ABSTRACT

Title of Dissertation:	EXAMINING HOW TENNESSEE STATE MERIT AID INFLUENCES INSTITUTIONAL GRANT AID: A DIFFERENCE-IN-DIFFERENCES APPROACH
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The creation of the Tennessee Education Lottery Scholarship (TELS) program provides a natural experiment where a difference-in-differences estimation design is employed to isolate how state merit aid funding may lead institutions to change their institutional grant aid. Principal agent and resource dependence theories together establish state and institutional context as well as inform potential institutional responses to the TELS program. Data are primarily observed at the institution-level from 2000 to 2009 and come from the Integrated Postsecondary Data System (IPEDS). The difference-in-differences estimation strategy incorporates multiple comparison groups and separate specifications by Carnegie Classification.

The results indicated that the nine Tennessee public four-year institutions reduced their recipient average institutional grant post-TELS. However, institutional responses differed across Carnegie Classification. Tennessee Doctoral Extensive

public institutions increased the number of students receiving institutional grant aid post-TELS. Tennessee Doctoral Intensive public institutions reduced their total institutional grant and number of recipients post-TELS, and thereby decreased their average institutional grant aid post-TELS. Tennessee Master's College and Universities, excluding Tennessee Technical University, also reduced their institutional grant aid post-TELS.

The results from this study provide some informative commentary for theory, research and policy. First, the combination of principal agent and resource dependence theories provide a more comprehensive set of potential responses that move beyond the Bennett hypothesis to suggest that institutions might not just reduce institutional grant aid. Second, this study created a comparison group of institutions subject to a state governing or coordinating board with budget authority, which produce more efficient estimates. Future research on financial aid or institutional finances may benefit from moving beyond the tradition governing board classification to include state coordinating boards with budget authority. Third, state policy on financial aid should better align new initiatives with existing institutional financial aid to ensure state funding is used effectively. With better goal alignment between state governments and institutions, it could reduce the agency problem that develops and ensure state does not duplicated existing financial aid strategies.

EXAMINING HOW TENNESSEE STATE MERIT AID INFLUENCES INSTITUTIONAL GRANT AID: A DIFFERENCE-IN-DIFFERENCES APPROACH

by

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CHAPTER ONE
INTRODUCTION

State-level public funding for higher education changed substantively in the past thirty years, where state financial support has declined while tuition revenue has grown. Direct state subsidies (e.g. state appropriations) provided a majority share of operating revenue to public institutions of higher education until the early 1990's (e.g. Toutkoushian, 2001; State Higher Education Executive Officers [SHEEO], 2015). Between 1990 and 2005, state appropriations per full-time equivalent student declined by thirteen percent at public higher education institutions nationally (SHEEO, 2015). Tuition and fees represent a growing proportion of revenue at public institutions (e.g. Toutkoushian, 2001; SHEEO, 2015). From 1990 until Tennessee created their merit aid program in 2005, tuition per full-time student increased by 47% at public higher education institutions nationally (SHEEO, 2015). This shift in funding from state appropriations to tuition revenue marks a privatization of public higher education, where students and families are paying a larger share of costs of higher education (e.g. Johnstone, 2004). Simultaneously, during the earlier the 1990's, a handful of states, such as Alabama and Georgia, created statewide merit aid programs (e.g. Soqjuist & Winters, 2012). The creation of these merit aid programs also marks a shift in how states fund public higher education, where large forms of new funding go directly to students as opposed to just providing institutions with a larger state appropriation (NASSGAP, 1991; 2006). In fact, state financial aid expenditures increased by 438% between 1990 and 2005 nationally (NASSGAP, 1991; 2006). In addition, the expansion of state merit aid programs presents one of the most substantive changes to financial aid policy in recent history (Doyle, 2006; Hu, Trengrove, and Zhang, 2012). The advent of state funded

merit aid programs injects a marketization in the state funding model (e.g. Heller, 2006; Hossler, 2004; Jongbloed, 2004), which may change how institutions allocate institutional aid (Long, 2004).

The marked shift in public funding given to directly students instead of colleges was exemplified in Tennessee. While other states also have shifted their funding model to provide merit aid, Tennessee allocated $1.6 billion for the Tennessee Education Lottery Scholarship (TELS) program in its first six years (Tennessee Higher Education Commission [THEC], 2011). In that same time period, Tennessee allocated $7.1 billion in state appropriations for institutional operating expenses (calculated from IPEDS survey data). Thus, the TELS program represented nearly one-fifth of Tennessee's total investment in the operating expenses of higher education between fiscal year 2005-2010. Hu, Trengrove and Zhang (2012) indicate that much of the research on state merit aid programs has focused on student-level outcomes of the policy, such as student access and migration, but they suggest that state merit aid programs should be looked at more broadly. One way of looking more broadly at state merit aid programs is to investigate institutional responses of these new and additional funds, such as changes in institutional grant aid, especially since the state merit aid program represents a large share of funding for higher education. Thus, this study will examine how state merit aid funding changes institutional grant aid funding for first-time, full-time students at Tennessee public four-year universities. This investigation will provide context to how state-level shifts toward market-based funding may yield productive or opportunistic responses from institutions, such as increasing or maintaining institutional grant aid (e.g. productive response) or decreasing institutional grant (e.g. opportunistic response). The Tennessee Education

Lottery Scholarship (TELS) program provides a natural experiment where a difference-in-differences estimation design can begin to isolate effects of merit aid funding on institutional behavior, especially with respect to institutions changing their grant aid. Under this research design, public four-year institutions in Tennessee will be compared to a subset of similar institutions in the United States to determine if the influx of merit aid changes institutional grant aid funding.

In order to situate this study, prior empirical and theoretical research will provide some context for understanding how Tennessee four-year institutions might respond to additional funding from a statewide merit aid program. Put simply, Tennessee public four-year institutions may have changed institutional grant aid funding in response to the indirect subsidies from the Tennessee state merit aid program in one of three ways: 1) no change to total institutional aid; 2) increasing institutional aid funding; or 3) decreasing institutional aid funding. Certainly, institutions could make other adjustments to their institutional grant aid, such as shifting funds from merit-based awards to need-based awards, but these other adjustments cannot be measured or observed from nationally available data. Prior research provides some evidence that public institutions will increase their willingness to pay for students who already receive Pell grants (Turner, forthcoming). Given Turner's findings with federal aid, this study will investigate whether Tennessee public four-year institutions increase institutional grant aid expenditures and access as a result of the Tennessee merit aid program. Similarly, Simone (2016) finds that both institutional and state grant aid increases for Pell recipients, which suggest that both institutions and states are willing to provide more aid to students already receiving a federal grant. However, institutions could use the state

grant aid to replace institutional grant aid. Long (2004) found that private institutions in Georgia decreased expenditures on institutional grants when a statewide merit aid program was created in the earlier 1990's. Thus, the advent of Tennessee merit aid programs may induce institutions to maximize revenue by reducing expenditures on institutional aid, thereby providing indirect funding/revenue to institutions from the TELS merit aid program. While it is informative to use prior empirical studies to hypothesize how Tennessee institutions might respond to the advent of a statewide merit aid program, it is also instructive to draw on theoretical work to explain institutional behavior.

This study will utilize prior theoretical and empirical research to help explain how Tennessee four-year institutions may adjust institutional grant aid funding in response to a statewide merit aid program. The theoretical framework in this study will be explained in two parts based on: 1) institutional/organizational behavior to explain how public four-year universities might respond; 2) and appropriately situate institutions in the state context/environment where they are located. The resource dependence (Pfeffer & Salancik, 2003) and principal agent (Lane & Kivisto, 2008) theories will be used to hypothesize institutional responses to the TELS merit aid program and whether these responses will be productive or opportunistic. In addition, the principal agent theory will be used to explain how public four-year universities function within a state-specific context (e.g. Lane & Kivisto, 2008). This study can provide perspective on whether market-based, state-level initiatives can assist with yielding productive or opportunistic responses from public four-year institutions within a principal agent and resource dependence theoretical framework.

Background of the Problem

The advent of larger state merit aid programs did not begin until the early-1990's (Doyle, 2006). Prior to this, state financial aid programs/policies were based primarily on financial need criterion (Doyle, 2006; Heller, 2004; 2006; Hu, Trengrove, & Zhang, 2012). In fact, financial aid from federal, state, and institutional sources were based on an equity principal to provide financial support to students with greatest financial need as defined by a student and/or family's ability to pay for higher education (Heller, 2002). Need-based financial aid is provided to equalize some inequities related to prior accumulation of wealth, resources, or access, which takes the form of redistribution (Heller, 2002; Paulsen, 2001). However, beginning with Arkansas and Georgia, states created financial aid with primarily merit-based criteria in 1991 and 1993, respectively. Since then, at least 29 other states have adopted merit-based programs, where Tennessee was one of the most recent adopters of the Tennessee Education Lottery Scholarship (TELS) program (e.g. Soqjuist & Winters, 2012). Tennessee is one of the few exceptions to have some means-tested parts of their award program (Heller, 2006; Ness, 2008). Heller (2004) takes issue with expansion of state merit aid program as detracting from the traditional purpose of financial aid, which is expanding college access and make sure it is affordable. In addition, Heller (2004) characterizes state merit aid program as giving financial support to student would already attend college even if they did not receive the grant. Heller (2002; 2004; 2006) asserts that state merit programs do little to help with any of the state rationales for creating their programs—expand access, keep the best and brightest in state, and reward academic achievement in high school or college. Bowen

and associates (2005) also take issue with state merit-based aid since it consumes exorbitant resources for little benefit and likely detracts financial support from need-based aid programs. The Tennessee merit aid program, like many other states, funds the program from lottery revenue, which is a regressive tax since lower income people purchase tickets (Bowen et al., 2005). Despite these criticisms, state merit aid programs proliferated being in the early 1990's and continuing into 2000's (Soqjuist & Winters, 2012).

Doyle (2006) has one of the few quantitative studies attempting to explain how and why state merit aid programs expanded through the 1990's and early 2000's by looking at a series of political, economic, educational/academic attainment, and demographic aspects. Political aspects, such as state government liberalism and party control were not predictors of states adopting a merit aid program (Doyle, 2006). However, states with higher median incomes were more likely to adopt the statewide merit aid program (Doyle, 2006), which may suggest that merit aid programs were a program to give benefits to middle- and upper-income voters but this has not be backed evidence. In addition, states with lower education attainment and lower direct enrollment from high school to college are more likely to create state merit aid program.

The aspects leading Tennessee to create a merit aid program did not differ from the other states. Most of Tennessee's state financial aid had only need-based criterion until the creation of the Tennessee Education Lottery Scholarship (TELS) in 2004-05 (Ness, 2008). There was much debate in the Tennessee state legislature on the need- and merit-based criteria, where the original proposal had income caps on near all awards, but this was the first thing to go after it moved through the legislature (Ness, 2008).

Legislators wanted the middle- and upper-income constituents to have access to the merit program (Ness, 2008). The notion of equity in the TELS program creation was usurped in order to ensure the TELS legislation would pass (Ness, 2008). The need-based parts of the program ended up being small supplements. A full description of the Tennessee context leading up the creation of the TELS program is in Appendix A and includes a description of the TELS award criteria.

Leading up to the creation of merit aid programs, there are some noticeable shifts in the public financing of higher education nationally. Toutkoushian (2001) provided more detail on the scope of education and general revenue sources within public institutions from 1974-75 to 1994-95. In particular, he found that the largest change in the proportion of revenue dependence was with state appropriations. In 1974-75, state appropriation represented 57 percent of the total net education and general revenue at public institutions, but the proportion of revenue from state appropriations declined to 47 percent in 1994-95. The second largest change in revenue dependency during this twenty year period was with net tuition and fees, which increased by roughly seven percent in the share of overall budget. Other studies have indicated a decline or leveling off of state support to public higher education after the 1970's (e.g. Zumeta, 2004). Thus, state appropriations were leveling off or declining leading up to the creation of statewide merit aid programs.

With public institutions less dependent on state appropriations, public institutions may turn to other methods of increasing net tuition revenue (e.g. gross tuition revenue less any institutional grant aid). Tennessee public institutions may have turned to the TELS program to generate additional revenue. For instance, Tennessee public four-year

institutions could increase net tuition revenue by reducing their expenditures on institutional grant aid in lieu of the new TELS awards. Tennessee public higher education institutions had limited growth in state appropriation leading up to the creation of the TELS program, and there is some evidence that Tennessee public institutions viewed the TELS program as a new revenue source (Ness, 2008). In the implementation process Tennessee public institutions were trying to limit the flow of TELS funding to private institutions (Ness, 2008), which demonstrates their propensity to act in their own self-interest and try to actualize as much new revenue as possible. The advent of the TELS program infused an additional $1.6 billion funding into Tennessee's higher education industry between 2005 and 2010. The substantive influx of state funding may encourage institutions to substitute state aid in place of institutional aid. The substitution effect would allow Tennessee public four-year institutions to capture the TELS funds to augment its net revenue, which could be construed as an opportunistic response to this state policy. There is some evidence demonstrating that institutions use other financial aid to replace institutional grant aid (Long, 2004). Georgia private institutions reduced institutional grant aid when the Georgia HOPE Scholarship began (Long, 2004). Similarly, when examining federal financial aid, McPherson and Schapiro (1993) found institutional aid expenditures decreased at public four-year institutions when federal financial aid increased, but it was not statistically significant. In addition, it is also possible for Tennessee institutions to admit more in-state students who might carry a TELS award, but this was not the case in Tennessee, where the number of admitted students (e.g. both resident and nonresidents combined) did not change post-TELS (see Appendix Table 4.4).

Alternatively, Tennessee public four-year institutions could continue to hold institutional aid constant or increase spending on institutional aid. There is some evidence that institutions will increase institutional aid spending when students carry external grant aid, such as federal grants (McPherson & Schapiro, 1993; Turner, forthcoming). McPherson and Schapiro (1993) found that private institutions increased institutional scholarships when federal financial aid increased. Turner (forthcoming) found that institutions increase their willingness to pay for students receiving a federal Pell grants. Given prior research showing institutions providing more aid to grant recipients, it is possible that Tennessee public four-year institutions would increase their expenditures on institutional grant aid in order to attract TELS award recipients.

Purpose of this Study

This study will build on prior research that examined how institutions change institutional grant aid funding relative to other sources of financial aid. In particular, this study will investigate whether Tennessee public four-year institutions changed their institutional grant aid funding when a statewide merit aid program was established in 2004-05. The primary research questions explored in this study are the following:

1) Did increased state merit aid funding induce Tennessee public four-year institutions to change their <u>total expenditures on institutional grants</u> given to first-time, full-time students when compared to similar institutions in other states?

2) Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?
3) Did increased state merit aid funding induce Tennessee public four-year institutions to change their entire class average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
4) Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?

This line of inquiry is situated within a conceptual framework that explains how these institutions might respond to a state policy, such as the creation of the TELS program, and utilizes a combination of principal agent and resource dependence theories. As will be discussed in the next section, the complementarity of these two theories suggest that institutions may respond to additional state funding, via the TELS awards, with either opportunistic or productive responses.

Theoretical Framework

Public four-year institutions are complex organizations where institutional decisions and behaviors operate within a broader state context. Given that this study is investigating how Tennessee public four-year institutions change institutional aid funding upon the creation of a statewide merit aid program, this conceptual framework will need to explain the state context that institutions operate and identify potential responses to

state financial aid policy changes. Principal agent and resource dependence theories will be used in this study to construct an appropriate theoretical framework to explain the environment that states and institutions operate in and address how institutions might respond to a new state merit aid program (Lane & Kivisto, 2008; Pfeffer & Salancik, 2003). Principal agent theory provides a framework to explain how state governments and public institutions operate and contract with each other to provide education opportunities (Lane & Kivisto, 2008). State governments in some form or another contract with public institutions to provide education opportunities, where institutions are agents beholden to the state government acting as a principal (Lane & Kivisto, 2008; Kivisto; 2005, 2007, 2008). In exchange for providing education opportunities, states provide funding for public higher education, which often come in the form of state appropriations but can also come through state financial aid programs, such as the TELS program. The contractual and financial relationship between states and public institutions can be explained in resource dependence theory, where organizations will seek out external resources and maintain revenue/funding streams (Pfeffer & Salancik, 2003). Resource dependence theory stresses the primacy that a broader environment plays in organization decisions making (Pfeffer & Salancik, 2003), which is why it will be necessary to appropriately describe state context through state-level characteristics. In addition, both principal agent and resource dependence theories provide rationales for how Tennessee public four-year institutions might respond to the new funding from the TELS program.

Principal agent theory provides some rationales to explain how institutions might respond to a state or principal level change in policy. A fundamental assumption of

principal agent theory is that the agent (e.g. college/university) will act in their own self-interest unless regulated or monitored (Kivisto, 2008; Lane & Kivisto, 2008). Within the context of principal agent theory, a public four-year university will respond to state policy changes in either an opportunistic or productive manner (e.g. Lane & Kivisto, 2008). Principal agent theory assumes that the universities, as agents, will seek an opportunistic response if left unchecked by monitoring or accountability efforts (e.g. Lane & Kivisto, 2008). In the context of Tennessee, principal agent theory would suggest that public four-year institutions will reduce their expenditures on institutional grant aid and replace those funds with the TELS award. In the TELS creation process, it was clear that Tennessee public four-year institutions were trying to act in their self-interest by attempting to limit the TELS funds that would flow to private colleges/university (Ness, 2008). In addition, Tennessee public four-year institutions saw the TELS funding as a new revenue source when there were scarce additional revenue from other sources (Ness, 2008). These two aspects demonstrate Tennessee public institutions' willingness to act in its own interest to garner additional revenue.

While principal agent theory would suggest an opportunistic response in Tennessee, resource dependence theory provides another explanation for how institutions might respond to the new TELS funding. A tenant of resource dependence theory explains that institutions/organizations will seek to maintain and expand revenue (Pfeffer & Salancik, 2003). Thus, in an effort to control additional revenue, Tennessee public four-year universities would seek to maintain or increase enrollment of TELS award recipients. Hillman (2012) explains that institutions may use institutional grants to attract students, which in the context of this study would suggest that institutional aid could use

institutional grant aid to attract/recruit TELS award recipients. Thus, resource dependence theory would suggest that public four-year institutions might provide TELS award recipients with additional institutional grant aid.

Research Design

The central line of inquiry in this study is to investigate how Tennessee public four-year institutions respond to new indirect subsidies/funding from the Tennessee Education Lottery Scholarship (TELS) program by changing institutional grant aid. Cellini (2008) discusses how there are numerous quantitative methods to investigate research questions on financial aid, but suggests experimental and quasi-experimental designs that can deal with reverse causality and omitted variable bias. Reverse causality arises when controlling and outcome variables are simultaneous determined (Cellini, 2008). For example, some state legislatures jointly determine tuition rates and state appropriations, so it would be inappropriate to use one as a predictor of other. Omitted variables bias occurs when determinants of the outcome are not included in the estimation. In order to overcome these issues, Cellini (2008) suggests using fixed effects and difference-in-differences estimation, when random assignment or regression discontinuity design cannot be applied to financial aid research inquiries. Thus, the research design in this study will move from the most basic ordinary least squares (OLS) to fixed effects estimations before using a difference-in-differences design to show how variation in other controlling variables is not substantive.

