding aspects of the GTPs, including determining the real change in the cost of college created by GTPs and the correlation between the changes in costs and the behaviors of participating students.

I seek to contribute to the literature on these programs in two main ways. First, I analyze the reasons GTPs are implemented and who is likely to participate in these programs. Second, I investigate the impact GTPs have on students and universities. I hope that these findings will provide insights to students and families to help determine their compatibility with GTPs, and to inform policy makers of the motivations behind the implementation of GTPs, and their subsequent impacts.

1.2 Research on Tuition and Guaranteed Tuition Programs (GTPs)

Economists and researchers have been interested in understanding and analyzing the broader issues regarding the demand for higher education and issues of affordability. Research has been conducted on a broad range of topics including price discrimination with tuition, the effectiveness of peer tutoring, the supply and demand of state appropriations, and the price elasticity of student populations. As it becomes more common to pursue a degree in higher education, the interest of analyzing the economic incentives and disincentives in the market for higher education has become more widespread.

The development of GTPs and the subsequent research analyzing them follows a similar trajectory. The amount of research about GTPs is growing, and provides valuable insight into their relationship with state appropriations and the impact they have on underrepresented communities. However, the existing research does not adequately explain the driving force behind the implementation of GTPs, nor does it encompass all impacts GTPs have on student success and behavior.

One main section of research that exists regarding GTPs is their relationship to the respective state budgets, which provides insight into the possible motivations for implementing or repealing a GTP. Most recently in 2015, Delaney and Kearney analyzed the impact of state guaranteed tuition laws on state appropriations, which is the money set aside by the state (usually the state legislature) to fund higher education. Many public universities rely on substantial support from their state legislatures but the fluctuating and decreasing state appropriations have resulted in tuition becoming the main source of revenue for universities (College Board 2013).[1] Delaney and Kearney discovered that the introduction of a guaranteed tuition law resulted in a 20% decrease in general state appropriations, on average, across affected institutions (Delaney & Kearney), although their research focuses on Illinois public institutions. Understanding the relationship between GTPs at public universities and their state appropriations is essential, especially for institutions that rely heavily on money from the state. Delaney's analysis provides insight into the existing dependent relationship between GTPs and state appropriations. Included in my analysis is the impact state appropriations have on the implementation of GTPs, which is a step before Delaney's analysis of the impact

[1] During the economic recession there was a steady decline in state appropriations, but that has diminished and by 2013 the overall trend was a decrease of 0.4%

GTPs have on later state appropriations. In addition, large changes in state appropriations could impact the services available to students, thereby influencing student behavior, which I am analyzing.

I was especially interested to explore existing research on the impact GTPs have on prospective and current students because of my focus on student behavior following the implementation of a GTP. Robertson (2007) examined price sensitivity before and after GTPs were implemented at minority-serving institutions. In this research, price sensitivity refers to the degree to which the price (or increase in price) of tuition affects the purchasing behavior of students. Robertson found that both new and continuing students are price sensitive, but that new students were more price sensitive than continuing students. Since price-sensitivity affects the behavior of students, this finding provides insight into my analysis of student and institution changes following the implementation of a GTP. All else equal, the more price sensitive a student is, the more likely they will not remain enrolled when tuition prices increase or fluctuate. I will broaden these research findings at minority-seeking institutions by including all comparable public and private institutions that have implemented a GTP in the analysis.

In addition to Robertson's research on minority-seeking institutions, Morphew (2007) focused on the effect GTPs have on students who are underrepresented and poor. Morphew asserts that GTPs negatively impact underrepresented and poor students because the students are less likely to continue their education after increases in price. Furthermore, Morphew discusses the concept of persistence and the worthiness of this argument. He explains that proponents of GTPs claim students will be more likely to persist and graduate because they face no price increase throughout the four years. This

claim is precisely what I investigate in my research. The concept of persistence would have an impact on many decisions students would make, and could be represented through changes in completion rate, net debt amounts, and retention rates.

Although these prior studies began to delve into the effect GTPs have on students and the progress on their degrees, I also wanted to review existing research on tuition increases and the impacts these have on student behavior. Since the implementation of a GTP may result in a price increase in year 1, research on the impact of sharp tuition increases may be relevant to analysis of GTPs. Shin and Milton (2006) looked at public universities to estimate the impact of tuition increases on enrollment, and found that enrollment was not affected by tuition and financial aid changes. Using Integrated Postsecondary Education Data System (IPEDS) data they focused on FTFT enrollment and in-state tuition, although their dataset captured only three years of data. Hemelt and Marcotte (2011) examined the impact on enrollment due to rising tuition at public universities and found different results than Shin and Milton. Concluding that, at the mean, an increase of $100 resulted in a decline of 25 students, they continued on to determine multivariate and institution type results, which my analysis will mirror. Although Hemelt and Marcotte did not limit their research to GTPs, they do provide data specific to "very-large" tuition increases, which can be similar to the effects of GTPs in their initial year. Although these tuition increases are mirrored, GTPs have many more potential influences on student behavior, including the promise of stability and predictability. Further investigation into enrollment at GTP participating institution could help determine between the influence of large tuition increases and the influence of these other factors.

Chapter 2: Marketing Schemes and Projections in Behavior

2.1 Affordability versus Predictability

When marketing GTPs to students, families, policy makers, and the community, many universities rely on the term "affordable" to describe the program's attractiveness. When Adams State University implemented a guaranteed tuition program, the chair of their Board of Trustees Arnold Salazar proclaimed "This shows that we are committed to making education affordable and assuring students graduate with less debt" (Waechter, 2015). But, to thoroughly understand GTPs and the impact they have, it is necessary to unpack how exactly a GTP is "affordable," and what this affordability encompasses. The general use of the term "affordable" is as an adjective describing something inexpensive or less expensive than a similar option with identical benefit or utility.[2] However, in terms of GTPs, administrations do not always use the term affordable as something less expensive, but rather as a more predictable, stable, certain, or reliable program alternative to traditional tuition and subsequent yearly tuition increases. The crux of this program is about managing the risk and uncertainty of future tuition increases, not actually making college affordable.

Universities use the rhetoric of making college "affordable," despite the fact that GTPs do not always result in cost savings, thereby employing an inaccurate marketing message. When the University of Arizona implemented a guaranteed tuition program in 2014, UA President Ann Weaver Hart said, "I understand how critical it is to keep education affordable. The UA wants to see students graduate with the tools they need to succeed in the workforce. To do that, we must make sure they can afford to attend"

[2] This is not a formal definition, but rather how the term is generally used.

(Smiley, 2014). The success of the GTP marketing scheme, and thus GTPs, relies on the perception of affordability, which would result in lower total costs for students. However, GTP's true effect is the stability of tuition costs over the years, and not necessarily monetary savings. In actuality, a higher net tuition price with a GTP may be marketed, perceived, and believed to be more affordable, making the "affordability" marketing scheme misleading. The GTP is rooted in the theme of affordability through a fixed tuition model, but the very essence of the program does not guarantee a lower net cost to participants.[3] The design and result of GTPs are equal or higher college costs, with increased predictability of costs, not increased affordability. These programs do provide stability and certainty about future costs, which provides value and can influence the preferences and decisions people make. However, that stability should not be conflated with the monetary savings of an affordable option.

Over time, the conflation of the concept of affordability with GTPs have transformed the cost savings of such plans into a pervasive myth, communicated by the administration and policy makers that control this message (or perhaps also believe this myth). This marketing approach, rooted in the demand for less expensive higher education options in the U.S., is successful at marketing GTPs. The myth of affordability influences the behavior of prospective participants, feeding on their fear of price instability when faced with increasing tuition price tags. Both the market and colloquial language result in the reification of the affordability myth, perpetuating the misunderstanding or misuse of this essential term.

[3] GTPs do not offer consistent cost savings, according to my analysis

2.2 Economic Agents Behavior

There are two main modern economic approaches regarding decision-making behavior: the neoclassical rational model and the behavioral model, which studies systematic departures from rational behavior. The rational individual is the ideal economic agent because it is rooted in traditional economic theory modeled on the assumption that people behave rationally (Ariely 2009). On the other hand, behavioral agents are more influenced by psychological factors, and these agents take into account social, environmental, cognitive, and psychological factors when making decisions. Since these agents are rooted in different theory, they would have different behavioral responses to a GTP. Below, I explain projected behavioral responses to a GTP based on the economic theory of rational agents (RAs) and behavioral econs (BEs).

According to the traditional model, RAs behave rationally in decision making situations, choosing the option that will result in the highest level of expected utility. Utility, in economic terms, may be measured by emotional, monetary, material, or societal impacts, or often a combination of these. Before coming to a decision, a RA consistently weighs and considers all available information, the costs and benefits of their preferences, and the probability of the events before them. In the context of a GTP, a rational agent would understand that under reasonable circumstances,[4] the GTP will be revenue neutral with a 4-year graduation path. With all else held equal, a rational agent would be indifferent when analyzing the cost savings between a GTP and traditional tuition path because in general there are no cost savings. An RA may

[4] No unpredictable changes in cost

appreciate or value a GTP for other reasons, because the predictability of a GTP means that the student's annual costs would be stable.

Contrary to the RA, the behavioral econ (BE) does not assume rationality. BEs have a tendency to suffer from projection bias, where they inaccurately perceive their future selves. This bias results in their current outlook clouding future judgments. Since GTPs rely on consistency and future planning due to the high initial price point, projection bias may have a significant impact to the affinity of a GTP. In addition, BEs suffer from short-term bias, and may be further discouraged by the GTP because of the high initial price point. A BE may be unable to accurately estimate their expected savings or lack thereof with a GTP because of their tendency to give more weight to the preferences and decisions in the short term. For example, a GTP may offer the BE higher expected predictability or perhaps perceived savings, but the BE will not be attracted to the GTP because of their over-weighting of short-term impacts.

On the other hand, the BE lacks self-control, and could view the GTP as an opportunity to control their behavior through a commitment device. The path of higher education presents unpredictable scenarios. A student participating in a GTP could conceivably change majors, setting them back a year, or transfer to a different institution, thus exiting the GTP without reaping the full benefits of the initial additional investment. Likewise, in a non-GTP, the institution could raise tuition drastically or change policies that would impact their graduation track. To a BE, a GTP could serve then as a way to commit and control their unpredictable future scenarios. The initial hike in tuition operates as a means of prepaying for the cost of their education. Similar

to a gym membership, a GTP could serve as a pre-commitment device, locking them in to a contract to mold future behavior and decision-making (Rogers 2014).

When choosing a college, and thus the tuition program, it is not uncommon for familial and peer influences to play a large role in the prospective student's decision. When this is the case, the prospective student's preferences will be impacted and the model behavior, whether rational or irrational, will not be perfectly characterized. For example, using a GTP as a commitment device will be spread between multiple individuals, which impacts its effectiveness. Commitment devices are picked voluntarily, because individuals are aware of a difference between their current preferences and future goals and wish to control for that disparity (Rogers 2014). A GTP may not be an effective commitment device for a student and their parents if all of their current preferences and future goals do not align. This inconsistency would not allow a GTP to be an effective commitment device for paying for and completing college.