Using a difference-in-differences estimation strategy, this study will identify how Tennessee public four-year institutions change institutional aid spending in response to the creation of the TELS program. The dramatic shift in Tennessee state policy can be

accounted much more succinctly in a difference-in-differences estimation than other estimation strategies since it accounts for levels in the dependent variable before and after the TELS program was created and includes a comparison group of institutions. Difference-in-differences estimation can be modeled using a basic ordinary least squares regression model, but simply accounts for time in a very specific way and includes a group of observations experiencing a treatment and another group of observations not experiencing the treatment. Time can be parameterized using panel data techniques that include a dichotomous variable for each year (e.g. time effect) and by adjusting the error terms to account for the repeated measures of institutions. Here, treatment means that something different is happening to an observation, which could be a policy change such as implementing a statewide merit aid program. In this study, difference-in-differences is essential for determining how the TELS program may have influenced changes in institutional grant aid spending at public four-year institutions relative to a comparison group of similar public institutions in other states. For example, if an increase or decrease in institutional aid was found after the TELS implementation, it would be difficult to attribute the effects solely to the TELS award without a valid counterfactual. A comparable group of public four-year institutions in other states is needed to develop a hypothetical counterfactual. By constructing a comparison group, Tennessee public four-year institutions can be compared to public four-year institutions in similar states both before and after the TELS program implementation. In essence, a natural experiment exists with the implementation of the TELS program, where the shock of new funding available functions as a treatment to Tennessee public four-year institutions. The difference-in-differences estimation strategy in this study simply accounts for two

important differences or comparisons: 1) the change or difference in institutional grant aid over time; and 2) the Tennessee specific change or difference in institutional grant aid levels from pre-TELS time periods to post-TELS time periods. The additive product of these comparisons or differences reveal any changes in institutional behavior that occur at Tennessee public four-year institutions as a result of the TELS implementation that are different from other comparison public four-year institutions. Even though this method may seem complex, difference-in-differences estimation has long history of addressing policies changes affecting only a particular group and growing usage in higher education research (e.g. Hillman, Tandberg, & Gross, 2014; Hu, Trengrove, & Zhang, 2012; Tandberg & Hillman, 2014).

Data

This study will incorporate institutional level observations before and after Tennessee implemented the TELS merit aid program in 2004-05. A panel data set will be constructed on U.S. public four-year institutions to capture how financial aid is allocated for undergraduate students. Institution level data will primarily come from the U.S. Department of Education, Integrated Postsecondary Education Data System (IPEDS), which is the most comprehensive data available on higher education institutions. Annually, IPEDS fields a series of surveys to college and universities participating in the Title IV federal financial aid programs to gather data on such aspects as institutional characteristics, admissions statistics, financial aid, and revenue/expenditures. Within IPEDS, nine Tennessee public four-year institutions can be examined for five years before the TELS program was implemented in fall 2004 and up to five years after

implementation for a total of ten year (e.g. Fall 2000-2008 or fiscal year 2000-2009). In addition, a comparison group of just over 390 public four-year institutions can be drawn from the United States during this same time period, but these public four-year institutions will be divide into different subgroups. Public four-year institutions will be identify in IPEDS using the 2000 Carnegie Classifications of Doctoral Extensive/Intensive Universities and Master's College and University I since these are three Carnegie Classifications that represent the nine Tennessee public four-year institutions. Much of the data for this study will be captured at the institution level, but state level higher education governance, merit aid program participation, and demographic characteristics will be incorporated to provide an appropriate state context.

Institutional level data on four-year public institutions will primarily come from IPEDS. In particular, this study will focus on the IPEDS Student Financial Aid (SFA) surveys to examine institutional enrollments of in-state and out-of-state first-time, full-time college students. In addition, the SFA survey includes information on financial aid awards for these first-time, full-time students disaggregated by awards from institutional, state, federal, and loan sources. The IPEDS Institutional Characteristics, Fall Enrollment, and Finance surveys provide important information on tuition/fee pricing, institutional type, Carnegie Classifications, geographic location, enrollment information, and revenue.

Variables

The dependent variable used in this study will be institutional grant aid, but expressed in four ways. First, institutional grant aid will be expressed as the total financial aid given to first-time, full-time students in a given year, which will be

calculated from the IPEDS Student Financial Aid Survey. Second, institutional grant aid will be expressed as the recipient average amount given to first-time, full-time recipients of the institutional funding in a given year. Third, the total institutional grant funding will be averaged over the entire entering class of first-time, full-time students. Fourth, the number of institutional grant aid/ recipients will investigated as an outcome. These four ways of examining institutional grant aid will provide a more comprehensive picture of potential changes in institutional grant aid, which show changes in total expenditures, recipient average award amounts, entire class average award amounts, and number of recipients.

The simplest specification of a difference-in-differences (DID) model does not require any other covariates or independent variables beyond a variable for pre- and post-treatment and a variable indicating which institutions are treated (e.g. Tennessee public four-year institutions). This study will run a simple specification of the DID model, which will include an indicator for being a Tennessee public four-year institution, an indicator for years after the implementation of the TELS program, and an interaction of these two indicators to capture the effect of being a Tennessee public four-year institution after the implementation of the TELS program. However, other institution and state level variables will be included as explicit controls in the model to improve precision of estimates or as a means for constructing an appropriate comparison group. A series of difference-in-differences models will be run with institution fixed effects and time effects to account for an unobserved time invariant aspects associated with public four-year institutions.

Additional controlling variables may not be necessary to yield an effective difference-in-differences model, but a series of institution and state level independent variables will be included to see is if model precision can be improved or to better isolate an appropriate comparison group. In particular, independent variables controlling for institutional access to donative resource, such as state appropriations, investment income, and private gifts, are needed to account for any varying availability of revenue (Paulsen, 2001; Winston, 1999, 2004). Total amount of federal grant aid given to first-time, full-time students in a given year to account for changes in financial need of the income class. In addition, the state population of eighteen-year-olds will be included to account for demographic shifts traditional college-aged entrants. As suggested by the principal agent theory, the governance structure of public four-year institutions will account whether an institution is controlled by a consolidated governing board or coordinating board with budget authority, where this variable will be used to construct different comparison groups. In addition, states participating in pre-existing large merit aid program will be used to construct another comparison group based on Dynarski's (2004) suggestion that states adopting a merit aid program are potentially more similar to each than other states without a merit aid program. Each of these institutional and state level variables will be included in the statistical model only to improve model precision or used to construct a comparison group.

Statistical Method

Applications of difference-in-differences (DID) estimation in research related to state merit aid programs were primarily conducted by economists (e.g. Cornwell et al,

2006; Dynarski, 2000; Goodman, 2008; Long, 2004). However, many of these DID models assessed how students respond (e.g. student demand effects) to the advent of statewide merit aid programs in Georgia and Massachusetts (Dynarski, 2000; Cornwell et al, 2006; Goodman, 2008). Long (2004) used a similar DID model as in the student focused studies, but she used DID to estimate the institutional responses to the Georgia HOPE scholarship. In addition to economists using DID methods, researchers in the higher education field of study have used DID estimation as well. Tandberg and Hillman (2014) used a DID estimation strategy to see how state performance based funding influences degree completion. Tandberg, Hillman and Gross (2014) examined how Colorado's shift in funding higher education effected cost efficiencies and college access. These prior studies using DID models provide methodological context and guidance on how the TELS program may influence institutions to change their institutional aid expenditures.

A difference-in-differences (DID) estimation technique provides two primary advantages for this study. First, DID models can separate institutional levels before and after the implementation of the TELS program by partitioning time into a pre- and post-levels of the institutional grant aid. Second, DID models allow for comparisons between Tennessee and other public four-year institutions, where institutional grant aid levels can be compared between these two groups both before and after the TELS program was implemented. This comparison group provides a reference and helps determine what might have happened in Tennessee had the TELS program not been implemented. When applied appropriately, the DID model will isolate how institutional grant aid changed at Tennessee public four-year institutions after they started receiving TELS funding.

Limitations

This study has three limitations to consider that may affect the results and interpretation. First, with respect to study design, the results of these analysis can only show aggregate changes in institutional grant aid. Unfortunately, it cannot measure changes in merit-based and need-based aid separately because institutional aid is not reported in a form that disaggregates aid by need- versus merit-based criterion. Second, the results/effects in this study are predicated on the validity of the comparison groups. This study employs multiple comparison groups to ensure the findings hold up against numerous specifications, but causality is based on the assumption that this comparison groups provide a sufficient control or counterfactual. Mora and Reggio's (2014) DQD analysis is employed to see if alternative parallel path assumptions are needed in estimation. Third, a critical assumption of the statistical method (e.g. difference-in-differences) is that other shocks or policy changes that would affect the outcomes of interest did not occur within Tennessee at the same time that the TELS program was implemented. It is only large changes in other covariates at the critical time point of implementing the Tennessee merit aid program (2004-05) that would bias the results. However, a difference-in-differences estimation strategy can handle time-invariant characteristics and observable time varying characteristics, which can be controlled for in the model (Hu, Trengrove, and Zhang, 2012). Fourth, with only nine Tennessee public four-year institutions, it may limit the ability to detect changes in institutional grant aid spending since the sample is small (e.g. reducing statistical power).

Implications

This study presents a series of implications for theory, research, and policy. First, this study evaluates how public four-year institutions respond to a state policy with productive or opportunistic reactions, which provide context for future state policies in higher education. Second, the study pushes theoretical discussions in higher education research by integrating principal agent and resource dependency theory to explain productive and opportunistic institutional responses to state financial aid policy. Third, this study employs a variety of methods for constructing a comparison group, which provides the field of higher education research with aspects to consider when constructing a comparison group especially on studies related to finance and financial aid.

CHAPTER TWO
LITERATURE REVIEW

Introduction

The primary focus of this study is to determine how public four-year institutions in Tennessee change their institutional grant aid with the creation of a broad statewide merit aid program. This study draws from principal agent and resource dependence theories to explain or hypothesize how Tennessee public four-year institutions might respond to the advent of the statewide merit aid program. As will be discussed in this chapter, both theories provide some indication of how institutions might respond to the Tennessee Education Lottery Scholarship (TELS) by either increasing, maintaining, or decreasing institutional grant aid. In addition, principal agent and resource dependence theories emphasize how a state environment/context may influence how Tennessee public four-year institutions respond to the TELS program. Thus, the institutional response conceptual framework explained later in this chapter is derived from both theories and prior empirical research.

Within this chapter, the first section addresses prior studies that assess state and federal financial aid programs including any institutional responses to these financial aid programs. The second section examines how previous studies investigated governance over higher education and how it shapes state and institutional policies. The third section discusses other state and institutional characteristics related to institutional financial aid in empirical research. The fourth section explains applications of theory used in prior studies that attempt to determine institutional responses to state or federal aid. The fifth section describes principal agent and resource dependence theories, addresses how they

have been used in prior empirical research in higher education, and explains how these theories can be used to guide this study. These four sections in this chapter address gaps in the literature while bringing together prior theoretical and empirical work to guide the intended purpose of this study. The focus of this study is to determine how Tennessee public four-year institutions change their institutional grant aid when a statewide merit aid program was created, where the primary research questions explored in this study are the following:

1) Did increased state merit aid funding induce Tennessee public four-year institutions to change their total expenditures on institutional grants given to first-time, full-time students when compared to similar institutions in other states?
2) Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
3) Did increased state merit aid funding induce Tennessee public four-year institutions to change their entire class average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
4) Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?

Previous Studies on Financial Aid Programs

Empirical Studies on State Merit Aid

Since the advent of statewide merit aid programs in the early 1990's, empirical studies investigated their creation (e.g. Ness, 2008; Ness & Misserta, 2010), dispersion (e.g Doyle, 2006), effects on students (e.g. Hu, Trengrove, & Zhang, 2012) and effects on institutions (e.g Long, 2004). Prior to their creation, most state financial aid had primarily need-based criteria (Heller, 2002; Ness, 2008). Ness (2008) chronicled the creation of the state merit aid programs beginning with Georgia in 1993 and concluding with Tennessee in 2003, where he discussed the political process leading to the creation of these program and compares the award criteria across states. Doyle (2006) investigated how and why merit aid program spread throughout the U.S. In addition, a series of studies investigated how state merit aid programs affected student enrollment and degree completions (e.g. Dynarski, 2004; Cornwell et al., 2006; Goodman, 2008; Oruswan & Heck, 2009; Zhang & Ness, 2010). For example, these existing studies indicate that an additional $1,000 of financial aid increases college attendance by 3-6 percentage points (Dynarski, 2000; Dynarski, 2003; Cornwell, et al., 2006; Zhang & Ness, 2010). The expansion of state merit has received criticism, where these programs are taken to task on whether they improve college access and attainment (Dynarski, 2000; Heller, 2002; 2004; 2006). For instance, Dynarski (2000) found that 80% of the Georgia HOPE Scholarship funds go to students who would normally go to college without a state merit award. Despite the student-level studies and criticism, only a limited few studies have investigated how state merit aid programs change institutional behavior (e.g. Long, 2004). Given the focus of this study, the subsequent section will focus on empirical

research examining how institutions respond to state merit aid but this line of inquiry is expanded to include federal financial aid as well.

Empirical Studies on Institutional Effects of State Grant Aid

A few studies, such as in Long (2004) examined the effects of state financial aid policy changes on institutional tuition/fees pricing and expenditures as result of the Georgia HOPE scholarship. Utilizing a difference-in-differences estimation strategy, she determined that the Georgia HOPE scholarship may have induced public colleges to decrease tuition (constant dollars) by three percent and increase room/board fees by five percent when compared with other southeastern states. However, she did not examine the public institutions' responses with their own institutional aid, which may have been due to the lack of available data at that time and structure of the Georgia HOPE Scholarship. Yet, she was able to determine that private colleges in Georgia with a high proportion of HOPE Scholarship recipients were increasing their tuition prices (6%) and decreasing their institutional grants (19%). In particular, she found that some private Georgia colleges were capturing 30 cents of every dollar in state merit aid by either increasing tuition or reducing institutional aid. Thus, there appears to be some incidence occurring at both public institutions with fees and private institutions with tuition and institutional aid. However, there is a need to more closely investigate how public institutions change their institutional grant aid in response to a state merit aid program.

Empirical Studies on Institutional Effects of Federal Grant Aid

Institutional responses to federal financial aid and tax credits are areas where more empirical research has delved in the past three decades. While not the first study to investigate the institutional effects of public sector for higher education, McPherson and Schapiro (1993a) examine how government funding via appropriations and financial aid affects institutional behavior in a more comprehensive way. They use a two stage least squares econometric model to determine how state/local appropriations and federal financial aid affect tuition pricing, institutional grant aid, and instructional expenditures. Their analysis is run separately by institutional type for four-year private, four-year public, and two-year public institutions, where they do find different effects by these institutional types. They find that increases in federal financial aid corresponded to an increase in institutional grant aid at four-year private institutions, but no effect at the public institutions. The authors suggest that private institutions are complementing the federal aid with more institutional aid. They were only able to isolate an effect of federal financial aid on tuition pricing for four-year public institutions, where a one dollar increase in federal aid corresponded to a 50 cent increase in tuition and fees. In addition, federal financial aid did not have an effect on instructional expenditures. However, it was unclear in their panel data, if they included a fixed effect for institutions and years to account for unobserved aspects associated with institutions and any shocks to all institutions in a given year. In addition, they note that their model includes some endogenous variables especially with tuition/fees and institutional aid, where a one dollar increase in institutional aid at four-year private institutions corresponded to $2.57 increase in tuition and fees. This could suggest that private institutions are likely price

discriminating using a high tuition, high aid model, but their study cannot confirm what is occurring between these two variables.

McPherson and Schapiro (2006) continue to question how institutions might maximize their revenue for their own objectives. For instance, in the context of institutional grant aid, they discuss whether or not institutions would pay for institutional merit aid increases by reducing need-based aid funding. In addition, McPherson and Schapiro (2006) bring up the notion that institutions might be capturing federal aid by increasing prices or reducing institutional grants. This notion has been dubbed the Bennett hypothesis. They note this is a difficult area to research given the financial interdependencies, such as pricing, aid, expenditures, and admissions policies.

Additional studies reviewed how institutions respond to federal financial aid by either adjusting tuition prices or changing financial aid (e.g. Cellini & Goldin, 2012; Simone, 2016; Singell & Stone, 2007; Turner, 2012; Turner, forthcoming). Cellini and Goldin (2012) examine a few select states' private for-profit institutions eligible for Title IV federal aid and find that these institutions charge higher tuition than their counterpart for-profit institutions who are not eligible for Title IV aid. Their incidence findings on for-profit institutions eligible for Title IV aid hold across different specifications. Even within for-profit institutions, programs eligible for Title IV aid charge higher tuitions than programs at the same institution that were not eligible for Title IV aid. The intra-institution difference in tuition price demonstrate that the higher tuition prices are likely not a result of institutional quality. Even though Cellini and Goldin (2012) focused on for-profit institutions, their studies shows how institutions can adjust institutional policies relative to financial aid. Other studies delved into institutional responses to federal

financial aid, which account for institutional grant aid changes as well (Simone, 2016; Turner, forthcoming).

Using a more comprehensive set of data and institutions, Turner (forthcoming) examined the economic incidence with respect to the federal Pell grant program. She found that institutions captured roughly 15 percent of every dollar of Pell grant aid through tuition pricing. However, there were important differences in pass through of Pell grant funding by institution type and sector. Private non-profit and for-profit institutions captured more Pell grant aid (0.179 and 0.677, respectively). Public institutions presented relatively low levels of global incidence and presented a higher level of willingness to pay Pell grant recipients. Turner's (forthcoming) findings suggest that some institutions are willing to provide more institutional grant aid to Pell recipients.

State Context in Higher Education Governance

The state environment/context is important for this study for two primary reasons: 1) it was the Tennessee state government that created the Tennessee Education Lottery Scholarship (TELS) program; and 2) the theoretical framework described later in this chapter explains how state context matters from a governance and environment perspective. The state governance structures and systems overseeing higher education present an aspect to consider when assessing how the TELS program may influence institutions to change institutional grant aid. State governments contract with public institutions to provide educational opportunities and with these contracts state governments have some ownership/control of the public institutions (e.g. Kivisto, 2006, 2008; Lane & Kivisto, 2008). However, across the 50 U.S. states, variation exists in the

governance structures over higher education, where states establish some combination of single or multiple coordinating agencies and governance boards that serve as intermediaries between individual universities and the state governments (e.g. Lowry, 2001; 2003; Tandberg, 2013). The presence and composition of these governance structures can effect institutional operations, such as an institution's ability to generate revenue from tuition (McGuiness, 1997, 2001; Lowry 2001; 2003; Tandberg, 2013). Even beyond the structure, the extent of power and control state governments and their intermediaries varies across states (Tandberg, 2013). For example, coordinating agencies or governing boards in Tennessee and North Carolina have authority to set tuition rates (SHEEO, 2011). Prior studies attempted to categorize this variation in governance structures and highlight how governance structures affect public higher education.

McGuiness (1997; 2001) pioneered much of the early work attempting to categorize difference in higher education governance. Governance structures over public higher education are complex and vary between states. However, a taxonomy to define and categorize state governance of public higher education was refined and maintained by the Education Commissions of the States (McGuiness 1981; 1986; 1888; 1991; 1994; 1997). McGuiness (1997; 2001) first makes a distinction between governing boards and coordinating boards/agencies, where governing boards oversee the operation of one or more colleges. Governing boards can be further categorized into three types including a consolidated, segmental, and campus based governing board (McGuiness, 1997; 2001). A consolidate governing board oversees multiple campuses, such as all public institutions in a given state (McGuiness, 1997, 2001). A segmental governing board is a derivation of the consolidate governing board with the only difference being that institutions in a

governing board are grouped by institutional type, such as all public four-year or all public two-year institutions (McGuiness 1997; 2001). Coordinating entities have more of planning role in state but can sit between institutional or consolidated governing boards and the state government (McGuiness 1997; 2001). For instance, Tennessee has a coordinating board that works with the consolidated governing boards for public colleges and universities. Essentially, the coordinating board is an extra layer in the governance of higher education, where it can assist with coordinating higher education offerings and provide more monitoring/accountability. McGuiness's taxonomy of governance over public higher education is detailed and comparative, which is why empirical research has incorporated aspects of it.

Researchers have built on McGuiness's taxonomy (1997; 2001) by layering in additional nuances to highlight the complexity and diversity of public governance over higher education (e.g. Knott & Payne, 2004; Lowry 2001; 2003). A series of studies endeavored to explain the relationship state governance has with state appropriations, financial aid, and tuition revenue (e.g. Knott & Payne, 2004; Lowry 2001; 2003; Nicholson-Crotty & Meier, 2003; Tandberg, 2013). Of these prior studies, Lowry (2001; 2003) was an early adopter of McGuiness's higher education governance taxonomy and explored the potential effects of governance structure on public institutions including centralization of higher education and trustee/regent selection. In particular, Lowry (2001) issues a series of hypotheses on how governance structure, through number of campuses governed and trustee selection, might influence institutional decision making on net tuition revenue and expenditures. Lowry (2001) uses McGuiness's taxonomy (1994) that identifies states with an overall coordinating board that has budgetary

responsibilities over public higher education and states with multiple governing boards. His findings from a single year cross-section suggest that the presence of state coordinating board or external politically appointed trustees reduce tuition/fee prices, but states with multiple governing boards or larger volumes of institutions increase net tuition/fee revenue. Building on his own earlier work, Lowry (2003) takes up the same hypotheses to test as before whether governance structures over public higher education institutions has an effect on tuition revenue. Lowry's (2003) findings were similar as before (Lowry, 2001) where state coordinating boards correspond to lower tuition revenue, more governing boards in a state increase tuition revenue, and more representation of external (e.g. non-academic) trustees is associated with lower tuition revenue. Again, Lowry (2003) conducts simultaneous equation modeling on a single year of data. There were only direct effects of governance variables are on net tuition revenue (e.g. no indirect effects). The presence of a statewide coordinating board and more external representation (e.g. politically appointed elected) independently lower tuition revenue, but the existence of more governing boards in a state increased tuition revenue. However, Lowry's studies (2001; 2003) were only based on data from fiscal year 1995 where results can only address between state differences in tuition revenue in a single year, but both of Lowry's studies provide a foundation for other research.

Pushing empirical research beyond Lowry's (2001; 2003) initial application of higher education governance, Knott and Payne (2004) expand their analysis to include multiple years and shift the governance focus to address the extent of regulatory control that governing bodies have over public higher education. In their study, governance and regulatory control was essentially derived from the distinction between consolidated

governing boards, coordinating boards, and planning agencies, where consolidated boards have the highest regulatory control and planning agencies typically have the least regulatory control. Their utilization of cross-sectional, time series data to account for regional fixed effects, which was a needed addition to build on Lowry's (2001, 2003) earlier work. The regulatory distinction they make are based on governing entities having authority over budgets and program approval, where some statewide entities, such as planning agencies, do not have any regulatory authority. In addition, they address centralization and define it dichotomously where a board oversees multiple institutions or a single institution. They indicated that Tennessee shifted from a state with moderate regulatory control to high regulatory control in 1997. Governance structures appeared to have little effect on total revenue at any public institutions, but moderate and high regulatory environment appear to reduce total revenue at public flagship institutions. Highly regulated states (e.g. with a consolidated governing board) were associated with lower tuition revenue, but these higher regulated states did not appear to provide more state subsidies relative low regulated states. In addition, both in-state and out-of-state tuition prices were lower in highly regulated states relative to states with lower regulation levels. Regulation levels did not appear to impact endowment levels except for states that shifted to more regulation. Knott and Payne's (2004) research indicate that governance structures can influence access to revenue, which demonstrate the need to account for differences in higher education governance when comparing public higher education across states.

A fundamental distinction in empirical research developed to address whether state governance has only a main, direct effect on public funding for higher education or

is the impact of state governance a moderating effect on other state aspects such as political characteristics (e.g Nicholson-Crotty & Meier, 2003; Tandberg, 2013). Put another way, this more recent line of inquiry hypothesized that higher education governance systems change how state governments and institutions interact, which may differentially influence how funding is allocated to public institutions. The first to take up this line of inquiry, Nicholson-Crotty and Meier (2003), interact governance structures and political aspects. In their study, they define higher education governance into a single dichotomous variable that indicates if a state has a consolidated governing board. Nicholson-Crotty and Meier (2003) are trying to determine if the presence of a consolidated governing board changes the political relationship between the state government and public funding of higher education. They do find significant interactions between higher education governance structures and political characteristics. The interaction of governance structures with political aspects produce heterogeneous effects on an institutional tuition revenue, state appropriations, and state financial aid allocations, where these political variables operate differently in an institution controlled by a governing board versus coordinating board. However, it appears they did not account for any fixed effects by region or state, which could be biasing some of these results where inherent differences between states are operating through the independent variables.

Developing a similar approach to Nicholson-Crotty and Meier (2003), Tandberg (2013) interacted governance structure with political aspects, but he delved more into some of the complexities of the governance and political aspects. Tandberg (2013) defines state-level higher education governance by whether or not a given state has a

consolidated governing board, which is the governance structure in McGuiness's taxonomy (1997; 2001) with the greatest control over institutions. In Tandberg's study, he found that the presence of a consolidated governing board had a main negative effect on state appropriation per $1,000 of personal income. In addition, his study indicated that more electoral competition, budget powers of governor, representation of higher education interest group, and a democratic governor had positive effects on state appropriations. The interaction of the consolidated governing board indicator with all the state-level political aspects yielded both positive and negative associations with state appropriations. However, when looking at some of the published graphical representations of the association, it appears that a few outlier states might be driving the relationship between these political variables and state appropriations.

While this series of studies on higher education governance address different outcomes than that in this study, they provide an important framework for how to define and categorize the diversity of higher education governance structures. In addition, they provide suggestive evidence that the higher education governance structure influences institutional access to different types of revenue, such as state appropriation, tuition, and in some cases financial aid. Certainly, other research has demonstrated that other state-level characteristics can influence state appropriations. However, from the few studies that account for higher education governance structures, it is clear that governance over public higher education is an important aspect to consider when trying to account for institutional access to multiple revenue streams (e.g. state appropriations, tuition revenue, and financial aid). And, while this study is looking specifically at the creation of a

statewide merit aid program, it will be important to account for other revenue streams and control for the governance structure over public four-year institutions.

Other State and Institutional Characteristics

Of the few studies that examined the effects of state merit aid programs on institutional behavior, researchers attempted to control or account for variation between states over time on key aspects such as unemployment rate, personal income levels, and educational attainment (e.g. Long, 2004). However, the statistical relationship of these variables with institutional behaviors was not discussed (Long, 2004), but other state-level higher education studies have examined these aspects in more depth and discussed how they can effect state and institutional policies. Curs and Dar (2010a; 2010b) account for similar state level characteristics in their assessment on how state financial aid programs affect institutions' tuition prices and institutional grant aid, where they found that only the population of 18 to 24 year olds living in state seemed to have statistically significant relationship with institutional grant aid. In particular, Curs and Dar (2010a) found that the population of 18 to 24 year olds residing in state corresponded to an increase in institutional grant aid, but this effect did not hold in their later research where they tried to account for a distinction between need versus merit aid. Given Curs and Dar (2010a) finding that suggests relationship between traditional college-aged population in state and institutional grant aid, it is a state level characteristic worth considering in this study.

There are additional state level characteristics beyond the college-aged population in state that related to this study. As discussed, a significant development in the U.S. higher education landscape in the past few decades has been the substantive expansion of

state merit aid programs in U.S. states. Prior research differs on which states should be counted as having a merit aid program (e.g. Doyle, 2006; Hu, Trengrove, & Zhang, 2012; Sojquist & Winter, 2012). However, Sojquist and Winters (2012) present a more comprehensive and complete categorization of states with merit aid programs. They identify 29 states with either large (e.g. "strong") or small (e.g. "weak") program. Nine states—Georgia, Florida, New Mexico, Louisiana, South Carolina, Kentucky, Nevada, West Virginia, and Tennessee—were categorized by Sojquist and Winters (2012) as having larger state merit programs given the number of potential recipients and dollar amount of the award. Tennessee was the last state to create a large merit aid program. Twenty states were characterized as have a small or weak state merit aid program at some point in the past three decades (Sojquist & Winters, 2012). The variation in the state grants program identified by Sojuist and Winters (2012) presented an important distinction in the literature where all state merit aid program should not be treated equally or as common entity. Thus, it will important for this study to consider whether a state has an existing merit aid program and the relative size of the program using the Sojquist and Winter's (2012) taxonomy.

Beyond these additional state level aspects, there are facets of institutional context relevant for study consider given prior research. Institutions are complex entities with numerous missions, develop of different sectors (e.g. public, nonprofit, and for-profit), and access to different financial resources. However, empirical research has endeavored to parameterize and quantify different institutional characteristics, which can assist with comparing institutions. Some of these aspects include the modification of the Carnegie Classification of institutions in 2000 and 2005. Other aspects were tabulated by the U.S.

Department of Education, Integrated Postsecondary Data System (IPEDS) to create common definitions and collect information on institutional grants, state appropriations, investment income, private gifts, and numerous other aspects. Since the creation of this information, researchers have examined these aspects and used these characteristics to compare/contrast higher education institutions. For instance, the tabulation of institutional grant aid has led some research to explore how it is related to other aspects in higher education.

Institutional financial aid or grant aid is a growing area of research where scholars endeavored to explain how and why institutions offer such funding. Instead of providing merely general subsidies to all students, some institutions provide institutional funds for some students based on financial need or merit based criterion (e.g. Winston, 2004; Hillman, 2012). Institutional aid can be used to attract and enroll students with certain characteristics, such as academic preparation or diversity (e.g. Bowen, Kurzweil, & Tobin, 2005; Paulsen, 2001; Hillman, 2012). In addition, institutions may discount prices for some students in an effort to generate more revenue (e.g. Hillman, 2012). Institutional financial aid or tuition discounting functions more as a form of price discrimination, which may differ across students (McPherson & Schapiro, 2006). Institutional aid can be used to offset increases in gross tuition prices (Kane, 2006). However, the ability to provide institutional aid or tuition discounts is likely dependent on access to donative resources (e.g. Winston 1999; 2004), which is a more central line of inquiry that relates to this study. In particular, Winston (2004) explains, "US higher education is a highly stratified hierarchy of institutions where society's resources—as student subsidies—are highly unevenly distributed, more unevenly than are the prices

students pay" (p. 352). Winston (1999; 2004) goes on to chronicle how institutions vary in their access to donative resources and suggests this may affect institutions' ability to give institutional grants. Thus, access to donative resources such as private giving and state appropriations may affect institutions' ability to provide tuition discounts.

Some additional empirical research has explored the relationship between donative resources such as state appropriations, investment income, and private gifts. For instance, Curs and Dars (2010a; 2010b) further investigate the relationships between donative resources and institutional grant aid. They found that increases in state appropriations were associated with a decrease in institutional grant aid (Curs & Dar, 2010a; 2010b). However, they found that increases in investment income were related with increases in institutional grant aid (Curs & Dar, 2010a; 2010b). They did not find any statistically significant relationships between private gifts and institutional grant aid (Curs & Dar, 2010a; 2010b). A larger body of research exists assessing the relationship between donative resources and gross or net tuition prices. For instance, Long (2004) included state appropriations as a control when she assessed whether the Georgia HOPE Scholarship induced public colleges/universities to change their gross tuition prices. Given the conceptual arguments from Winston (1999; 2004) and empirical evidence from Curs and Dar (2010a; 2010b), donative resources, such as state appropriations, investment income, private gifts, are additional aspects to consider in this study to account for the variation that exists between institutions.

Theoretical framework

Application of Theory in Prior Studies

McPherson and Shapiro (1998) discuss how applicable theories and corresponding evidence are not extensive when it comes to explaining institutional responses to financial aid programs. In particular, they indicate the theories on for-profit firms or companies are not entirely applicable to public and nonprofit higher education institutions (McPherson & Shapiro, 1998). However, there are a series of recent studies investigating institutional responses to financial aid programs that developed primarily in the field of economics (e.g. Long, 2004; McPherson & Shapiro,1993; Turner, forthcoming) but are slowly spreading to the field of higher education research (Tandberg, Hillman, Gross, 2014). As expected, these studies drew from economic rationales, such as crowd out, to explain institutional responses to financial aid programs, where public funds take the place or crowd out private funds. In the context of this discussion, crowd out refers to the phenomena where institutions substitute the state/federal aid in the place of their own institutional aid. For instance, when Long (2004) examined how institutions would change financial aid in response to the creation of the Georgia HOPE Scholarship program, she hypothesized that private institutions would substitute their institutional aid with the state financial aid. Put another way, Long (2004) tested whether private institutions lowered their expenditures on institutional aid when the Georgia HOPE Scholarship program was created in 1993. However, Long (2004) did not present a broader theoretical argument of why institutions would reduce institutional aid in response to the creation of the state merit aid program. Also, given the

structure of the Georgia HOPE Scholarship program, Long (2004) could only investigate private institutions' changes to institutional grant aid in her study.

The series of studies that looked at how institutions respond to federal financial aid also investigated crowd out or capturing revenue. The impetus for McPherson and Shapiro's (1993) study of institutional behavior appeared to be in response to former U.S. Secretary of Education, William Bennett's (1987) assertion that colleges raise tuition price when federal financial aid is increased. However, McPherson and Shapiro (1993) also investigated how institutions changed their institutional aid expenditures, but they did not situate this in any other theoretical framework beyond what was dubbed the Bennett hypothesis of raising prices in concert with increased financial aid. Turner (2012) modified the Bennett hypothesis to include institutional grant aid, where he asserted that institutions could reduce institutional grant aid when students receive tax credits. Besides referencing the Bennett hypothesis, these studies did not discuss any other theoretical underpinnings, which is in part due to the fact that the crowd out phenomena is a well-accepted rationale in applied microeconomic research addressing the role of public funding in areas such as healthcare and education (Culter, 2002). Crowd out refers to situations when public resources or funding replace a function that was already funded by the private sector or another entity. However, crowd out is not a phenomena investigated by researchers that developed out of the field of higher education studies. Yet, some higher education researchers have looked at the interaction of states and public colleges/universities and applied other theoretical frameworks to explain how these two types of entities related with each other.

More broadly, some studies that investigated public higher education within the context of states use principal agent theory to explain how states and public institutions interact. Often principal agent theory was used simply to explain the structure of public higher education where the state acts as principals and public colleges/universities operate as agents (e.g. McLendon, Deaton, & Hearn, 2007). In addition, Titus (2009) used principal agent theory to explain how states interact with higher education institutions through policies such as providing state appropriations and financial aid. Some studies apply principal-agent theory to explain how and why states and institutions behave in certain way, such as states wanting more oversight or accountability and institutions acting in their own self-interest. Lane and Kivisto (2008) explain that "…[Principal agent theory] can be useful for investigating and explaining why universities respond to legislative action in different ways" (Lane & Kivisto, 2008, pp. 142). For instance, Tandberg and Hillman (2014) utilize principal agent theory to explain why states might impose performance based funding to achieve more accountability and how institutions might respond to performance based funding by doing what is best for themselves. Similarly, Liefner (2003) incorporated principal agent theory to explain how resource allocation and performance funding might change institutional and faculty behavior, where different modes of funding might incentivize positive and negative responses. While the applications of principal agent theory are limited but growing in higher education research, these few prior studies incorporating principal agent theory demonstrated how this theory explains both the relationship of state governments and public institutions as well as addressing how state policies shape institutional behavior.

Beyond principle agent theory, resource dependence theory is another framework used to explain how public institutions change institutional revenue and expenditure patterns and policies. However, resource dependence theory has not specifically been applied to studies investigating how institutions change institutional financial aid funding. Instead, resource dependence theory has been used as a framework to address institutions shifting tuition revenue. In particular, Delaney and Kearney (2016) apply resource dependence theory to their study investigating how Illinois public colleges respond to a state imposing a guaranteed in-state tuition policy. These authors found that Illinois public four-year institutions increased fees and out-of-state tuition when a state mandate was imposed limiting the ability to raise revenue from in-state tuition (Delaney & Kearney, 2016). While their study did not look at institutional financial aid as an outcome, it does suggest that public institutions are willing to adjust financial aspects within their direct control, such as setting fee and out-of-state tuition rates.

Theoretical Perspective and Conceptual Model to Guide this Study

Principal agent theory provides a core theoretical framework to understand state-level policy changes and any potential impacts on institutions. Kivisto (2005, 2007, 2008) provides the most comprehensive set of discussions analyzing how principal agent theory can be used in higher education research addressing state policies and college/universities. Principal agent theory describes hierarchal relationships or contracts, such as between states and institutions (Lane & Kivisto, 2008). In the example of higher education, the state operates as a principal on behalf of citizens and students to contract with colleges and universities to provide educational opportunities. Colleges and universities are the agents that have the expertise to provide postsecondary educational opportunities among other goods and services, such as research and public service. While multiple hierarchical principal-agent relationships exist in public higher education (Kivisto, 2007, 2008), the discussion herein will be simplified to the construct of a single principal-agent relationship between state governments and public four-year institutions. Principal agent theory goes beyond this simplistic specification of relationships/contracts in higher education to explain why such a contract may exist in the first place and what behaviors may manifest in the principal-agent relationship.

A principal engages in a contract with an agent when the principal needs goods or services that might better be performed by a given agent. In the context of the U.S. higher education, state governments contract with colleges and university to provide undergraduate and in some cases graduate education, which is in part due to a perceived expertise credited to postsecondary institutions (Lane & Kivisto, 2008; Kivisto, 2008). However, some state governing bodies are in place to operate as intermediaries between

the state and institutions, where these intermediaries are governing boards or coordinating boards (e.g. Tandberg, 2013). Historically, states provide appropriations to institutions in exchange for the educational offerings or services (Lane & Kivisto, 2008). Depending on the state and institution, the nature of the contract could be explicitly articulated in legislation, statute, or charter, but in some case, it is more of an implicit contract with strings attached to funding (Lane & Kivisto, 2008). Each state has slightly different funding guidelines for how appropriations are allocated, but all states with the exception of Colorado provide some form of direct financial support to public institutions (Tandberg, Hillman, & Gross, 2014). Beyond an explanation of the contract between states and institutions, principal agent theory explains how and why the contract may not work as it was intended.