When considering college attendance as a decision, each year the student decides to remain enrolled they weigh the alternate options and the costs and benefits associated with each possibility. In economics, this decision is described as marginal cost, where the change in total utility is calculated from a one-unit change in cost/benefit. In the behavioral situation of higher education, the marginal cost of going to one year of school is a year of work, income, experience, or time-off in the real world.

Since neither of these agents are certain to elect to prefer a GTP, an essential component of the success of a GTP is marketing it to prospective students and families.

The perfect agent that would elect to choose the GTP would be risk averse with a low discount rate. This agent would prefer the guarantee and security of the GTP rather than taking a chance on potential tuition hikes of unknown sizes. In addition, they will not severely discount future decisions and their future rewards and punishments, making GTPs appear attractive because of the perception of cost savings in year 3 and 4 of the GTP. Institutions must appeal to potential students in such a way that the rational and irrational biases align, making them prefer the GTP.

A GTP is an effective device to avoid risk. Students know that tuition will go up and are worried that those increases will be large enough to the point they cannot afford them. The GTP would serve as a standard attempt to reduce risk, and thus appeals to the risk averse agent. Although, in models of risk aversion the effective strategy is to put the risk on those that can bear it the most, or in the situation where the statistical aggregation can mitigate the risk (Kahneman, 340). In some ways this program does not follow this strategy, because the risk is on the university, not the student or family. Universities are only able to adjust their anticipated tuition revenue for incoming cohorts of students, since the rest are locked in to a rate for the prescribed time. In general, students and families have more opportunities to diversify the weight of the risk and decisions, where the university may not have this flexibility.

2.3 Motivations for the Institutions

My research is centered around the motivation for implementing GTPs and the impact they have on student behavior. Above, I have outlined predicted student behavior to a GTP, and the preferences they encounter. On the other hand, institutions have motivations and reservations regarding the GTP, how it is marketed, and what

financial impact it has on the operations of the university. GTPs offer advantages to the university, especially in terms of recruitment, but there are also financial limitations.

First and arguably the most important is the recruiting advantage of the GTP. I anticipate that much of the driving force on campuses considering the implementation of GTPs would come from the Admissions and Recruitment offices. The narrative of GTPs is marketable. In a society of fast rising and uncertain future costs for higher education and the increasing demand for a degree, the ability to promise students and families flat-tuition rates is a potential advantage. Students and families are *promised* a reliable rate that they can financially plan for throughout their track to graduation. When the University of Oregon was considering implementing a GTP, Roger Thompson, Vice President for Enrollment, explained this benefit at a student forum, "We are able to talk with families honestly and ethically about the total cost to earn a degree. We can't do that if we don't know what that's going to be. That, to me, is the biggest benefit" (EMU, October 2015). When discussed at the University of Oregon, Thompson was a proponent of implementing a GTP, expressing the recruiting advantage as a motivation for choosing the program.

The narrative of predictability appeals to the risk averse individual, who would prefer a guaranteed rate over risking sharp and unpredictable increases in tuition and fee rates. However, for this to be an advantage to the university, the marketing of a GTP must be precise in scope to ensure that the dependability of a GTP is at the forefront of the narrative, and the disadvantages are not. For example, the high initial price point is a disadvantage to the prospective student, but a pointed marketing agenda could overcome the inflated price point (Kahneman, 338). In actuality, the individual must

strongly prefer the dependability of the program to overcome any concerns about the higher tuition price in year one.

On the other hand, the financials of GTPs are more complicated. Similar to the advantage of financial planning for the student and their family, universities can plan and rely on set revenue for each cohort of students. After determining the rate of each cohort, there is a predictable stream of revenue that universities can financially plan for.[5] However with that predictability comes a lack of flexibility. Apart from the incoming cohorts tuition rate, the university has very little flexibility in their tuition revenue. Universities that rely heavily on tuition revenue may face difficulties when faced with shortcomings. They do not have the ability to raise tuition rates for all undergraduate students, and must rather depend on the incoming cohort (about ¼ of undergraduate population) for any net revenue increases. At private institutions where most students to not pay the full tuition rate, they may compensate by giving out fewer scholarships.

At institutions that experience fluctuating amounts of support from foundations and/or the state, this inflexibility is heightened. The University of Oregon receives less state appropriations than comparable peer institutions, and thus relies more on tuition revenue. When speaking at a forum, Jamie Moffit, the University of Oregon Vice President for Finance and Administration, explained that their university must be willing to take on the financial risk that comes with the GTP. She explained, "If we hit a year where we have a dramatic cut [to the budget], we have to be willing to let our reserves drop" (EMU, October 2015). This inflexibility is a risk that universities

[5] Apart from the small influx in enrollment and withdrawal rates that changes total undergraduate student numbers

considering GTPs must be willing to take on, and can limit feasibility of overcoming budget shortfalls. Economic theory of efficient risk says that the risk should be borne by the agent that can handle it the easiest, which does not seem to be the university in this circumstance (Kahneman, 340).

2.4 Hypothesis

Given that students do not behave rationally when planning for and choosing which school and program to invest in, the various motivations for an institution to implement a GTP, and diverse array of institutions in my dataset, I predict that there will not be many statistically significant findings in my regression analysis. I would assume that there are trends within subsets of institutions that are closely linked, but those trends may not be consistent enough to make a wide analysis of the motivations and impacts of a GTP that I wish to do. For example, all of the Illinois public schools switched to the program at the same time when mandated by the state legislature during an economic recession. These institutions are closely associated and rely on the same state appropriations, political atmosphere, economic conditions, and similar student characteristics. It is not unreasonable to believe that these institutions may have similar motivations for implementing a GTP, and thus may have similar results once the program is implemented. But, when my analysis is broadened to the 140 public and private schools, the motivations and impacts will not be consistent with the small set Illinois schools. Analyzing correlation between small subsets of schools such as publics from a specific state or comparable peer institutions may garner more significant results, but I wish to analyze the larger picture of GTPs in general in the U.S.