Principal agent theory acknowledges that tensions exist between principals and agents were agents may act in their own self-interest and principals may not have the ability or resources to ensure that contract objectives are fulfilled (Lane & Kivisto, 2008). Thus, the implicit contract between states and colleges could present some principal-agent problems where institutions will knowingly or unintentional shirk their responsibilities in participating in the state merit aid program (Lane & Kivisto, 2008). Beyond shirking, Lane and Kivisto (2008) summarize the potential opportunistic behavior of institutions for their own self-interest in effort to obtain prestige, garner more revenue, or subsidize other facets of the institution. In addition, to achieving these ends, institutions may knowingly or inadvertently not work toward the contract objectives or distort monitoring efforts (Lane & Kivisto, 2008). When agents choose private/self-interested goals in lieu of public/principal goals, Kivisto (2008) describes this as an

agency problem or moral hazard. Agents that seek self-interest may exploit information asymmetries and since institutions are highly specialized the information asymmetries might be more pronounced (Kivisto, 2005). Kivisto (2007; 2008) explains a few potential ways that an institution may operate in their own self-interest, such as shirking or underperforming, pursuing prestige, seeking revenue, cross-subsidizing, and circumventing monitoring activities. Certainly, some of these activities, such as pursuing prestige or revenue are not inherently an agency problem, but they become an agency problem if they run counter to the contract objectives. The notion of shirking is described by Lane and Kivisto (2008) as when, "A university behaves opportunistically when it deliberately produces less or less effective outputs with the same inputs or consumes more inputs with same output" (p. 161). However, principal agent theory assumes public universities will act in its own self-interest, but it does not provide a strong theoretical basis for this argument.

An example of institutions pursuing their on self-interests exists in Long's (2004) study, where she found that Georgia private non-profit institutions increased tuition prices and decreased institutional grant when the Georgia HOPE Scholarship was created. In addition, she did find the public institutions increased their room and board expenses and decreased their resident tuition price after the Georgia HOPE scholarship was created (Long, 2004), but was not able to observe institutional grant aid change in part since data was not available in IPEDS. While it is difficult to know why Georgia public institutions did not increase tuition prices like private institution, it is possible that tuition pricing is a highly regulated and monitored aspect of public institutions, where some level of state government through boards and legislature explicitly set tuition rates.

However, financial aid strategies are subject to less public monitoring and approval, where financial aid expenditures are buried in institutional budgets and financial sheets making it difficult to monitor and track at the state level. However, if a public institution doesn't change their tuition price but reduces their institutional grant aid expenses while maintaining enrollment, then a public university would have more net revenue available to subsidize other aspects of the institution. It appears Tennessee has little monitoring of institutional grant aid aside from governing boards approving operating budgets, which make it more possible for public institutions to change with impunity. In addition, Ness (2008) identified that institutions saw the TELS program as a new revenue source: "the higher education community realized that this lottery revenue was the only source of new money their sector would claim for years to come" (p. 119). Tennessee public four-year institutions may operate in their own self-interest by reducing institutional grant in an effort to garner more net tuition revenue.

Principal agent theory presents a near unidimensional perspective of institutional behavior, where institutions will only act in their self-interest unless they are monitored (Kivisto, 2008; Lane & Kivisto, 2008). However, resource dependence theory provides some alternative explanations of institutional behavior and how an institution might respond to a merit aid program. Resource dependence theory, developed out of organizational studies/theory, posits that institutions or organizations will seek additional revenue or resources and attempt to maintain the revenue/resources in effort to gain more autonomy (Pfeffer & Salancik, 2003). In addition, Pfeffer & Salancik (2003) acknowledge that this notion of institutions or organizations seeking revenue may seem so basic an idea, but they build on this basic concept to formalize how

institutions/organizations achieve more revenue/resources through tactics. In particular, they describe how institutions and organizations will attempt to control sources of revenue/resource. Bowen and associates (2005) acknowledge that institutions will act in their own self-interest to maintain position and quality, which can include using financial aid. While Pfeffer and Salanick (2003) do not describe specifically how public universities would control revenue/resources, some higher education studies have incorporated resource dependence theory, which help to examine how institutions might attempt to control revenue/resources.

A few studies have found resource dependence theory to be applicable to public colleges/universities (Delaney & Kearney, 2016; Fowles, 2014). Delaney and Kearney (2016) find that Illinois public four-year institutions expand alternative revenue streams when a primary revenue source is constrained. Fowles (2014) applies a resource dependence framework to assess whether institutions respond to changes in revenue. In the context of state merit aid program, institutions do not have direct control over the funding, however by attracting and enrolling merit aid recipients they could garner indirect access to the funds from the financial aid program. Higher education institutions often use institutional grant aid to attract and enroll students (Hillman, 2012). McPherson and Shapiro (1998) validate this notion that institutions use institutional financial aid as means for managing enrollment and revenue, where institutions use institutional aid to garner more tuition revenue. In addition, Bowen et al. (2005) discussed the various uses of institutional grant aid to help build an entering class by enhancing equity in access and attracting talented students. Since state merit aid programs presented a new source of revenue (e.g. Ness, 2008), public four-year

institutions may attempt to attract and retain students with merit aid awards by using institutional grant aid. Within a resource dependence theory framework, Froelich (1999) suggests that organizations will adapt and align their practices and policies to increase their likelihood of obtaining new funding, especially for relatively stable government funding. Thus, resource dependence theory suggests that public four-year institutions may be willing to pay or provide more institutional grant aid to TELS recipients.

The use of resource dependence theory to explain how public institutions respond to changes in state fiscal policy is a growing area in higher education literature. However, in the other disciplines, resource dependence theory is used more extensively (Davis & Cobb, 2010). By investigating citations, Davis and Cobb (2010) found that resource dependence theory is used in education studies but more often it is used in business, sociology, political science, and health care research. For every three education articles using resource dependence theory, there were nearly 100 articles in other disciplines using resource dependence theory (Davis & Cobb, 2010). However, Delaney and Kearney (2016) used resource dependence theory to explain how Illinois public institutions responded to a state law allowing for guaranteed in-state tuition prices for residents. This state policy would constrain Illinois public institutions' access to in-state tuition revenue, which the authors hypothesized would push institutions to raise revenue from other fees and out-of-state tuition revenue. Delaney and Kearney's (2016) hypothesis was based squarely on resource dependence theory which suggests organizations will seek addition resources/revenue when a primary resource is constrained. The authors note that this is a form of revenue/resource diversification that is a principle embedded in resource dependence theory (Delaney & Kearney, 2016). In

addition, Delaney and Kearney (2016) establish an appropriate state context for their empirical analysis, which is another key principle of resource dependence theory.

While the core basis of the principal agent and resource dependence theories suggest different institutional responses, the two theories align on the importance of environment and context. Resource dependence theory details the importance of the broader environment to determining institutional or organizational behavior (Davis & Cobb, 2009; Pfeffer & Salancik, 2003). In resource dependence theory, the parameters used to define environment are inherently broad and universal to cover a myriad of different types of organizations. Resource dependence theory addresses how organizations manage their environments through different tactics in order to garner or maintain more resources (Davis & Cobb, 2009). Pfeffer and Salancik (2003) use a higher education example that highlight state government as key part of environment where a change in state government led to changes in financial support for the University of Illinois. Resource dependence theory is flexible enough to encompass the financial relationship between states and public institutions and the theory is more acutely aware of how organization use tactics to garner or maintain resources. However, principal agent theory provides a more succinct approach to defining the state environment or context for public four-year institutions.

Principal agent theory defines the environment of public universities more succinctly in part since it has been more widely applied in empirical research on higher education. State governments and governance structures over higher education are key aspects of state context/environment that account for how institutions are able to operate, where states can control the process of setting tuition rates and allocating state

appropriations. Tandberg (2013) found that the presence of a consolidated governing board does affect how public institutions are funded, where institutions governed by a consolidated governing board receive less state appropriations. Other studies have shown some relationship between consolidated governing boards and institutional tuition revenue, tuition rates/prices, and expenditures (e.g. Knott & Payne, 2004; Nicholson-Crotty & Meier, 2003). Thus, state governance systems over the public four-year institutions in Tennessee and comparison states might be an important aspect to consider in a study on a how a state merit aid program could influence institutions to change their institutional aid.

Beyond governance over higher education, another aspect of environment worth considering is institutional access to other revenue sources such as state appropriations and investment income. Resource dependence theory addresses the importance of considering all revenue sources as part of assessing and describing environment (Pfeffer & Salanik, 2003). Institutions' existing revenue sources reveal how and whether institutions are constrained by their financial situation (Pfeffer & Salanick, 2003). In addition, the sources and relative sizes of revenue may reveal important interdependencies for institutions (Pfeffer & Salanik, 2003), where some public four-year institutions may have differential access to revenue due to their environment (Winston, 199; 2004). Access to donative resources, such as state appropriations, investment income, or private donations can impact institutional grant aid, where more donative resources might allow more institutional grants or lower tuition prices (Paulsen, 2001). Winston (1999, 2004) describes how higher education institutions have differential access to donative resources, which may affect how institutions can provide institutional

financial aid. However, Winston (2004) indicates that there is less variability in access to donative resources at public institutions when looking within a given Carnegie Classification. Given the importance of existing resources in resource dependence theory, the established primary revenue streams at public four-year institutions will be important aspects to consider when assessing institutional behavior. Aside from tuition, the three other primary revenue streams related to undergraduate enrollment are state appropriations, investment income, and private gifts. Thus, a study on institutional behavior will need to account for access to state appropriations and endowment/investment income to help establish the existing environment.

Given that this study draws from principal agent and resource dependence theories, Figure 2.1 displays how these theoretical concepts combine to explain how public four-year institutions might respond to the Tennessee Education Lottery Scholarship (TELS) program while account for state and institutional context/environment. Both principal agent and resource dependence theories address the necessity of establishing the broader state context that Tennessee public four-year institutions operate, which is being explained in this study in Boxes 1-3. Principal agent theory describes the relationship more precisely between state governments and public higher education institutions, which operates through a state's governance structure (Box 1). Resource dependence theory asserts the importance of accounting for other revenue when assessing institutions, which includes private gifts, investment income, and federal grants (Box 2). In addition, resource dependence theory suggests accounting for aspects specific to the institutional environment, which in the context of this study is undergraduate enrollment and federal financial aid (Box 2). Both principal agent and

revenue dependency theories address a need to account for the broader state level environment, which is accounted for in this study by the college-aged population in state, existence of prior state level merit aid program, and state appropriations (Box 3). The population of college-aged students is an aspect to consider given prior empirical literature on institutional grant aid (e.g. Curs & Dar, 2010a). Existing state appropriations and state financial aid funding are two additional important aspects of the state context, since they highlight how the state and public institutions operate/transact. These state and institutional environment are depicted as aspects affecting public four-year institutions in Tennessee (Box 5), but these environmental factors are also acting upon any other public four-year institution that could provide a comparison. In 2004-05, Tennessee created a broad merit aid program (Box 4), which is shown as influencing Tennessee public four-year institutions. It is the effect of the creation of the TELS program on institutional grant aid that is the primary aspect of interest in this study. After the creation of the merit aid program, Tennessee public four-year institution could respond by increasing, decreasing, or maintaining their institutional grant aid funding for new students (Box 6), which will be the primary focus of this study. An increase or maintenance of institutional grant could be viewed as an attempt to control or maintain revenue from enrollment, which is based on resource dependence theory. A decrease in institutional grant could be an attempt to replace state aid for institutional aid, which align more with principal agent theory but is congruent with resource dependence theory.

Conclusion

McPherson and Shapiro's (1998) assertion that limited theories and evidence exist to explain institutional responses to financial aid remains true nearly twenty years later especially for public institution. Many studies still reference the Bennett hypothesis when assessing how public institutions respond to financial aid programs, but this hypothesis lacks empirical evidence. However, a series of recent studies presented convincing empirical evidence addressing how public institutions respond to financial aid by using concepts of crowd out and willingness to pay. Turner (forthcoming) provides substantive evidence explaining how public institutions respond to students receiving Pell grants by increasing their willingness to pay (e.g. give them more aid). In addition, Simone (2016) identify a similar result where all institutional types are willing to provide more institutional grant to Pell grant recipients. Given the limited theoretical developments and investigation into how institutions respond to financial aid, there is a need for both the development of theory and empirical evidence to address how public four-year institutions respond to changes in state merit aid.

This study endeavors to bring together a more comprehensive theory to explain institutional responses to financial aid programs and research how Tennessee public four-year institutions responded to the creation of a statewide merit aid program. This study will draw from principal agent and resource dependence theories to explain how Tennessee public four-year institutions will respond to the expansion of state financial aid while appropriately establishing the state context and institutional environment. In addition to these theories, the growing research on state level policy will help guide this study by identifying important state level characteristics, such as governance of public

higher education. The primary research questions explored in this study are the following:

1) Did increased state merit aid funding induce Tennessee public four-year institutions to change their total expenditures on institutional grants given to first-time, full-time students when compared to similar institutions in other states?
2) Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?
3) Did increased state merit aid funding induce Tennessee public four-year institutions to change their entire class average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
4) Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?

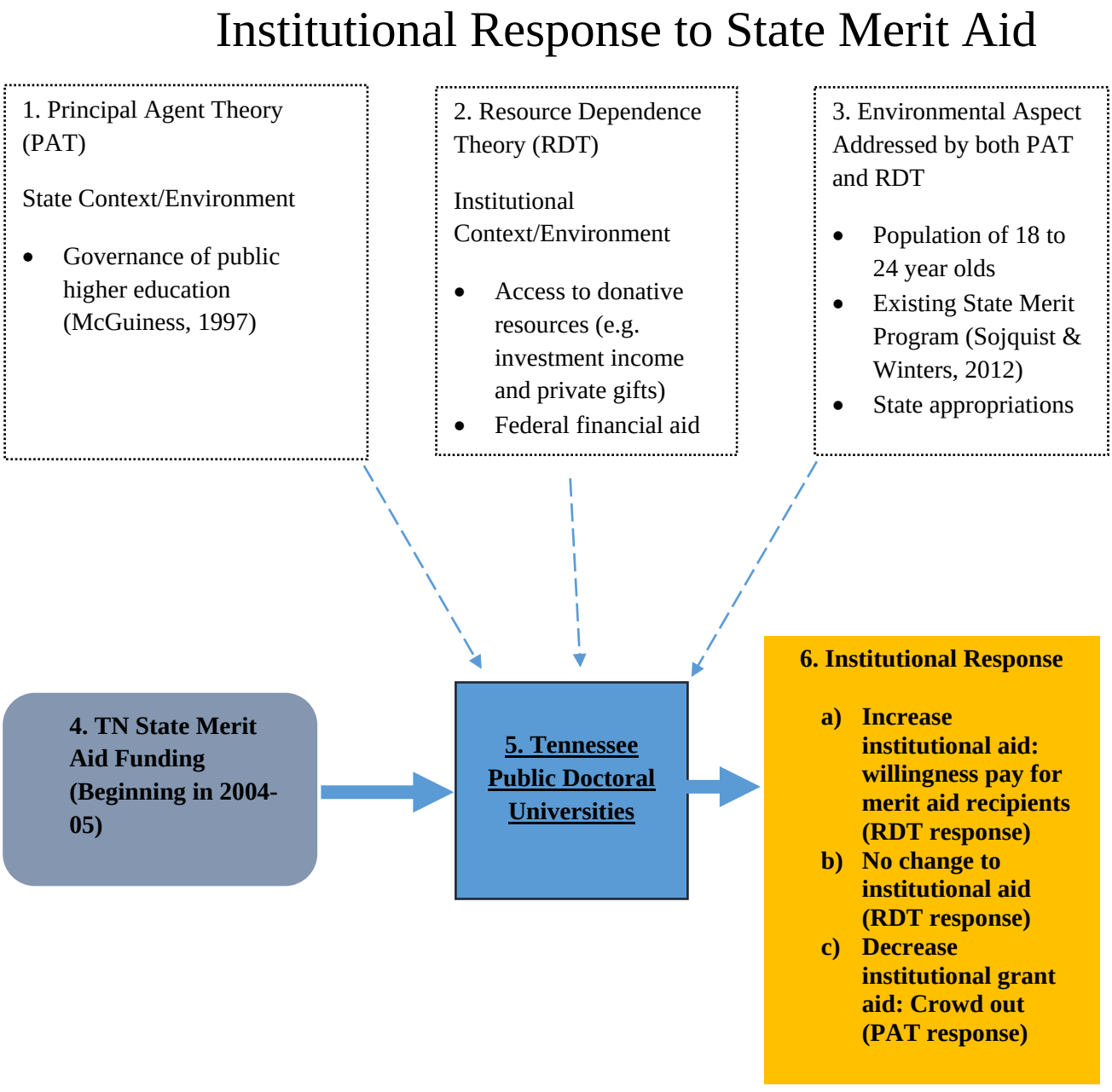

Figure 2.1. Conceptual frame for how Tennessee institutions may change institutional aid in response to state merit aid program.

CHAPTER THREE
RESEARCH METHOD

Introduction

Using principal agent and revenue dependency theories, this study examines whether the Tennessee Education Lottery Scholarship (TELS) influences public four-year institutions in Tennessee to change their institutional grant aid funding. This chapter will be divided up into six sections. First, the research questions discussed in the prior chapter will be reintroduced for context. Second, a discussion of the data used in this study will be discussed followed by a subsection detailing the variables. Third, a detailed discussion of the statistical method will be explained. Fourth, a series of alternative specifications are described as potential checks on the robustness of any results. Lastly, the limitations of the proposed method will be addressed to help shape the reliability of the potential results.

Research Questions

The primary research questions explored in this study are the following:

1) Did increased state merit aid funding induce Tennessee public four-year institutions to change their <u>total expenditures on institutional grants</u> given to first-time, full-time students when compared to similar institutions in other states?

2) Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?
3) Did increased state merit aid funding induce Tennessee public four-year institutions to change their entire class average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
4) Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?

Data

In order to address these questions, data was gathered from multiple sources to appropriately account for institutional and state level context. However, the U.S. Department of Education's Integrated Postsecondary Data System (IPEDS) provides the core data for this study through its numerous annual surveys. The IPEDS survey began collecting institutional level data beginning in 1980 on all institutions participating in Title IV financial aid programs. Earlier data collection efforts by the US Department of Education date back even further in the Higher Education General Information Survey (HEGIS) collections. Over the years, IPEDS has expanded its data collection efforts and it developed a Student Financial Aid (SFA) survey that began collecting data in 1999. This first iteration of the SFA survey included some basic information on financial aid for undergraduate students. In the subsequent years, the SFA survey was expanded in 2003 and 2008 to include more comprehensive information on undergraduate student financial

aid. The creation and expansion of the IPEDS institutional survey allowed for more precise analysis on the effects of state merit aid programs, but are limited to first-time, full-time students, which exclude first-time, part-time and transfer students. The exclusion of these part-time and transfer students from the SFA metrics may eliminate some state merit aid recipients that enroll part-time and in later post-TELS years ignore some transfers students. Long's study (2004) had to rely on a cruder categorization of institutional financial aid in her assessment on the effects of the Georgia HOPE Scholarship program, because the SFA survey did not exist. However, this study will rely on the more detailed SFA survey to derive an analytic sample of institutions to evaluate whether or not institutional financial aid changes when the TELS began providing funding.

The analytic sample in this study is based on the population of institutions that participate in the Title IV federal financial aid and provide annual reporting in the Integrated Postsecondary Education Data System (IPEDS), Student Financial Aid (SFA) survey. As the research questions suggest, this population of institutions focuses on public four-year institutions from 2000 through 2009 in order to balance pre- and post-TELS observed years. During this time period, Tennessee had nine public four-year institutions that operated and participated in the IPEDS SFA Survey. In the other US states, there were 390 public four-year institutions that participated in the IPEDS SFA survey, which can be used to draw a comparison group of similar institutions as those in Tennessee.

As mentioned, this study is focusing on public four-year institutions in the Tennessee. The classification of institutions utilized in this study comes from the

Andrew W. Carnegie Foundation for the Advancement of Teaching's (e.g. Carnegie Foundation) grouping of institutions in 2000. While the Carnegie Foundation has classifications dating back to 1970, this study uses the 2000 classification in part because it aligns with the creation of the IPEDS SFA survey and was the classification used up through the implementation of the TELS merit program in 2004-05. The Carnegie Classification in 2000 created ten broad types of institutions including:

1) Doctoral/Research Universities—Extensive,

2) Doctoral/Research Universities—Intensive,

3) Master's Colleges and Universities I,

4) Master's Colleges and Universities II,

5) Baccalaureate Colleges—Liberal Arts,

6) Baccalaureate Colleges—General,

7) Baccalaureate/Associate's Colleges,

8) Associate's Colleges,

9) Specialized Institutions, and

10) Tribal Colleges and Universities.

This study focuses on the Doctoral/Research Universities designated as research extensive or intensive and Master's Colleges/Universities I by the 2000 Carnegie Classification since these three categories include all Tennessee public four-year institutions. When creating these categories, the Carnegie Foundation defined them as the following:

> "Doctoral/Research Universities—Extensive: These institutions typically offer a wide range of baccalaureate programs, and they are committed to

graduate education through the doctorate. During the period studies, they awarded 50 or more doctoral degrees per year across at least 15 disciplines.

Doctoral/Research Universities—Intensive: These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the doctorate. During the period studied, they awarded at least 10 doctoral degrees per year across three or more disciplines, or at least 20 doctoral degrees per year overall.

Master's Colleges and Universities I: The institutions typically offer a wide range of baccalaureate program, and they are committed to graduate education through the master's degree. During the period studies, they awarded 40 or more master's degrees per year across three or more disciplines" (CFAT, 2001, pp. 1).

Prior studies relied on Carnegie Classifications to account for the diversity of higher education institutions in the U.S. For instance, Winston (2004) used the Carnegie Classification system to demonstrate differences in prices, subsides, and financial aid across and within sectors and institutional types. In addition, some studies, such as Knott and Payne (2004), employ the Carnegie Classification to segment higher education institutions, such as institutions with comprehensive and doctoral classification.

Beyond the Carnegie Classification and IPEDS SFA survey, this study draws from other IPEDS surveys to appropriate establish an institutional and state context. In particular, aspects of the IPEDS Institutional Characteristics, Enrollment, and Finance surveys include relevant characteristics that help establish context/environment.

Beginning in 1980, the Institutional Characteristics survey gathers information on educational offering, location, tuition/fees, and other directory information. The Enrollment survey annually collects information on fall enrollments that provide demographic information on the undergraduate and graduate student population going back to 1980. The Finance survey has changes over the years since its initial collection in 1980, but provides information on the revenue and expenditures at institutions. When institutions participate in a system of institutions, they have the option of reporting information as a single institution or grouped with other institutions in a system. Thus, IPEDS data will need to be assessed to insure that all variables are reported at a common level, such as at the single institution level. This study will account for the appropriate parent and child reporting relationships to ensure all variables are listed or adjusted to be at a single institution level (e.g. Jaquette & Parra, 2014). The IPEDS survey data provide information on the institutional context but other data sources will be needed to establish public four-year institutions' state context or environment.

Information on governance over higher education institutions comes from the Education Commissions of the States (ECS). McGuiness (1981) established a taxonomy for classifying higher education governance structure as a consolidating governing board or coordinating agency going back at least as far as 1981. Since then, McGuiness has made periodic updates of the governance classification to account for any changes (McGuiness 1981; 1986; 1888; 1991; 1994; 1997). These regular updates on higher education governance capture whether one board governs one institution or one board governing multiple institutions. In addition, McGuiness (1997) documents the role

coordinating boards/agencies have in each state by categorizing their authority to set/review budgets and approve academic programs.

Given that Tennessee was a late adopter of a statewide merit aid program, it is necessary to understand which other states had previously adopted a merit aid program. The few research studies that have looked across states come up with different lists of states with merit aid programs (e.g. Doyle, 2006; Hu, Trengrove, & Zhang, 2012; Ness, 2008; Sjoquist & Winters, 2012). State merit aid programs can offer a wide range of dollar amounts and number of students receiving an award, where some research studies many not acknowledge smaller award programs. However, Sjoquist and Winter (2012) provide the most comprehensive list of states with merit aid program, where they categorize stronger (e.g. larger) and weaker (e.g. smaller) programs. Tennessee is included in this categorization of states that implement a larger merit aid program in 2004-05. In addition to Tennessee, there are 28 other states that adopted a small or large merit aid program in the past three decades.

Variables

Institutional grant aid is the dependent variable in this study but parameterized in four different ways, where each is potentially influenced by the creation of the Tennessee Education Lottery Scholarship (TELS) 2004-05. The key independent variable in this study is the dichotomous variable indicating when Tennessee started awarding TELS awards to graduating high school students. A series of other independent variables relating to state appropriations, endowment income, private gifts, financial aid, governance structures, and population of 18 year olds are included in effort to identify a

better comparison group and improve precision of estimates. All variables based on a dollar amount are adjusted for inflation using the CPI-U adjustment. In addition, all continuous/scaled variables will be log transformed so results can be interpreted in percentage change rates.

Dependent Variables

The dependent variable, institutional grant aid, is drawn from the Integrated Postsecondary Education Data System (IPEDS) Student Financial Aid survey. Institutional grant aid refers to any scholarship or grant that is funded by the institution or where the institution selects the recipient, which can include such awards as merit-based scholarships awarded on the basis of prior academic/talent performance, grants awarded on the basis of financial need, or athletic awards. Unfortunately, there is not a means to disaggregate this overall institutional aid into distinct need-based and merit-based criterion. IPEDS collects institutional grant aid on undergraduate degree-seeking students who are enrolling for the first-time in college at a full-time status in a given fall semester. An undergraduate degree-seeking student can include any student enrolled in two- and four-year programs where a formal degree is awarded. A first-time student refers to a student who is enrolling in college for the first-time since completing high school. A full-time student includes anyone enrolled for at least 12 credits in the fall semester or quarter or taking at least 24 contact hours in a given week. Information on institutional grant aid given to first-time, full-time undergraduate degree-seeking students is available going back to fall 1999. Prior to 1999, the IPEDS Finance survey collected information on institutional grants given to all students (e.g. first-time, transfer, and

continuing undergraduate students and all graduate students), which is the method that Long (2004) used to determine if private institutions change their institutional grant aid in response to the creation of the Georgia HOPE Scholarship program. However, the Finance survey data on institutional grant is an imprecise measure when a research question focuses on a state policy (e.g. TELS program) affecting entering undergraduate students. In this study, measures of institutional grant aid will be utilized in the four ways collected in the IPEDS Student Financial Aid Survey: total institutional grant aid, recipient average institutional grant aid, entire class average institutional grant aid, and number of institutional grant aid recipients. These four parameterizations of institutional grant aid will help uncover changes in total expenditures of institutional aid as well as understanding how institutions change their average and number of awards.

Independent Variables

State appropriations: State appropriations provide a large share of funding to public institutions, where it historically has been the largest share of operating budgets at public institutions (e.g. Toutkousian, 2001). Prior research has hypothesized a relationship between state appropriations and institutional grant aid and/or tuition pricing at public institutions, where more state appropriations will lead to lower gross tuition prices or more financial aid (e.g Winston, 1999; 2004). Some empirical studies have investigated the relationship between state appropriations and gross tuition prices, net prices, and institutional grant aid (Curs & Dar, 2010a; 2010b). These studies' findings suggest that increased state appropriations decrease institutional grant aid (Curs & Dar, 2010a; 2010b). Long (2004) controlled for state appropriation in her study investigating how the

Georgia HOPE Scholarship changed gross tuition prices, and she found that state appropriations did not change the effect of HOPE scholarships on tuition pricing. In fact, the inclusion of state appropriations did not even increase the precision of her model. Despite the limited empirical evidence on the relationship between state appropriations and institutional grant aid, the inclusion of controlling for state appropriations is warranted given the theoretical or conceptual assertions by Winston (1999; 2004). Thus, this study will account for state appropriations as captured and defined in the Integrated Postsecondary Data System (IPEDS) as funding for operating expenses received by the institution from a state legislative body. However, in IPEDS, institutions are allowed to report any given survey as an independent institution or grouped with institutions in their system. Most public four-year institutions in the sample report finance data as a single, independent institution, which account for between 369 and 378 institutions in any given year. Of the remaining institutions, the finance data was adjusted to distribution their state appropriation by their full-time equivalent (FTE) enrollment as suggested by (Jaquette and Parra, 2010), which accounted for an additional 20-25 institutions in any given year. When finance and enrollment information was reported with institutions grouped together, there was not any information available to distribute aid by FTE enrollment, which only affected between one and five institutions. For example, in 2005, there were 376 institutions with only their finance data reported, 21 institutions had finance data adjusted for FTE enrollment to distribute state appropriations across a group of campuses/institutions, and only one institution had finance data that could not be adjusted for enrollment. However, none of these adjustments were need for Tennessee

institutions since each of the nine institutions had complete and separate data reported in IPEDS.

Investment income and private gifts: Public universities have investment income which comes from interest or dividends from investments. Private gifts include any funding given to institutions that was not added to the institution's permanent endowment. Funding from investment and private gifts can provide another subsidy for universities, which Winston (1999) notes can be used to provide institutional scholarships/grants. However, institutions have varying levels of donative resources, such as investment income (Winston, 1999; 2004). Given the variation and likely relationship with institutional grant aid offerings (Winston, 1999; 2004), investment income is an important variable to control for in any analysis of changes in institutional grant aid. Studies on the institutional effects of state merit aid program have not controlled or examined endowment income (e.g. Long, 2004). However, Curs and Dar (2010a; 2010b) assessed the relationship between investment income and private gifts with institutional grant and found that an increase in private gifts or investment income corresponded to an increase in average institutional grant aid. Given Winston's (1999; 2004) conceptual argument and Curs and Dars's (2010a; 2010b) empirical evidence, this study will include endowment income and private gifts. Annual investment and gift income is collected in the IPEDS Finance survey will be the source data for these aspects. Since this information came from the IPEDS survey, any grouped institutions had investment income and private gift aid distributed across campus, but this only affected at most 6.3% of the analytic sample of public four-year institutions.

Federal financial aid: Federal financial aid, such as Pell and Supplemental Education Opportunity Grants (SEOG), can vary by institution and year depending on the financial need of a given institution's student population. Curs and Dar (2010a; 2010b) and Simone (2016) find that an increase in federal financial aid can correspond to an increase in institutional grant aid. Similarly, Turner (forthcoming) found that public institutions increase their willingness to pay for students receiving a Pell grant. Thus, given the empirical evidence suggesting a positive relationship between federal and institutional grant aid, it will be an important aspect to control for in this study.

Governance of higher education: State level governance of higher education can vary across each of the 50 US states. However, McGuiness created a taxonomy of higher education governance structures to account for variation but allow for grouping states with relatively similar governance structures/systems. McGuiness's (1997) taxonomy accounts for institutions that have a consolidated governing board, coordinating board with consolidate/aggregate budget authority, coordinating boards with less or no budget responsibilities, and planning agency without any budget responsibilities. Many researchers have focused on only consolidated governing boards (e.g. Tandberg, 2013) or included another governing layer for coordinating boards (e.g. Curs & Dar, 2010a). However, given the study is focused on institutional funding for grant aid, it is more important to group governance structures by those that have consolidated budget authority, which includes consolidated governing boards and coordinating boards with consolidated budget authority. Thus, this study will create a dichotomous variable to

account for any public four-year institution with a state governing body holding consolidated budget authority, which includes public four-year institutions in 38 states. Table 3.1 shows the states that had a governing body with consolidated budget authority.

Table 3.1

Higher Education Governance Structures with Consolidated Board or Coordinating Board with Consolidated Budget Authority

Cosolidated Governing Board (One Board for All Institutions)
Alaska
Hawaii
Idaho
Montana
Nevada
North Dakota
Rhode Island
South Dakota
Utah
DC
Cosolidated Governing Board (Two or More Boards for All Institutions)
Arizona
Florida
Georgia
Iowa
Kansas
Maine
Minnesota
Mississippi
New Hampshire
North Carolina
Oregon
Vermont
West Virginia
Wisconsin
Wyoming
Coordinating Board with Consolidated or Aggregate Budget
Alabama
Arkansas
Colorado
Illinois
Indiana
Kentucky
Louisiana
Maryland
Massachusetts
Missouri
Ohio
Oklahoma
South Carolina
Tennessee

(McGuiness, 1997)

State Merit Aid Program: Researchers have presented varying accounts of which states have a merit aid program, which is in part due to the size and intensity of these programs. Sjoquist and Winter (2012) account for a more full list of state merit aid programs while addressing the relative size and amount of funding provided by each state program. They group nine states (e.g. Georgia, Florida, New Mexico, Louisiana, South Carolina, Kentucky, Nevada, West Virginia, and Tennessee) into a "strong" merit aid program because these merit aid programs are larger in size and also provide more financial aid to recipients. In addition, they identify 20 states with relatively "weak" or small merit aid programs. Table 3.2 shows the states that adopted a merit aid program and year the program was implemented, where states are grouped by the Sjoquist and Winter's (2012) classification of "strong" and "weak" programs. Table 3.3 combines information on the governance structure and state merit aid program to show which states have similar governance structure to Tennessee and had not created a merit aid program before Tennessee.

Table 3.2

States with Merit Aid Programs

Strong Merit Programs	Year of Implementation (e.g. Fall YYYY)
Georgia	1993
Florida	1997
New Mexico	1997
Louisiana	1998
South Carolina	1998
Kentucky	1999
Nevada	2000
West Virginia	2002
Tennessee	2004
Weak Merit Programs	
Arkanasa	1991
North Dakota	1994
Mississippi	1996
Oklahoma	1996
Missouri	1997
New Jersey	1997
New York	1997
Alaska	1999
Utah	1999
Illinois	1999-2004
Washington	1999-2006
Michigan	2000-2008
California	2001
Idaho	2001
Maryland	2002-2005
South Dakota	2004
Massachusetts	2005
Montana	2005
Delaware	2006
Wyoming	2006

(Sojquist & Winters, 2012)

Table 3.3

State Merit Aid Programs and Higher Education Governance Structures

Strong Merit Programs	Year of Implementation	Consolidated Budget Authorirty	Non-Merit Aid States with Consolidated Budget Authority (Potential Comparison States)
Georgia	1993	Yes	Alabama
Florida	1997	Yes	Colorado
New Mexico	1997		DC
Louisiana	1998	Yes	Hawaii
South Carolina	1998	Yes	Indiana
Kentucky	1999	Yes	Iowa
Nevada	2000	Yes	Kansas
West Virginia	2002	Yes	Maine
Tennessee	2004	Yes	Minnesota
			New Hampshire
Weak Merit Programs			North Carolina
Arkanasa	1991	Yes	Ohio
North Dakota	1994	Yes	Oregon
Mississippi	1996	Yes	Rhode Island
Oklahoma	1996	Yes	Vermont
Missouri	1997	Yes	Wisconsin
New Jersey	1997		
New York	1997		
Alaska	1999	Yes	
Utah	1999	Yes	
Illinois	1999-2004	Yes	
Washington	1999-2006		
Michigan	2000-2008		
California	2001		
Idaho	2001	Yes	
Maryland	2002-2005	Yes	
South Dakota	2004	Yes	
Massachusetts	2005	Yes	
Montana	2005	Yes	
Delaware	2006		
Wyoming	2006	Yes	

(McGuiness, 1997; Sojquist & Winters, 2012)

Population of 18 year olds: State population of 18 year olds provides a proxy for number traditional college-aged students. In addition, it helps account for differences between states on the potential pool of traditional college-aged students. Prior studies looking at the effect of changes in state financial aid program have included a population measure for 18 to 24-year olds (e.g. Curs & Dar, 2010a; 2010b), where a relationship existed between institutional grant aid and state population of 18-to-24 year olds (Curs & Dar, 2010a). The study will incorporate a measure for the population of 18 year olds from the U.S. Census Bureau since it is focusing only on first-year students primarily enrolling after high school.

Analytic Framework

Given the quantitative nature of this study, it is important to begin the investigation with exploratory data analysis. A series of descriptive statistics will be an important first step in understanding how the dependent and independent variables vary between states, institutions, and over time. First, overall averages, standard deviations, minimums, and maximums will be presented to provide an overall picture of the data for each of the dependent and independent variables. Second, the averages will be partitioned into two time periods to collapse the pre- and post-TELS years, where results will presented juxtaposing Tennessee public four-year institutions against groups of other public four-year institutions. This comparison of pre- and post-TELS years in Tennessee and other public four-year institutions will show if any general changes occurred when Tennessee implemented the TELS program relative to other public four-year institutions. Third, a series of line graphs will be presented to show more finite changes in the

dependent variables over time. These initial exploratory data analyses will show a rough sketch of what might be occurring at Tennessee public four-year institutions and will provide a foundation for other advanced quantitative analyses.

Ordinary Least Squares (OLS) and Fixed Effects Estimation

The analytic approach continues with assessing the general associations between the institutional grant aid and a series of other institutional and state variables. This is similar to the work done by Curs and Dar (2010a; 2010b), which examine the relationship between state financial and other finance related variables to determine how they are related to institutional grant aid. As a first step on the path, ordinary least squares (OLS) estimations will be applied to the four dependent institutional grant aid variables while controlling for a series of independent variables. OLS estimation is long standing facet of education research to approximate how a series of aspects are associated with an outcome or dependent variable. The OLS estimation is represented in the follow equation:

$$y_i = \beta_0 + \boldsymbol{\beta_1 X_i} + \varepsilon_i \qquad (1)$$

where *y* represents institutional grant aid for a given institution (*i*) at a given time (*t*). Institutional grant aid will be defined as the recipient average, entire class average, and total institutional grant aid as well as number of institutional grant aid recipients. A vector of initial covariates ($\boldsymbol{X_i}$) are included to account for state appropriations, investment income, private gifts, federal grant aid, state population of 18 year olds, indicator for being governed by a board with budget authority, and indicator for states with large merit aid programs. In addition a separate OLS model will be run to include

all of the already mentioned controlling variables as well as some admissions related variables, such as test scores of enrolled students, number of applicants, admission offers, and confirmed students. The admissions variables are added in a separate iteration since IPEDS only began collecting consistent test score data in 2002, which leaves out two years of data for most institutions included in the analytic sample.