Depending on the results, an appropriate follow-up research project would be to hone in on different aspects of the program or similar subsets of participating institutions.

Chapter 3: Methodology

3.1 Data

To determine the reasons for implementation and measure the impact of the implementation of guaranteed tuition programs, I relied on the Department of Education College Scorecard report. Originally released in September 2015, the College Scorecard is a compilation of data from the Integrated Postsecondary Education Data System (IPEDS), the National Student Loan Data System (NSLDS), and the Department of Treasury. The intent of the College Scorecard is to provide transparent information for students, families, and researchers 'about the costs and quality of institutions of higher education' (3). In the case of my research, the College Scorecard served as an exhaustive, yet accessible, dataset that provided the foundation for my statistical analysis.

The majority of the data used for this project in the College Scorecard comes from IPEDS, an institution level data set including all reporting four-year higher education institutions in the United State. IPEDS serves as the main data collection program from the National Center for Education Statistics, and it includes performance data such as completion rates and tuition, and also contains intuitional information such as location, enrollment size and the amount of state appropriations received. The data provided through the IPEDS database is gathered through questionnaires. Any institution participating in the Title IV federal student aid program must complete these questionnaires. As a result, there are about 7,253 institutions that provide data to IPEDS annually, as of 2013 (IPEDS). In addition to IPEDS, the College Scorecard relies on data and reports from the NSLDS, which is the Department of Education's method for

measuring federal student aid through student loans and Pell grants. These data are derived from federal borrowers and grant recipients since the 1960s (College Scorecard).

Before using data from the College Scorecard, I compiled a list of institutions that have implemented Guaranteed Tuition Programs, and the program details at each of these institutions. I assembled a dataset of 140 public and private universities that reported they had GTPs from lists of participating institutions available on IPEDS individual admissions or finance webpages. GTPs have varying characteristics, and I collected data on as many varying program details that I found including: state, public or private institution, year the GTP was implemented, how it was implemented, who is eligible, how long students can participate, whether fees are included, withdrawal result, eligibility of summer, online course participation, etc.

In the merged dataset, I took the College Scorecard data that did not match the types of institutions that were in my GTP specific dataset. I dropped for-profit schools, small baccalaureate and doctoral programs, and dropped small 4-year institutions. This resulted in a final sample similar in size, which had comparable institutional characteristics.

Although the final merged dataset had more than 150 variables, I focused on a few variables in my regression analysis. First, I chose state appropriations, and the subsequent annual change in state appropriations because of the strong link between public schools and state appropriations, which Delaney et al. discussed in their research (Delaney 359). In addition, I chose retention rates of first year students, 4-year completion rates, admission rates, cost of attendance, number of undergraduate degree-

seeking students, and net price. These are the core measures of institutional performance and student behavior, so I thought that these statistics could be initial identifiers of any pre-implementation patterns. Below is a table of their abbreviations, names, and explanations, as defined by IPEDS and/or the College Scorecard.

Table I: Variable Abbreviation and Explanations

Abbreviation	Explanation
adm_rate	Admissions rate
app	Revenues received by an institution through acts of a legislative body, except grants and contracts.
costt4_a	The average annual total cost of attendance, including tuition and fees, books and supplies, and living expenses for all full-time, first-time, degree/certificate-seeking undergraduates who receive Title IV aid.
npt4	Average net price for public and private Title IV institutions. The average annual total cost of attendance (CostT4_A, CostT4_P), including tuition and fees, books and supplies, and living expenses, minus the average grant/scholarship aid. It is calculated for all full-time, first-time, degree/certificate-seeking undergraduates who receive Title IV aid.
overall_yr4_n	Number of students in overall 4-year completion cohort
ret_ft4	The proportion of full-time, first-time, degree/certificate-seeking undergraduates who were enrolled at the institution in the fall 1 year after starting at the institution, calculated from the IPEDS Fall Enrollment component.
ugds	Enrollment of undergraduate degree-seeking students

In addition to the variable definitions, here are tables providing summary statistics of the 11-year database I use for statistical analysis, showing an initial comparison between institutions with and without GTPs.

Table II: Summary Statistics of Variables without GTP

stats	N	Mean	SD	Q1	Median	Q3
Admission Rate	4341	.654	.189	.550	.683	.792
Retention Rate	4556	.772	.107	.709	.770	.841
State App	2573	106.76	106.3	40.3	65.0	130.4
Cost of Attend	2233	24822	12284	16682	19687	28751
Net Price	4615	7548	9168	0	0	13964
4-year Comp	4136	2564	3286	1259	1972	3076

Table III: Summary Statistics of Variables with GTP

stats	N	Mean	SD	Q1	Median	Q3
Admission Rate	339	.660	.148	.559	.648	.763
Retention Rate	340	.763	.099	.701	.766	.831
State App	246	130.6	132.9	39.7	76.7	206.5
Cost of Attend	214	20021	5308	16766	19791	21954
Net Price	340	8248	7015	0	9716	14136
4-year Comp	297	2988	1791	1633	2705	3951

3.2 Statistical Analysis

To most analyze the data, I created a panel dataset, separated by year, combined with the College Scorecard data,[6] IPEDS state appropriation data, and the dataset with GTP details. The panel design is most compatible with datasets with a large number of variables and observations (N) over a short people of time (T). My data is set up in a similar form, where N was the individual school information over 11 years. This separates all available information by year, leaving variables of interest in a consistent yearly distribution despite the large sample and small distribution of time. This empirical design is appropriate for before and after studies, where the implementation of a GTP represents the moment of impact. In this form, I am able to control for measurable characteristics, such as exogenous independent variables implicit in regression analysis, to the best of my ability.