While OLS estimation is fine for a single cross-section, it is inappropriate to extend to studies where there are multiple measurements on subjects (e.g. more than one time period for each institution). A simply parameterized OLS model assumes independence of the error term, but with multiple measures on same subjects the independence of error is violated since the errors are being estimated across observations on the same institution. However, OLS can work as an estimation strategy with multiple measures on subjects if the model is parameterized to include a dummy variable or fixed effect for each subject/unit. The data compiled in this study include multiple or repeated measures on public four-year institutions from 2000 to 2013, which create a cross-sectional, time series data set or panel data set. Thus, a simple OLS estimation technique would be insufficient to analyze the data in this study given the institutions are measured for ten years. Fixed effects provide a way to account for the repeated measures on the same public four-year institutions by creating an explicit parameter for each subject in the model. This helps to ensure any time-invariant, unobserved aspects of public four-year institutions will not bias the estimates. Fixed effects can be run using OLS where dummy variables would be created and included in any models as well as clustering the errors at the unit being measured (e.g. public four-year institutions). However, panel data analysis techniques can be applied to produce similar results. Given the structure of the study,

fixed effects will be observed at either the institution or state level. The use of only institutional effects is likely best suited for this analysis since units are measured at this institutional level. The fixed equation is a slight extension of the simple regression equation list in Model 1:

$$y_{it} = \beta_0 + \beta_1 X_{it} + u_i + t_t + \varepsilon_{it} \quad (2)$$

Here, a subscript for *t* is added to all parameters to account for the institutions measured at multiple time periods. In addition, parameter u_i accounts for any unobserved time invariant aspects associated with each institution. In addition, a time effect (t_t) is added to account for any time specific shock that would affect all institutions in that given time period, such as a recession. While the fixed effect analysis in Model 2 is marketed improvement on the simple regression in Model 1, it does little to answer the research questions to determine if and how Tennessee public four-year institutions changed their institutional grant aid post-TELS. A slight extension of the fixed effects is to parameterize difference-in-differences estimation approach to explicit define a set of parameters to see how Tennessee changes their institutional grant aid strategy post-TELS.

Difference-in-Differences Estimation

Research on state policy interventions, such as the Tennessee Education Lottery Scholarship (TELS) programs, warrant a thorough quantitative analysis. In fact, Hu, Trengrove, and Zhang (2012) discuss the need for casual inferences with respect to state merit aid programs by using quasi-experimental designs to determine the average treatment effect against a counterfactual or control group. They suggest difference-in-differences as a quasi-experimental design to estimate the effects of a state implementing

a merit aid program. Difference-in-differences estimation models provide an appropriate analytic framework for investigating a single state policy change where it can be compared to a subset of the other 49 states. Applications of difference-in-differences models examining higher education policies and practices have grown in the past 20 years, but it is a technique with a longer history and more frequently usage in economics (Imbens & Wooldridge, 2008). In fact, much of the research using DID models with respect to higher education were conducted by economists (Dynarski, 2000; Long, 2004; Cornwell et al., 2006; Goodman, 2008). Within the context of state financial aid programs, many of these DID models assessed how students respond (e.g. student demand effects) to the advent of statewide merit aid programs in Georgia and Massachusetts (Dynarski, 2000; Long, 2004; Cornwell et al, 2006; Goodman, 2008). Long (2004) uses a similar difference-in-differences model as in the student demand studies, but she uses it to estimate the institutional responses to the Georgia HOPE scholarship. A few other studies related to higher education and workforce development utilized a DID estimation design (e.g. Sjoquist & Winters, 2012; Tandberg & Hillman, 2014; Tandberg, Hillman, & Gross, 2014). These prior studies using DID models provide methodological context and guidance for this study on how the TELS program may induce Tennessee public four-year institutions to change their institutional aid awards.

Given difference-in-differences (DID) estimation applications in higher education are bit more limited in prior research, a conceptual discussion of this estimation technique is warranted in this study. DID is a broad term referring to econometric models that compare a treated group(s) to a control group(s) while accounting for pre- and post-

treatment observations (Imbens & Wooldridge, 2008). The essential aspects to perform a DID model is to have at least two groups/units and two time periods, where one group was treated in the latter time period (Imbens & Wooldridge, 2008). However, DID models have numerous extensions to this basic, simple parameterization, where three or more groups and/or multiple time periods can be included in the model (Imbens & Wooldridge, 2008). The focus of DID models is on estimating the average gain or decline over time for the treated group while accounting for changes in the same outcome for a control group (Imbens & Wooldridge, 2008). In an effort to show how a DID model can take form in the context of this study, it is helpful to think about the study line of inquiry in a hypothetical example to show how DID works as an estimation strategy.

DID estimation may seem like a complex quantitative analysis, but it can easily be explained in a visual display of how institutional grant aid changes when the TELS program is implemented. Figures 3.1, 3.2, and 3.3 shows visually how a DID model works in hypothetical example that is related to this study. Figure 3.1 shows the average institutional grant aid award at Tennessee and other public four-year institutions between fiscal year 2000 and 2004. In this example, Tennessee public four-year institutions provide smaller average institutional grant aid awards than other public four-year institutions. If a prediction was generated for the average institutional grant aid in Tennessee and other public four-year institutions for fiscal year 2005-2010, it would appear as something like Figure 3.2, where both groups would increase at the same rates as in 2000-2004. However, since Tennessee implemented the TELS program taking effect for 2005, it may cause institutions to change their average institutional grant aid. Figure 3.3 shows the hypothetical observed results of average institutional grant aid after

the TELS program was implemented, which shows that Tennessee decreased its average institutional grant aid award while the other states continued to increase their average award. In particular, the institutional effects of the TELS program can be estimated by taking the control states' increase (e.g. Line XY) in institutional aid and subtract it from Tennessee's change in institutional aid allocations (e.g. Line ZB), which removes any permanent differences and time varying differences between the control states and Tennessee before the TELS program was implemented (Imbens & Wooldridge, 2008). Then a post-TELS comparison can be made between Tennessee and other states by comparing/differencing Line YZ average and Line BD average while accounting for the estimated pre-TELS difference. In this process, the Tennessee pre- and post-TELS periods can be compared as well (e.g. Line AB versus Line BD). While this provides a simplistic description of difference-in-differences estimation, it is discussed here as a primer to provide a general conceptualization, where more details on the empirical model will be explained in subsequent sections. However, first, a series of exploratory data analyses will be conducted, which help provide a conceptual and analytic foundation for more advanced quantitative methods.

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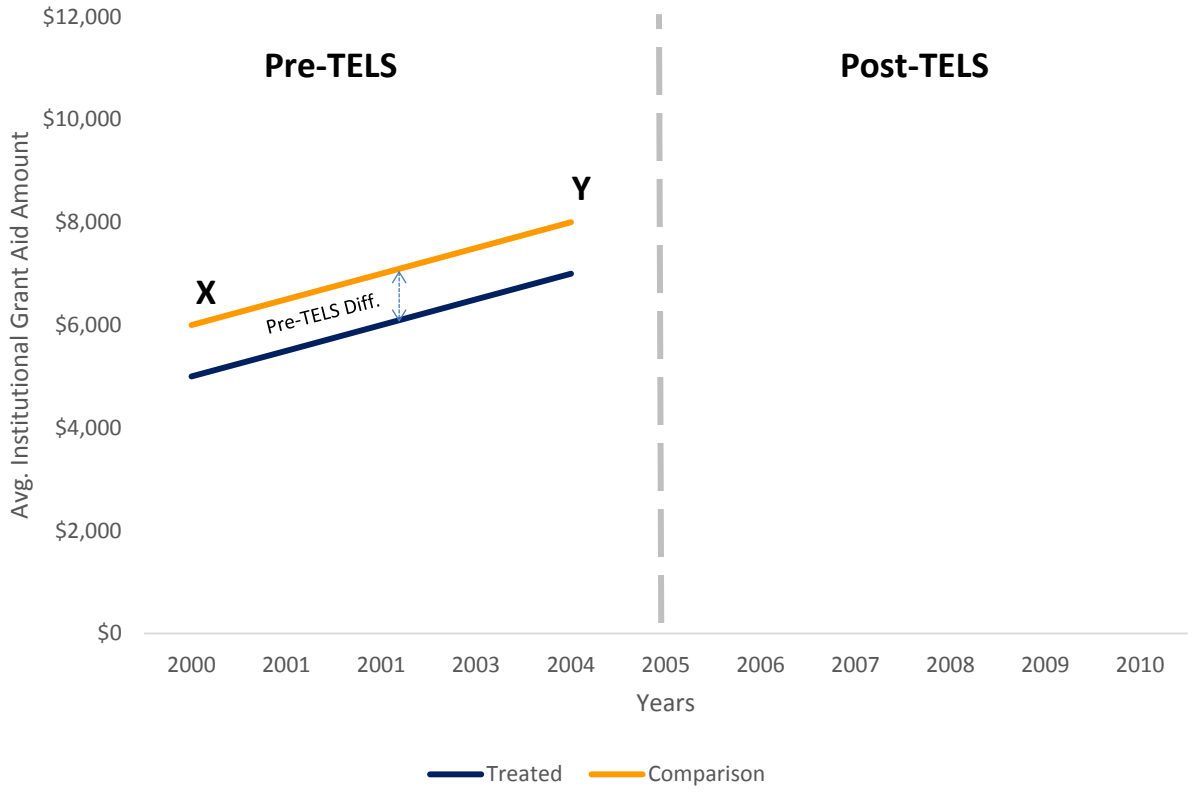

Figure 3.1. Average institutional grant aid award at Tennessee and other public four-year institutions between fiscal year 2000 and 2004.

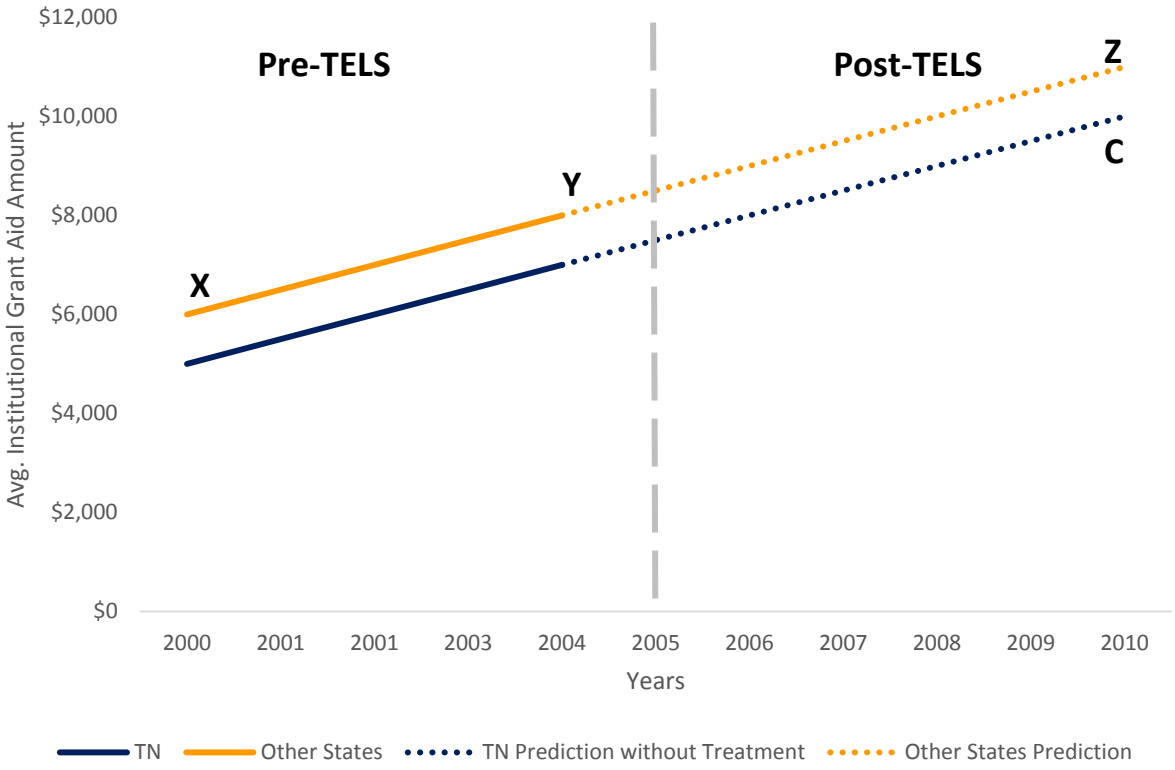

Figure 3.2. Hypothetical average institutional grant aid in Tennessee and other public four-year institutions for fiscal year 2005-2010.

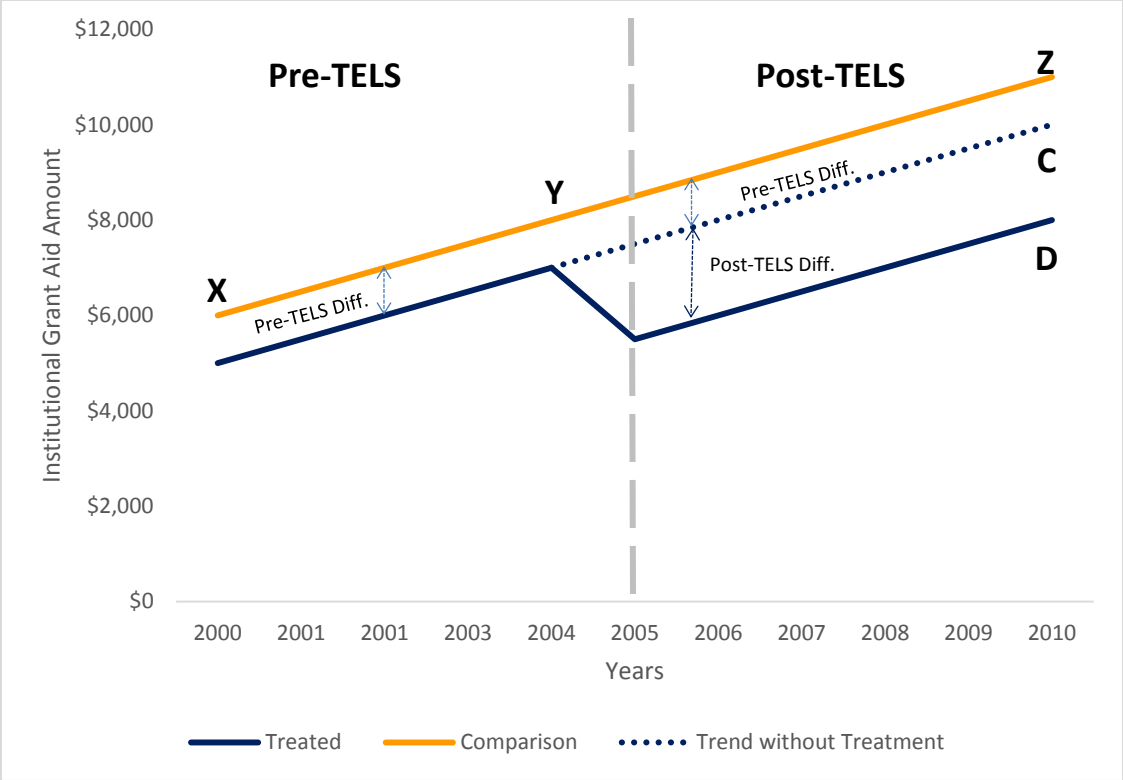

Figure 3.3. Example of difference-in-differences estimation of institutional grant aid.

A series of difference-in-differences models will be estimated to provide a more comprehensive analytic picture of how institutional grant aid at Tennessee public four-year institutions changes with the advent of the TELS program. First, a basic difference-in-differences model will be estimated to understand the institutional responses to the TELS implementation. The simple difference-in-differences model takes the following form:

$$y_{it} = \beta_1 + \beta_2\, TN_i + \beta_3\, Post_{it} + \beta_4(TN_i * Post_{it}) + u_i + t_t + \varepsilon_{it} \qquad (3)$$

where *y* represents institutional grand aid for a given institution (*i*) at a given time (*t*). Institutional grant aid will be defined as total, recipient average, and entire class average institutional grant aid as well as number of institutional grant aid recipients. Since Tennessee institutions can be observed before the TELS program, the model can account for Tennessee specific pre-TELS levels in the β_2 parameter that are distinct and additive to the other states pre-TELS levels (β_1). However, the inclusion of the fixed effect (u_i) will take the place of β_2 since they are duplicative. The change in institutional grant aid in other states after the TELS implementation is accounted for by the β_3 parameter. Here, β_4 is the parameter of interest showing the effect of the TELS program by indicating if and how Tennessee universities respond to the program after its implementation. Institutional fixed effects will be accounted for by u_i and time effect is accounted for in t_t. Standard errors are grouped at the institutional-level since this is where data are typically measured in this study. Figure 3.4 shows how this empirical equation relates to the hypothetical example depicted in the earlier Figure 3.3.

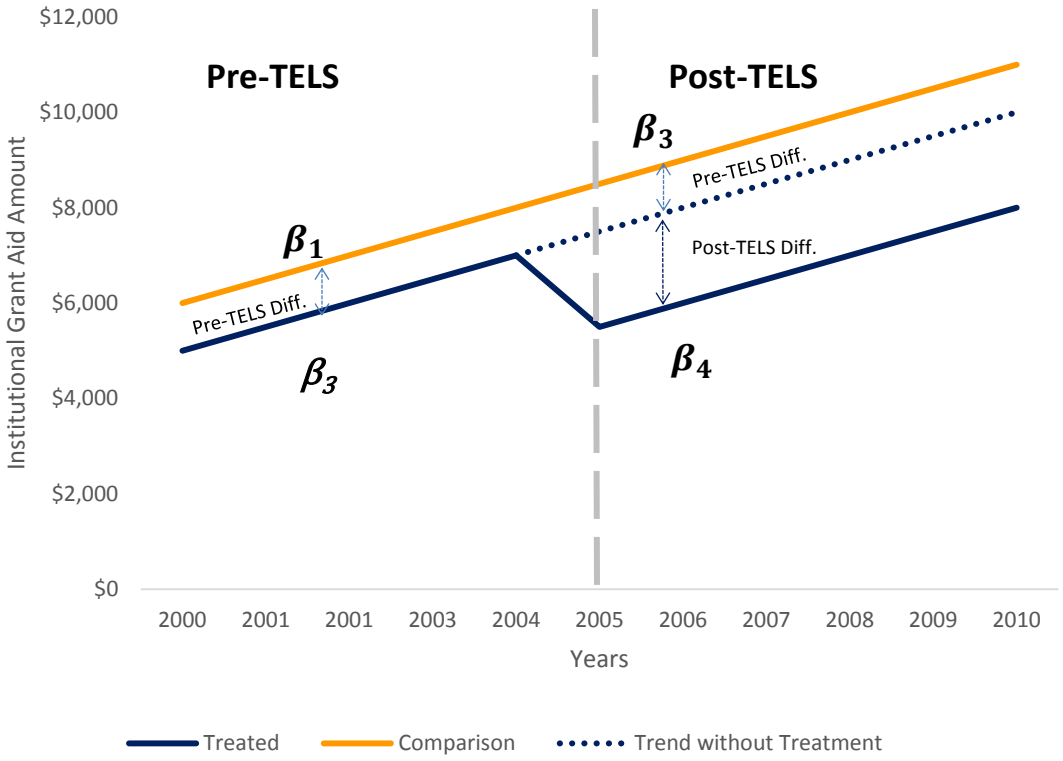

Figure 3.4. Example of difference-in-differences estimation of institutional grant aid with corresponding coefficients.

In addition, a slight extension of this difference-in-differences model is proposed to help improve the precision of the estimates. Additional covariates will be included to potentially improve the precision by reducing the standard errors, so an additional vector is added to the model:

$$y_{it} = \beta_1 + \beta_2\, TN_i + \beta_3\, Post_{it} + \beta_4(TN_i * Post_{it}) + \boldsymbol{\beta_5 X_{it}} + u_i + t_t + \varepsilon_{it} \quad (4)$$

In addition, a vector of covariates ($\boldsymbol{X_{it}}$) is included to control for institutional and state characteristics, such as state appropriations, investment income, private gifts, federal

grant aid, and population of 18-year olds. All other parameters in Model 4 are the same as Model 3.

A more flexible function of the difference-in-differences model is constructed to account for a potential lagged effect, where institutions may not respond immediately to the creation of the TELS program. In order to see if there was a delayed effect, each post-TELS year is parameterized separately to see if and when Tennessee public four-year institutions responded to the TELS program. Here a model with any additional controlling variable is represented in the following equation, but still having a separate parameter for each post-TELS year:

$$y_{it} = \beta_1 + \beta_2\, TN_i + \tau_{1\ldots5}\, Post_{i1\ldots5} + \omega_{1\ldots5}(TN_i * Post_{i1\ldots5}) + u_i + t_t + \varepsilon_{it} \quad (5)$$

Each post-TELS year for the comparison institutions in parameterized in τ_1 for the first post-TELS year (e.g. 2005) through τ_5 for the fifth post-TELS year (e.g. 2009). In addition, ω_1 accounts for the Tennessee public four-year institutions response in the first year post-TELS (e.g. 2005), where a separate parameter exist for each year post-TELS through the fifth year as ω_5 (e.g. 2009). Model 5 is replicated with the addition of other controlling variables to potentially improve precision, which is represented in equation 6:

$$y_{it} = \beta_1 + \beta_2\, TN_i + \tau_{1\ldots5}\, Post_{i1\ldots5} + \omega_{1\ldots5}(TN_i * Post_{i1\ldots5}) + \boldsymbol{\beta_5 X_{it}} + u_i + t_t + \varepsilon_{it} \quad (6)$$

Here $\boldsymbol{X_{it}}$ represents a vector of controlling variables including state appropriation, investment income, private gifts, federal grant aid, and population of 18-year olds for institution *i* in time *t*.

Alternative Comparison Groups

The identification of appropriate comparison states is important in order to ensure bias is not injected into the model. Traditional, control groups in difference-in-differences model typically rely on finite distinctions, such as states in a similar region or limited interdependency (Long, 2004). While these are important distinctions, recent studies have found that higher education governance structure to be an important aspect in determining institution revenue patterns (e.g. Knott & Payne, 2004; Nicholson-Crotty & Meier, 2003) and institutional grant aid (e.g. Curs & Dar, 2010a). Thus, a separate model will be run using the above model but limiting the comparison group of public four-year institutions to public four-year institutions with a similar higher education governance structure as in Tennessee. Specifically, a comparison group will be constructed of only institutions having a governance structure with responsibility over the institution's budget, such as the ability to change institutional grant aid allocations/expenditures. Tennessee public four-year institutions are governed by coordinating boards with budget responsibility, which is why consolidating governing boards and coordinating boards with budget responsibilities may provide a more suitable comparison group. In addition, Tennessee public institutions will be compared to other states with a merit aid program in existence well before the TELS program was created. This comparison to other states with a merit aid program is similar to Dynarski (2004), where she posited that non-merit states may differ substantively from a state that adopts a merit aid program. In the context of this study, preexisting merit aid states might be similar to Tennessee in terms of the state and institutional context but on unobservable aspects, which may provide another perspective to the effects of the TELS program.

Since preexisting merit aid states have already experienced the policy/funding shock of the merit aid program, they should have relatively consistent patterns on the variables included in this study, which will be checked as part of the analysis. Lastly, each Tennessee public four-year institution will be compared to their similar counterparts on the basis of their Carnegie Classification. For instance, doctoral extensive institutions will be compared to other doctoral extensive institutions nationally.

Robustness Checks

A series of alternative specification will be conducted to test the robustness of the results. First, a placebo test will be conducted where the above difference-in-differences models is run on only years before the implementation of the TELS program (e.g. 2000-2004). In this placebo test, an artificial treatment year will be selected at random between 2000 and 2004. This placebo test should yield non-significant differences in 2000-2004, which indicates other aspects were not influencing institutional grant aid at Tennessee public four-year institutions. Second, the difference-in-differences models will be run systematically to leave one Tennessee public institution out of the analysis to ensure that one institution wa/s not biasing the results (e.g. an outlier Tennessee public four-year institution).

Limitations

While this study conducts a series of alternative specifications to check the robustness of the results, there are some limitations with this analytic approach which can be grouped into two broad aspects: 1) study design and sample, and 2) issues with

estimation with respect to error terms. First and foremost, any other policy/practice shocks to Tennessee public institutions at the same time of the TELS implementation could bias the results and interpretation. In order for there to be a detectable casual effect associated with the TELS program, there cannot be any other substantive policy/practice changes in 2004-05 that are not related to the TELS program. For instance, it would be difficult to link changes in institutional grant aid to the TELS program if Tennessee had simultaneous cut state appropriations in a dramatic way in the same year TELS was implemented. Second, the sample size of "treated" institutions (e.g. nine Tennessee public four-year institutions) is relatively small, which may limit the statistical power to detect a difference between Tennessee and comparison public four-year institutions. Put another way, this study might not be able to find a statistical significant difference in institutional grant aid between the nine Tennessee public four-year institutions and comparison public four-year institutions due to the small sample size. Third, since institutional grant aid is measured in aggregate in IPEDS, there is not a way to measure institutional need-based and merit-based aid separately. This limits the ability to hone in on how institutions might change need-based and merit-based in different ways post-TELS.

A series of limitation in this study may develop with respect to estimating the error terms. First, given that this study is using multiple years before and after the implementation of the TELS program, it is possible that serial correlation might be biasing the standard errors in the difference-in-differences models. This study will run a series of checks on the error terms to ensure that serial correlation and heteroscedasticity does not pose a substantive issues. In particular, this study will run the Pesaran cross-

sectional dependence test to determine if serial correlation presents a problem for estimation (e.g. xtcsd in Stata). In addition, this study will investigate whether non-constant variance exists in the errors (e.g. xttest3 in Stata), which indicated whether or not heteroscedasticity presents a problem for estimation. Depending on the results of these test, different estimation strategies might need to account for all three disturbances. Prais-Winsten panel correct standard errors (PCSE), feasible generalized least squares (FGLS), and Discroll-Kraay standard errors can correct for different combinations heteroscedasticity, autocorrelation, and cross-sectional dependence. However, PSCE and FLGS require relative long panels with between 20 and 40 time periods of data to appropriated correct standard errors (Beck & Katz, 1995). Given the shorter number of time periods in this study, Driscoll-Kraay standards would be the better estimation approach if all three disturbances are present. If only autocorrelation and heteroscedasticity are present, then the standard robust standard errors are appropriate and commonly used with fewer time periods and a larger number of observations (Hoechle, 2007a). Second, given that this study suggests including numerous independent variables, it may violate some classical statistics assumptions, such as multicollinearity. Thus, this study will explore the correlations between independent variables and many need to remove any higher correlated variables. Third, as with any quantitative study, measurement error and unobserved heterogeneity can present issues that may bias the results, especially with respect to the error terms, but the presence of classical measurement error bias results toward zero. However, given the difference-in-differences design in this study, it is time varying unobserved heterogeneity that would be more concerning for interpreting the results. All additional controlling variables will be

checked to see if they vary post-TELS to ensure there are not other time varying shocks that may affect the results.

CHAPTER 4
RESULTS

Introduction

This study examines how Tennessee public four-year institutions changed institutional grant aid in four different ways as listed in the following primary research questions:

1) Did increased state merit aid funding induce Tennessee public four-year institutions to change their total expenditures on institutional grants given to first-time, full-time students when compared to similar institutions in other states?
2) Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?
3) Did increased state merit aid funding induce Tennessee public four-year institutions to change their entire class average institutional award amount for first-time, full-time students when compared to similar institutions in other states?
4) Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?

This results in the chapter are presented in way that they are meant to build on each other. All results presented in this chapter are on log-point scale which is close approximation to percentages. First, a series of descriptive statistics are discussed including some graphical representations of the dependent variable. Second, basic

statistical models showing the relationships between potential additional controlling variables the dependent variables are discussed using ordinary least squares (OLS) and fixed effect models. Third, a series of generalized difference-in-differences models are presented. Fourth, year specific indicators for each post-TELS models are added to the model to show if institutions responded differently in any given post-TELS year. Fifth, a series of additional covariates are added to these models to demonstrate any increased precision. Sixth, Tennessee institutions were compared to a series of sub-groups using the existing models. Seventh, a series of robustness checks were included to help determine the validity of the models and findings. Eighth, Tennessee institutions were compared with only the counterparts within their same Carnegie Classification. Ninth, given the multifaceted analytic approach, this chapter will conclude with a summary of the results by research question, where results will be summarized across model specifications and different comparison groups

Descriptive Statistics

A series of descriptive statistics represent information on the analytic sample of public four-year institutions across the 50 US States between 2000 and 2009. Table 4.1A shows the overall summary statistics as collected by their respective sources. All monetary values are reported in 2013 constant dollars using the Consumer Price Index (CPI-U). Appendix Table 4.1B displays the log transformation of the relevant variables. Given the nature of the research questions, it is important to review these descriptive statistics separating Tennessee public four-year institutions from all other public

institutions and reviewing pre-TELS and post-TELS summary statistics as shown in Table 4.2A and Appendix Table 4.2B.

Table 4.1A

Descriptive Statistics

	N	Mean	Stad. Dev.	Min	25th Percentile	75th Percentile	Max
Total institutional grant aid	3983	$2,697,095	$3,854,959	$0	$473,568	$3,179,006	$43,800,000
Number of institutional grant aid recipients	3983	663.4199	696.6421	0	191	890	5779
Entire class average institutional grant aid (includes non-recipients)	3983	$1,194	$1,050	$0	$463	$1,612	$11,290
Recipient average institutional grant aid (includes only recipients)	3983	$3,446	$1,894	$0	$2,141	$4,387	$16,113
State appropriations (in millions)	3939	$115.0	$122.0	$1.6	$39.3	$142.0	$872.0
Private gifts (in millions)	3963	$12.5	$30.5	-$0.3	$0.3	$9.4	$447.0
Investment income (in millions)	3963	$7.6	$67.4	-$1,970.0	$0.2	$4.3	$1,760.0
Total state grant aid	3983	$2,227,561	$3,031,582	$0	$533,859	$2,624,359	$30,000,000
Total federal grant aid	3983	$1,919,741	$1,450,491	$0	$906,724	$2,580,786	$12,800,000
Population of 18 year olds (state based calculation)	500	83,297	91,540	7,428	24,227	94,403	549,643

Notes. Analysis is for fiscal year 2000-2009 for all public four-year institutions with a Doctoral Extensive, Doctoral Intensive, or Master's College/University Carnegie Classification.

Table 4.2A

Descriptive Statistics, by State and Time

	TN Pre-TELS (2000-2004)		Other States Pre-TELS (2000-2004)		TN Post-TELS (2005-2009)		Other States Post-TELS (2005-2009)		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Total Institutional Grant Aid	$2,711,888	$669,048	$2,069,851	$63,311	$2,692,259	$357,682	$3,323,144	$104,416	$2,697,095	$61,082
Number of institutional grant aid recipients	494	87	581	14	665	83	750	18	663	11
Entire class average institutional grant aid (includes non-recipients)	$1,277	$209	$991	$20	$1,260	$79	$1,394	$26	$1,194	$17
Recipient average institutional grant aid (includes only recipients)	$4,199	$323	$3,072	$38	$4,055	$135	$3,787	$46	$3,446	$30
State appropriations (in millions)	$107.0	$16.3	$115.0	$2.8	$115.0	$19.1	$114.0	$2.7	$115.0	$1.9
Private Gifts (in millions)	$14.1	$4.3	$14.0	$0.8	$7.1	$1.9	$11.1	$0.6	$12.5	$0.5
Investment income (in millions)	$6.5	$2.5	$6.1	$0.7	$9.6	$5.7	$9.0	$2.1	$7.6	$1.1
Total state grant aid	$534,827	$60,048	$1,933,928	$62,527	$6,859,160	$668,649	$2,452,852	$71,815	$2,227,561	$48,036
Total federal grant aid	$2,166,155	$384,843	$1,708,731	$29,840	$2,336,108	$120,527	$2,115,115	$34,512	$1,919,741	$22,983
Populations of 18 year olds	77,716	156	145,359	2,921	81,514	404	153,592	3,130	147,900	2,099

Institutional Grant Aid

There are four metrics with information on institutional grant aid for first-time, full-time undergraduate students including the total institutional grant aid spent per year, number of institutional grant aid recipients, average institutional grant aid only including recipients, and average institutional grant aid including both recipients and non-recipients. During 2000-2009, the overall mean of total institutional grant aid was $2,697,095 across all public four-year institutions in the analytic sample, but values ranged from zero to $37.8 million. Before the implementation of the TELS program (2000-2004), the mean total institutional grant aid at public four-year institutions was $2,711,888 in Tennessee and $2,069,851 in all other states. After the TELS program began (2005-2009), the mean total institutional grant aid at public four-year institutions was $2,692,259 in Tennessee and $3,323,144 in all other states.

The average number of institutional grant aid recipients across public four-year institutions was 663.42 between 2000 and 2009. The range in number of institutional aid recipients spanned zero to 5,779 during this time period (2000-2009). The average number of institutional aid recipients before the TELS implementation (2000-2004) was 493.96 in Tennessee and 580.84 in other state public four-year institutions. After the TELS program was implemented (2005-2009), the average number of institutional aid recipients was 665.42 in Tennessee and 749.74 in other state public four-year institutions.

It is also helpful to examine the average institutional aid amount at each institution by averaging values over recipients only and the entire entering class, which includes recipients and non-recipients in the denominator. The recipient average of institutional aid amount was $3,446 and ranged between zero and $16,113 during 2000-

2009. In the pre-TELS time period (2000-2004), the recipient average institutional aid amount was $4,199 in Tennessee and $3,072 in other states. The post-TELS recipient average institutional aid amount was $4,055 in Tennessee and $3,787 in other states. Between 2000 and 2009, the entire class average of institutional grant aid was $1,194 with values ranging between zero and $11,290. The pre-TELS entire class average institutional aid amount was $1,277 in Tennessee and $991 in other states. The post-TELS entire class average institutional aid amount was $1,260 in Tennessee and $1,394 in other states.

Given the estimation strategy, it is important to examine the dependent variables leading up to the implementation of the TELS program and afterward. Figures 4.1-4.4 show the log-transformed dependent variables averaged across Tennessee and all other public four-year universities nationally, where the y-axis is listed in log-points. Since there are only nine Tennessee institutions, the Tennessee specific line will appear less smooth than the overall line which is averaging up to 390 public four-year institutions nationally. However, the total, entire class average and recipient average institutional grant aid demonstrate relatively parallel trend pre-TELS from 2000 to 2004 except for a slight decline in 2002. The number of institutional grant aid recipients have pre-TELS trends more closely intertwined between Tennessee and other comparison schools where they are within 0.185 log-points of each other in any given year. In addition, Mora and Reggio's (2014) DQD analysis showed that the standard difference-in-differences model would be sufficient for estimation, where alternates to the parallel path assumption or flexible models were not needed.

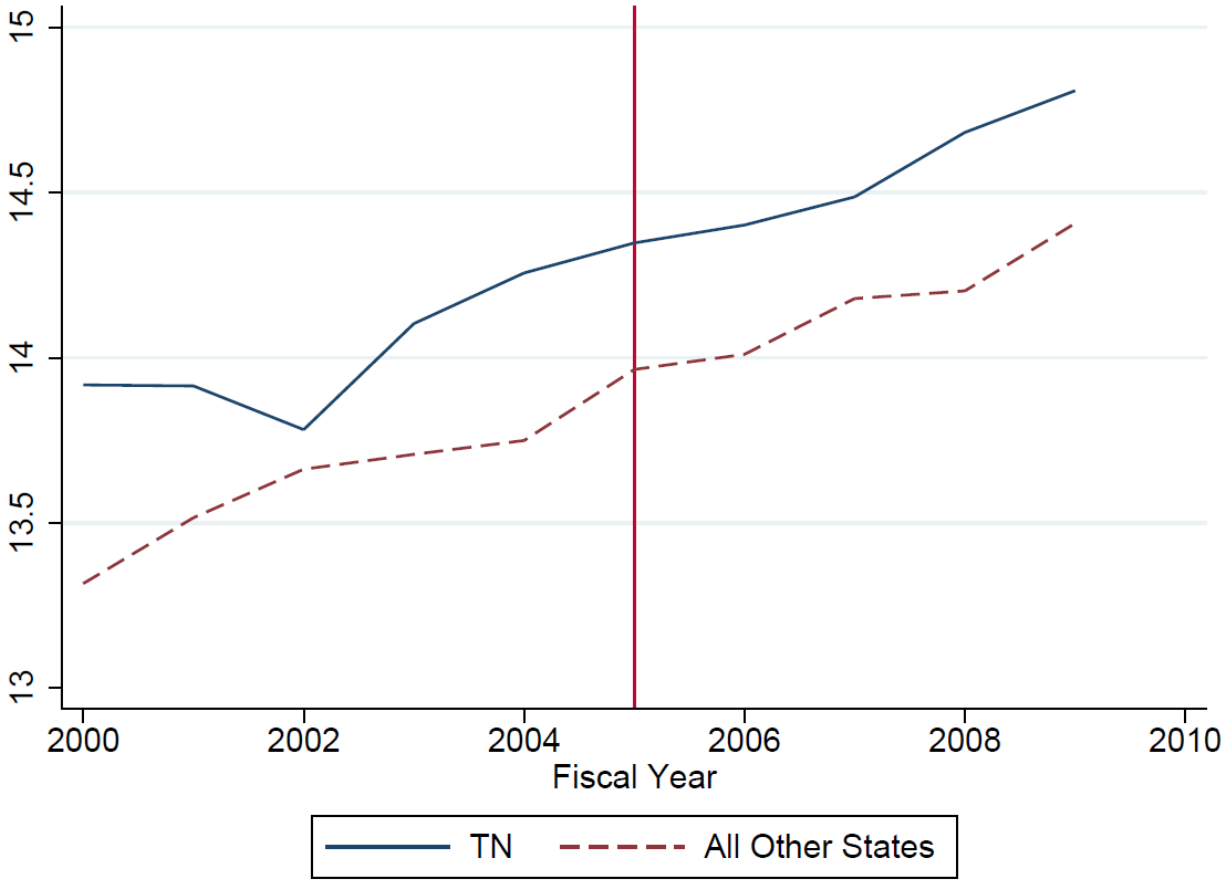

Figure 4.1. Total institutional grant aid at Tennessee and other public four-year institutions (log-transformed).