In the panel dataset, each panel is separated by individual year, making the time variable year, resulting in a panel dataset spanning 11 years, 2003-2013. Although the panel dataset is in the form of years (denoted as yr), there were other time related variables that I used in my statistical analysis. First, I used the variable *date* to indicate the year in which the GTP begins at a new school, so the implementation of a GTP in 2009 would be represented by *date* = 2009. Second, I generated a descriptive variable that calculated the difference between the year in the panel and the date of implementation where *years_before= date- yr*. This variable, *years_before*, followed a continuous model where five represents five years prior to the implementation, zero represents the implementation year, and negative three represents the third year

[6] The College Scorecard database is updated routinely. The data I used for my research was last updated March 2, 2016.

following the implementation. In addition, I generated dummy variables coded as the implementation year where 0= no GTP and 1=GTP to flag the year in which each school implemented a GTP. These dummy variables provided a more consistent method for analyzing the impact of GTPs by serving as a flagged variable for each institution's implementation year.

When analyzing my panel data, I had two main areas of focus: to determine why schools choose to implement a GTP and what effect the implementation has on school characteristics. To begin, I looked at the means of my variables of focus throughout the 11-year time span of the *years_before* variable.

Table IV: Mean Values by Year Pre GTP Implementation

years before	app	costt4_a	npt4	overall_yr4_n	adm_rate	ret_rate
1	114.3	19608.3	4262.184	2548.9	.699	.748
2	116.3	21880	5109.816	2936	.717	.749
3	116.37	20771.3	4515.974	2879.5	.702	.751
4	130.6	20151.4	6636.269	3232.9	.738	.744
5	150.0	20614.1	2479.022	3490.9	.701	.759

Table V: Mean Values by Year Pre GTP Implementation

years_before	app	costt4_a	npt4	overall_yr4_n	adm_rate	ret_rate
-5	184.2	22022	10454	22022	.591	.789
-4	98.3	18900.5	7795.2	18900.5	.686	.750
-3	95.6	17803.2	6787.1	17803.2	.697	.754
-2	97.7	16905.8	7022.9	16905.8	.692	.760
-1	109.6	16625.1	3465.3	16625.1	.694	.767
0	113.2	17582.6	952.9	17582.6	.666	.755

In this table, the dummy variable *years_before* is represented on the left-hand side with the values ranging from -5 to 5. The vertical columns represent the number of schools (N), and mean of each of the variables. I used these tables as a tool of descriptive analysis, determining if there were any notable patterns or dramatic changes in any variables that may be related to a GTP. In the four years leading up to the switch, mean retention rates increase from 0.7495 to 0.7667 the year before the implementation, a deviation of 0.0172. Mean net price had a large decrease the year of implementation (from $3,465 to $952) and then jumped up again in second year of the guarantee to a price higher than before the guarantee ($952 to $4,262). Similarly to net price, cost of attendance had a large jump in year 2 of the implementation. The four-year completion numbers were relatively level (within 200 students from one another) the two years leading up to and following the implementation of the guarantee, and jumped up by

about 800 in the 4th and 5th years following the implementation, which would be the first and second cohorts of students with the guaranteed rate. Lastly, admissions rates and undergraduate degree seeking students enrolled followed similar trends with a slow increase throughout the 11-year time period. This is consistent with the increase in popularity of a higher education degree. Based on these observations of descriptive patterns, I decided to further investigate these changes through two types of regressions.

I used two methods to investigate statistical significance, which allows me to answer my two questions: what are the motivations for GTP implementation and what effects does implementation of a GTP have on institution variables. To examine institutional patterns leading up to the implementation of GTPs, I relied on a variation of a hazard model with a truncated dataset. To focus on the potential motivations to implement a GTP, I used the *years_before* data to determine the time period leading up to the implementation date for each individual institution, represented in Tables IV and V.I deleted any data following the year of implementation because I am trying to explain why schools chose to implement GTPs. This model is represented as:

$$y_{it} = \alpha + \beta\, x_{it} + v_i + \varepsilon_{it}$$

In this analysis, y_{it} is my dependent variable (the change to guarantee) with the value 0 (does not have GTP) or 1 (has GTP), x_{it} are my independent variables which are the school characteristics that vary by school and time,, and β are the coefficients that I want estimates of, and), $v_i + \varepsilon_{it}$ are my error terms within the random effects model. The error term consists of school specific errors represented by v_i and the error that vary by school and time represented by ε_{it}.

Effect of GTP Implementation:

I relied on a variation of a time series regression model to analyze institutional changes following the implementation of a GTP. The regression model is represented as:

$$y_t = \beta + \beta\, x_t + \beta\, x_{it\text{-}1} + \varepsilon_t$$

Here, y_t is the dependent variable represented by each of the six variables that I focused on. The βx_t terms are the various independent variables that may bear influence on the dependent outcome, including the implementation of the guarantee.

Using the original panel dataset sorted annually by institution, I stored the lagged *years_before* variable over an 11 year time period. For each institution, I had data and dummy variables for five years leading up to the switch to guarantee, the year of the switch, and five years following the switch. These lagged variables allowed me to investigate whether there are any changes from the trend of university outcomes leading up to the implementation, and to determine whether the implementation affects any changes in behavior.

Chapter 4: Analysis

4.1 Results

Motivations for GTP Implementation:

Based on the patterns represented in Tables IV and V, I did three hazard model regressions to identify variables that may influence the decision to implement the GTP.

Table VI: Regression Output of Guarantee Implementation and Variables

VARIABLES	(1) Guarantee All variables	(2) Guarantee Removed 4 Variables N=479	(3) Guarantee Removed 2 Variables N=476
app	1.71e-05		
	(5.23e-05)		
ugds	0.00225**		0.00269***
	(0.00107)		(0.000862)
adm_rate	0.0191	-0.0290**	-0.0332**
	(0.0151)	(0.0125)	(0.0141)
ret_ft4	-0.0743	-0.00321	-0.0305
	(0.0476)	(0.0323)	(0.0363)
npt4	-0.00155	-2.14e-05	-0.000108
	(0.00113)	(0.000130)	(0.000151)
costt4_a	0.00141		
	(0.00121)		
overall_yr4_n	-0.00299		-0.000429
	(0.00417)		(0.00200)
Constant	0.0222	0.054	0.0488
	(0.0381)	(0.0278)	(0.0308)
Observations	878	4,317	3,893
Number of unitid	299	479	476

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The table above represents three regressions with the guarantee as the dependent variable, denoted as the three vertical columns of results. The various explanatory

variables are listed on the left and correspond to the coefficient value in each column. The coefficient value is the value for the regression equation predicting the change in guarantee from each independent variable, holding all other variables constant. The asterisks represent the corresponding p-values used in testing the null hypothesis that the coefficient is 0. The first regression had all core variables included, which resulted in a small sample size. To get a larger sample, I removed state appropriations, undergraduate enrollment, completion numbers, and cost of attendance, amounting to a sample of N=479. Then, I performed a regression including everything but cost of attendance and state appropriations, amounting to a sample N=476.

Working with the basis of at least 90% confidence, a p-value of ≤ 0.1 would be required for any result to be statistically significant. Given that standard, undergraduate degree seeking student enrollment and admissions rates have significant results, but the change is minimal. For the first regression, undergraduate student enrollment is significant (p-value<0.05) with a coefficient of 0.002, meaning that the larger the undergraduate student population, the more likely the institution is to implement a GTP. In the second regression, admissions rate has a statistically significant coefficient of -0.029, meaning that with the change to a GTP, we expect a decrease of 0.029 in admissions rates, holding all other variables constant. In the last regression with most of the variables and a large N both the coefficients for undergraduate enrollment and admissions rate are significant. Holding all other variables in the regression constant, the implementation of a GTP is correlated with an increase of 269 undergraduate students, and a decrease in admissions rate of 3.3% (with a relatively large standard error of 0.014).

Although these results are statistically significant, I am doubtful that these translate to real effects with GTP implementation. When a new tuition plan is implemented, many other variables are changing as well, including but not limited to price of education, marketing and recruitment strategies, and outcome variables such as completion. These results are significant when holding all other variables in the regression constant, which will not happen in most institutional settings.

To investigate these pre-GTP patterns further, I did a second similar regression analysis using lagged independent variables to focus on effects over time.

Table VII: Regression Output of Guarantee Implementation and Variables

VARIABLES	(1) Guarantee All Variables	(2) Guarantee Remove 2 N=319	(3) Guarantee Remove 1 N=453
app_lag2	0.000137**	9.07e-05**	
	(5.84e-05)	(4.61e-05)	
ugds_lag2	-0.00123		0.000491
	(0.000995)		(0.000637)
adm_rate_lag2	0.00851	0.00631	0.00602
	(0.0188)	(0.0186)	(0.0131)
ret_ft4_lag2	-0.0671	-0.0808*	-0.0446
	(0.0500)	(0.0488)	(0.0323)
npt4_lag2	-0.000158	-0.000246	-0.000124
	(0.000306)	(0.000297)	(0.000152)
overall_yr4_n_lag2	0.000446		0.000457
	(0.00272)		(0.00194)
Constant	0.0696	0.0725	0.0428
	(0.0403)	(0.0401)	(0.0276)
Observations	2,382	2,386	3,392
Number of unitid	319	319	453

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These results had more statistical significance than the previous regressions using the original variables. Using two-year lagged variables, state appropriations were

statistically significant with the all-inclusive variable regression model and the regression with a few variables omitted. The coefficients are 0.000137 and 0.0000907 with a p-value< 0.01 and p-value<0.05 respectively. This means that when a GTP is implemented, an estimated increase of $13.7 and $9.1 million in state appropriations will occur. Both of the coefficients are positive, demonstrating that there is a positive relationship between the implementation of a GTP and state appropriations. Although these results are significant, the standard errors are large (between 0.00046 and 0.00058). To further analyze state appropriations, I did a similar regression analysis with the dependent guarantee variable and state appropriations and other institutional characteristics as 1-year lags and change between the variable and 1 year lags. Neither of these regressions was statistically significant, suggesting that it may take multiple years of a pattern to form before affecting the implementation of a GTP.

The other results were not significant, but the results are interesting. There is a negative association for retention rates and net price, which is consistent with Tables IV and V. This suggests that a GTP may be implemented if these are decreasing. The admissions rate coefficient is slightly positive, as is the completion cohort, both of which are consistent with the growing undergraduate enrollment represented in Tables IV and V.

Effects of GTP Implementation:

To test the descriptive patterns in Tables IV and V, I did time series regressions on the variables I focused on. The regression results are listed on the following page.

Table VIII: Regression Output of Retention Rates and Control Variables

VARIABLES	(1) ret_ft4 All variables	(2) ret_ft4 Removed student demographics	(3) ret_ft4 Removed median debt amounts	(4) ret_ft4 Removed first generation
guarantee	-0.00728	-0.0103	-0.00699	-0.00726
	(0.0111)	(0.0116)	(0.0120)	(0.0113)
control	-0.0346***	-0.0332***	-0.0170*	-0.0333***
	(0.0103)	(0.0106)	(0.0103)	(0.0102)
satmt75	0.000396***	0.000419***	0.000379***	0.000389***
	(6.24e-05)	(6.27e-05)	(5.84e-05)	(6.21e-05)
satvr75	0.000196***	0.000185***	0.000225***	0.000192***
	(6.18e-05)	(6.23e-05)	(5.71e-05)	(6.13e-05)
ugds_white	-0.0141***	-0.00751	-0.0116***	-0.0135***
	(0.00482)	(0.00467)	(0.00449)	(0.00479)
ugds_black	-0.0173*		-0.00738	-0.0161*
	(0.00983)		(0.00935)	(0.00973)
ugds_hisp	0.0408***		0.0417***	0.0415***
	(0.0107)		(0.0103)	(0.0106)
ugds_asian	0.0552***		0.0646***	0.0540***
	(0.0193)		(0.0188)	(0.0192)
firstgen_yr4_n	-5.61e-06	-6.71e-06	5.65e-06	
	(1.08e-05)	(1.10e-05)	(1.06e-05)	
pell_yr4_n	1.01e-05**	1.27e-05***	3.19e-06	7.88e-06***
	(4.45e-06)	(4.49e-06)	(4.00e-06)	(2.14e-06)
lo_inc_debt_mdn	2.70e-06**	2.87e-06**		2.73e-06**
	(1.27e-06)	(1.28e-06)		(1.26e-06)
md_inc_debt_mdn	-2.76e-07	-1.55e-06		-3.04e-07
	(1.68e-06)	(1.68e-06)		(1.67e-06)
hi_inc_debt_mdn	7.71e-07	1.98e-06*		6.57e-07
	(1.12e-06)	(1.09e-06)		(1.11e-06)
Constant	0.400***	0.390***	0.420***	0.405***
	(0.0308)	(0.0311)	(0.0302)	(0.0307)
Observations	972	972	994	972
Number of unitid	294	294	299	294

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To begin my regression analysis, I compiled a list of as many potential control variables as possible, represented in the left hand column of this table. I included institutional characteristics such as public or private and student characteristics such as the 75th percentile of verbal and math SAT scores, the race of undergraduate enrollment, amount of pell eligible and first generation college students, median debt amounts by income level, and the guarantee dummy variable. I experimented with removing certain student characteristics within each regression, attempting to determine which group of control variables will most adequately control for measurable characteristics affecting GTPs and outcome variables. I used the initial exhaustive list of control variables for the remainder of regressions.

Similar to the regression above, I did various regressions keeping the variables of interest the dependent variable and included various control variables. The results of this regression are represented in Table VIII, listed on the following page.

Table IX: Regression Output of Core and Control Variables

VARIABLES	(1) adm_rate	(2) app	(3) costt4_a	(4) npt4	(5) overall_yr4_n
guarantee	2.27e-05	26.13	0.987	-0.0125	0.173***
	(0.0270)	(16.99)	(0.693)	(0.593)	(0.0629)
control	0.00158		15.81***	8.253***	-0.0961*
	(0.0254)		(0.626)	(0.553)	(0.0562)
satmt75	-0.000503***	0.303***	0.00454	0.00625*	0.000661***
	(0.000178)	(0.0706)	(0.00299)	(0.00365)	(0.000230)
satvr75	-0.000124	0.0608	0.00278	0.00535	0.000601***
	(0.000180)	(0.0629)	(0.00287)	(0.00366)	(0.000217)
ugds_white	0.0363**	3.750	0.129	0.344	-0.00458
	(0.0141)	(4.341)	(0.224)	(0.286)	(0.0169)
ugds_black	-0.135***	1.504	-1.030**	0.0402	-0.0480
	(0.0284)	(8.714)	(0.462)	(0.579)	(0.0350)
ugds_hisp	-0.0342	-4.961	1.138**	-1.785***	-0.146***
	(0.0310)	(9.848)	(0.497)	(0.630)	(0.0376)
ugds_asian	-0.164***	-52.86***	3.996***	-0.173	-0.136**
	(0.0566)	(16.87)	(0.894)	(1.146)	(0.0673)
firstgen_yr4_n	6.51e-05**	0.0472***	0.00145**	0.00233***	0.00137***
	(2.85e-05)	(0.0166)	(0.000576)	(0.000604)	(4.68e-05)
pell_yr4_n	-2.68e-05**	-0.00481	-0.000244	-0.000794***	0.000702***
	(1.23e-05)	(0.00766)	(0.000225)	(0.000255)	(1.77e-05)
lo_inc_debt_mdn	-5.28e-06	0.000167	2.39e-05	5.74e-05	8.90e-06*
	(3.58e-06)	(0.00158)	(6.15e-05)	(7.37e-05)	(4.74e-06)
md_inc_debt_mdn	9.33e-06*	-5.74e-05	0.000237***	0.000182*	4.92e-06
	(4.94e-06)	(0.00196)	(7.77e-05)	(0.000100)	(5.84e-06)
hi_inc_debt_mdn	-6.19e-06*	-0.00187	0.000467***	0.000259***	-7.51e-07
	(3.29e-06)	(0.00133)	(5.12e-05)	(6.64e-05)	(3.84e-06)
o.control		-			
Constant	1.041***	-115.9***	-13.27***	-10.93***	-0.528***
	(0.0814)	(38.74)	(1.659)	(1.724)	(0.136)
Observations	972	619	972	972	972
Number of unitid	294	228	294	294	294

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Similar to the regressions analyzing the motivations for the implementation of GTPs, there is not a lot of statistical significance in these regressions. When analyzing th, we want to focus on the independent variable guarantee to determine what affect, if any, it has on the core institutional variables. The only regression that was statistically significant was the correlation between the four-year completion cohort with a p-value <0.01 and a co-efficient value of 0.173. The four-year completion cohort is measured in real numbers. So, we expect that a GTP cohort would be 0.173 higher than a non-GTP cohort, since guarantee is coded 0/1. This variable is represented as the number of students in their 4-year completion cohort, so this would be the equivalent to 173 additional students. This is reasonable since undergraduate enrollment is steadily increasing, so we would expect more students to be in each year's completion cohort.

Although the results are not significant, GTPs and admission rates have a positive association with a co-efficient of 0.0027. State appropriations also have a positive association with a co-efficient of 26.13, although this is also not significant. This finding seems to go against Delaney's et al. conclusion that there is a negative association between the implementation of a GTP and subsequent state appropriations. Net price has a slight negative association, and cost of attendance has a slight positive association, but both of these stand errors are large and the coefficients are not significant. Of the four regressions I did on retention in Table IX, all of the coefficients were negative ranging from 0.001 to 0.06, but none were statistically significant.

These results are consistent with my hypothesis that most of the motivations and impacts of a guaranteed tuition program may not be statistically significant. There are

many other factors that influence the effectiveness of GTPs, outlined in section 4.2, that may influence the motivations and effects of GTPs and thus impact the significance of changes before or after the implementations of GTPs.

4.2 Implications and Avenues for Further Research

I view this research as a starting point for avenues of further exploration. I focused on two main questions: why might a GTP be implemented, and what effect does this GTP have. To my knowledge, this is one of the most thorough GTP datasets collected, but there are unfortunately still gaps in information. Overall, there was a relatively small amount of data available, limiting the ability and power to find significant differences with GTPs, if they exist. I think having more access to individual student data will be the best avenue for further significant discoveries in the future regarding GTPs. This will allow analysis on more specific details of GTPs and their affects, such as the difference and impacts opt-in and opt-out GTPs have on institutional characteristics and student behavior.

My statistical analysis had an element of simplicity, where my regressions focused on six core variables, controlling for as much variability and codependency as possible. I chose to do a time series approach structured as panel data, but could have done a different model such as a difference in difference analysis. Past research on GTPs have relied on difference in difference models, such as Delaney etc.. However, I believe that a panel dataset with GTP information was more suited to my broad analysis.

The analysis spans a time period of 11 years, which is relatively short when analyzing drastic or significant changes in student behavior. As more institutions adopt this program, or as current participating institutions switch back to a traditional model,

more data will become available to analyze. One of my main limitations in my regressions was the small sample size that I had. Through my research I was able to find detailed information on 140 private and public institutions that have implemented a GTP. When analyzing the significance of the GTP in the time period of only one year, that results in a maximum sample size (N) of 140, and of those some will have missing values. When regressing changes over many years, my N was larger although my group size is still maximized at 140. Over time, this N will grow, and more data will be available as more institutions test this program.

In addition, these 140 institutions were derived by my personal outreach and research with participating institutions. Significant portions of the detailed dataset of GTPs and their characteristics have missing values due to information that was not available to the public, and which I was unable to obtain from my outreach. Thus, I was unable to acquire an updated exhaustive list of GTP characteristics from each participating institution. The base of this dataset, the institutions with GTPs, was reliant on self-reporting from institutions to the IPEDS database. This may not have provided a comprehensive list of participating institutions. As this program becomes more popular, my hope is that more institutions will provide details of their participation to help the development of research in this field.

Next, I chose a few main variables to focus on. Based on my research, these variables seemed to be most present within the debate of GTPs. These variables do not encompass all potential effects GTPs have on the higher education process. It is becoming increasingly popular to think of return on investments while investing in a degree and I think more analysis could be given to the concept of return on investments,

and how this is related to GTPs. Assuming rationality, prospective students and families will perceive higher education as an investment, and will weight the costs and benefits of this investment. Prospective students and families would seek the investment in knowledge that offers the best interest rates with increasing economic returns (such as quality of a degree). But since this program is aimed at reducing risk and not reducing cost, I do not predict that this would significantly alter student's returns on investment.

In addition, I would perform more research in the areas of completion and time to degree. The efficiency of completing a college degree is paramount to other factors that impact institutional and student characteristics. The opportunity cost of completing a degree early or late is significant, and would impact other related variables like cumulative net price, return on investment, and net student debt. If possible, I would spend more time comparing and contrasting completion rates and time to degree, and their relation to GTPs. When calculating for total cost, a rational prospective student would sum the amount of perceived years required to obtain their degree, and the predictability and upfront price of a GTP may influence this. This relationship could be a follow-up research study to delve more in to years needed for a degree.

Lastly, there are various variables I wish I could have analyzed as outcome variables or used as controls in my regressions. There are countless immeasurable variables that may also be having an impact on the variables that I focused on and their relation to GTPs. Changes in tuition plans can be motivated by changes in administration, pressure from outside forces such as the state, economic conditions, supply and demand of a degree, and preferences of the students. I used state appropriations that are related (but not perfectly correlated) to state preferences and economic conditions, but most of these

variables do not report on these factors in any consistent way. Despite what I concluded from my analysis, there is not way to completely eliminate the confounding of various factors that tie in to the higher education market, and thus have an impact on GTPs and it's related effects.

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