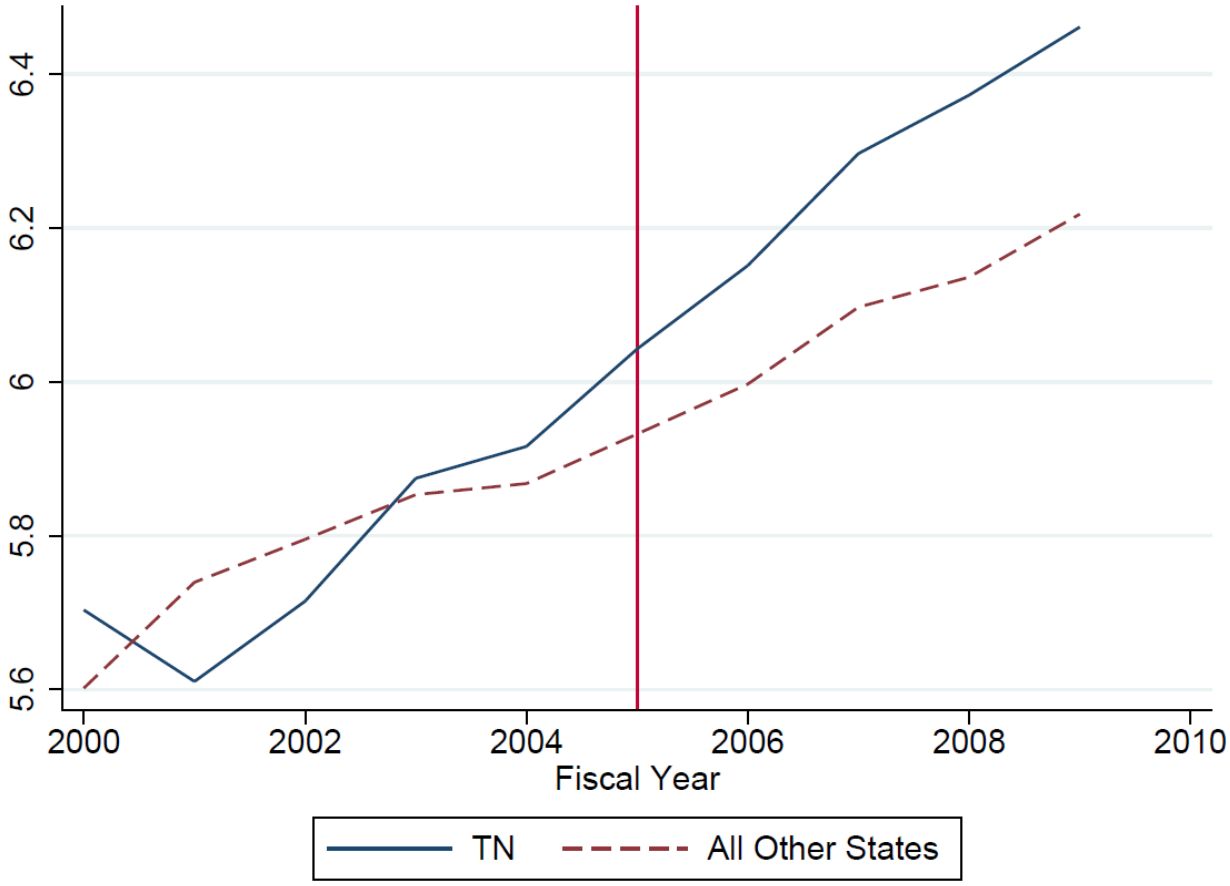

Figure 4.2. Number of institutional grant aid recipients at Tennessee and other public four-year institutions (log-transformed).

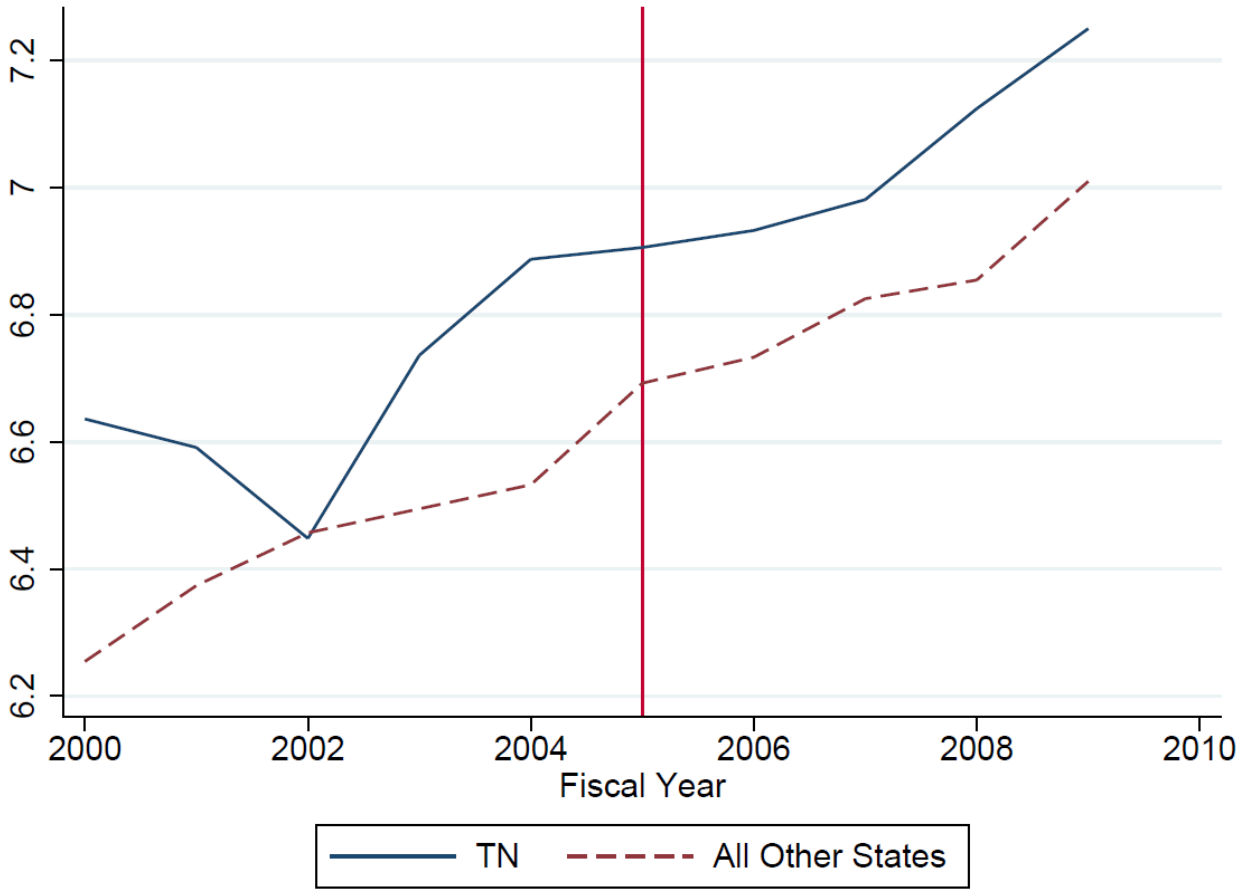

Figure 4.3. Entire class average institutional grant aid award amount at Tennessee and other public four-year institutions (log-transformed).

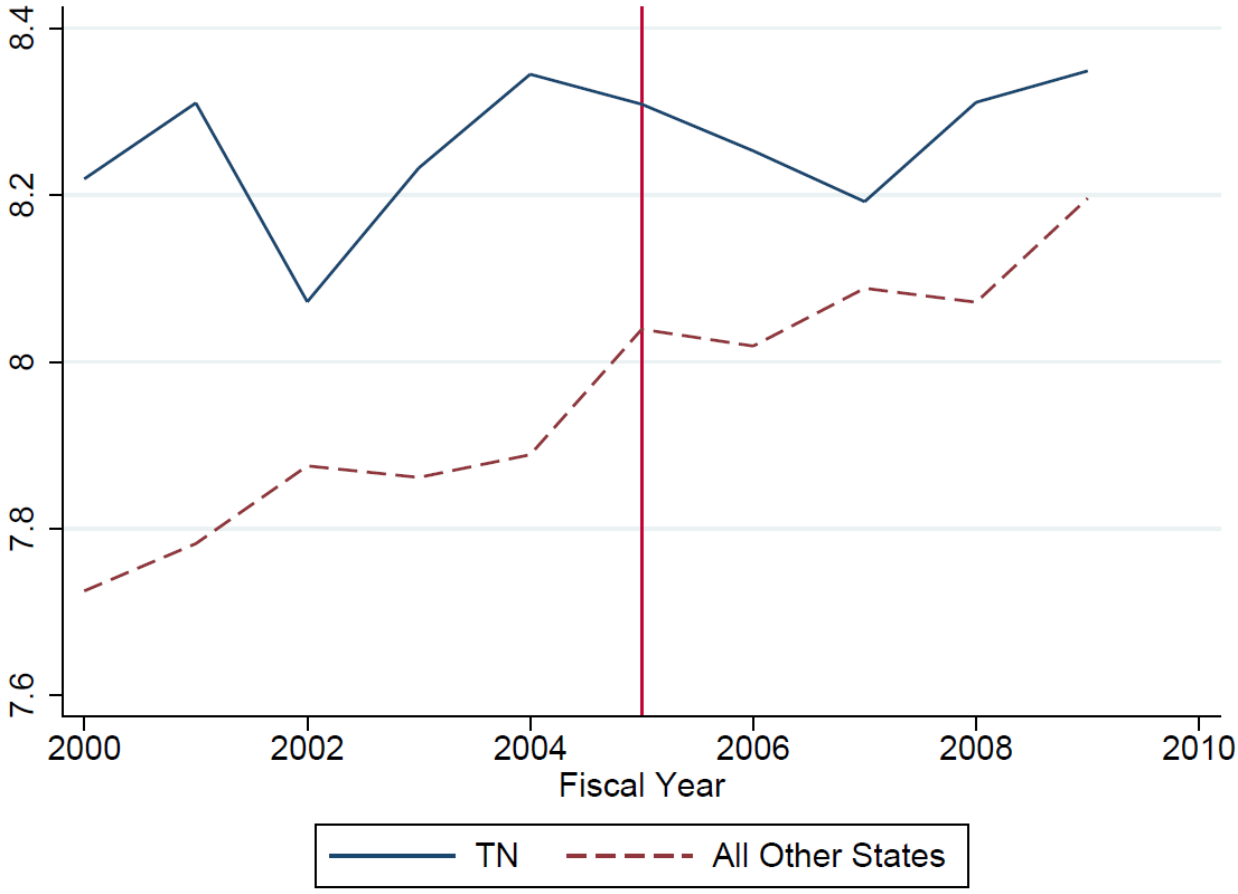

Figure 4.4. Recipient average institutional grant aid award amount at Tennessee and other public four-year institutions (log-transformed).

State Appropriations

The average state appropriation across public four-year institutions was $115 million. Since all public four-year institutions were included the range of state appropriations spanned from $1.6 million and $872 million. During the time period of this analysis, the State of Colorado changed their process of allocating funding to public institutions beginning with fiscal year 2006, which effectively eliminated state appropriations as reported in IPEDS. The state appropriation values are missing for any Colorado public institution beginning with fiscal year 2006.

Private Gifts and Investment Income

The average of private gifts across public four-year institutions was $12.5 million. However, the range of values for private gifts span from -$0.3 million to $447 million. The average investment income at public four-year institutions during 2000-2009 was $7.6 million. Investment income ranged between -$1.97 billion to $1.76 billion. IPEDS allows institutions to report both realized and unrealized losses/gains, which is why negative values can occur. The -$1.97 billion occurred during fiscal year 2009, which was the first fiscal year recorded after the recession.

Total Federal Grant Aid

The total federal grant aid as reported in IPEDS includes all federal financial aid grants given to first-time, full-time undergraduate degree-seeking students. This include Title IV financial aid, such as federal Pell grants and the Supplemental Opportunity Education Grants (SEOG) as well as any grants from other federal agencies. The average total federal grant aid at public four-year institutions was $1,919,741 between 2000 and 2009. During this time, the values ranged between $0 and $12.8 million.

Population

The average population of 18 year olds across the fifty states was 83,297 (calculated using state based data as to avoid duplication using institutional based data). Between 2000 and 2009, state population was at its lowest of 7,428 (Wyoming fiscal year 2006) and highest of 549,643 (California fiscal year 2008).

Ordinary Least Squares and Fixed Effects Estimation

A series of ordinary least squares (OLS) and fixed effects estimates were conducted on each of the dependent variables to show the relationships between the independent and dependent variables. The OLS estimates show general associations between dependent and independent variables. All results are described as percentages, but are actually log-points, which is approximately a percentage point. Table 4.3A-D shows the OLS estimates between the controlling variables and dependent variable. However, given there are multiple measures on each institution, the independence assumption is being violated, which will lead to biased results. Institutional fixed effects were included to account for the multiple measure on each institution, which will help for any unobserved aspects that do not vary over time. In addition, a time effect was included to absorb any time specific shocks that affect all institutions, such as a change in federal financial aid policy. Table 4.3A-D also displays both the fixed effects estimates.

Total Institutional Grant Aid

With respect to total institutional grant aid, the OLS estimates shows that all the independent variables are related to total institutional spending on grant aid for the first-

time, full-time entering class (See Table 4.3A). However, once fixed effects are added to the model many independent variables are not statistically significant. In the fixed effects model, increases in total state grant aid and federal grant aid independently have a positive relation with total institutional grant aid funding. A one percent increase in state grant aid corresponded to an approximate 6.7% increase in total institutional grant aid ($p<.01$). Similarly, a one percent increase in federal grant aid was associated with an approximate 59% increase in total institutional grant aid funding ($p<.01$). The addition of some admissions variables reduced the effect size and increased the standard errors of state and federal grant aid ($\beta=0.04$, $p<.05$ and $\beta=0.263$, $p<.01$, respectively), but none of the admissions variables were statistically significant at the $p<.05$ level. However, the analytic sample size was reduced by over 1,000 observations due to missing admission variables in some years and 15 fewer institutions represented in the sample, which could be influencing some of the change in effect sizes.

Table 4.3A

Total Institutional Aid using OLS and Fixed Effects

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) Fixed Effects	(5) Fixed Effects	(6) Fixed Effects
State Appropriations	0.940	0.531	0.216	0.194	0.228	0.031
	(0.034)**	(0.036)**	(0.042)**	(0.107)+	(0.101)*	(0.086)
Private Gifts	0.160	0.172	0.138	0.014	-0.000	0.020
	(0.017)**	(0.016)**	(0.015)**	(0.022)	(0.021)	(0.021)
Investment Income	-0.043	-0.033	-0.024	0.014	0.005	0.007
	(0.069)	(0.064)	(0.051)	(0.047)	(0.044)	(0.032)
Population of 18-yr-olds	-0.208	-0.306	-0.252	0.637	0.152	0.590
	(0.032)**	(0.030)**	(0.029)**	(0.523)	(0.494)	(0.533)
Board Budget Authority	0.112	0.062	-0.120			
	(0.060)+	(0.056)	(0.055)*			
Large Merit Program	-0.242	-0.344	0.052			
	(0.064)**	(0.063)**	(0.063)			
State Grant Aid Amount		0.050	-0.071		0.067	0.040
		(0.016)**	(0.019)**		(0.017)**	(0.019)*
Federal Grant Aid Amount		0.645	0.450		0.590	0.263
		(0.032)**	(0.043)**		(0.033)**	(0.040)**
Applicants			-0.099			0.029
			(0.079)			(0.101)
Admits			0.544			0.171
			(0.080)**			(0.087)+
25th Test Percentile			-1.435			0.214
			(0.402)**			(0.419)
75th Test Percentile			4.361			0.739
			(0.469)**			(0.429)+
Constant	-2.173	-3.834	-7.189	1.989	-1.696	-2.863
	(1.578)	(1.482)**	(1.463)**	(6.273)	(5.903)	(6.494)
Observations	3,939	3,939	2,895	3,939	3,939	2,895
R-squared	0.330	0.414	0.496	0.112	0.217	0.174
Institution FE				YES	YES	YES
Time Effect				YES	YES	YES

Notes.All continuous variables are log-transformed. Admissions variables not reported in IPEDS for 2000-2001. See Note in Table 4.2A for sample restrictions. Standard errors in parentheses.
** p<0.01, * p<0.05, + p<0.1

Institutional Grant Aid Recipients

In the number of institutional grant aid recipients OLS estimation, nearly all independent variables were statistically significant except for the indicators designating institutions with budget authority and states with a large merit aid program (see Table 4.3B, Column 3). However, after applying fixed effects to account for time invariant aspects associated with institutions, only a limited subset of variables still hold statistical significance. A one percent increase in total state grant aid corresponded to 3.3% increase in institutional grant recipients in the fixed effects model ($p<.01$), Table 4.3B, Column 5). A series of other variables were associated with increases in institutional grant recipients in the fixed effects model including total federal grant aid and population of 18 year olds (See Table 4.3B). The addition of some admission variables reduced the effect sizes slightly, but the only statistically significant association was with number of admitted students ($\beta=0.149$, $p<.01$, Table 4.3, Column 6).

Table 4.3B

Number of Institutional Grant Aid Recipients using OLS and Fixed Effects

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) Fixed Effects	(5) Fixed Effects	(6) Fixed Effects
State Appropriations	0.714	0.444	0.216	0.086	0.100	0.018
	(0.022)**	(0.023)**	(0.029)**	(0.059)	(0.056)+	(0.056)
Private Gifts	0.122	0.131	0.086	0.011	0.005	0.016
	(0.011)**	(0.011)**	(0.011)**	(0.012)	(0.012)	(0.014)
Investment Income	-0.013	-0.006	-0.006	0.013	0.009	0.006
	(0.045)	(0.042)	(0.036)	(0.026)	(0.025)	(0.021)
Population of 18-yr-olds	-0.138	-0.201	-0.154	1.066	0.853	0.899
	(0.020)**	(0.020)**	(0.021)**	(0.288)**	(0.277)**	(0.349)*
Board Budget Authority	0.127	0.093	-0.026			
	(0.039)**	(0.036)*	(0.039)			
Large Merit Program	-0.201	-0.266	-0.025			
	(0.042)**	(0.041)**	(0.044)			
State Grant Aid Amount		0.031	-0.041		0.033	0.017
		(0.011)**	(0.014)**		(0.009)**	(0.012)
Federal Grant Aid Amount		0.428	0.380		0.264	0.207
		(0.021)**	(0.030)**		(0.019)**	(0.026)**
Applicants			-0.453			-0.042
			(0.055)**			(0.066)
Admits			0.768			0.149
			(0.056)**			(0.057)**
25th Test Percentile			-1.015			-0.060
			(0.283)**			(0.275)
75th Test Percentile			3.141			0.309
			(0.330)**			(0.281)
Constant	-6.970	-8.084	-11.550	-8.633	-10.349	-9.985
	(1.022)**	(0.958)**	(1.031)**	(3.446)*	(3.313)**	(4.253)*
Observations	3,939	3,939	2,895	3,939	3,939	2,895
R-squared	0.404	0.482	0.553	0.123	0.193	0.156
Institution FE				YES	YES	YES
Time Effect				YES	YES	YES

Notes. Standard errors in parentheses. See Note in Table 4.3A for additional information.
** p<0.01, * p<0.05, + p<0.1

Entire Class Average Institutional Grant Aid Amount

Nearly, all independent variables were statistically significant in the OLS estimates with the entire class average as the dependent variable, where coefficients tended to follow a similar direction as prior models with total institutional grant aid amount and number of institutional grant aid recipients (See Table 4.3C). The fixed effects models with the entire class average also follow similar patterns as the other models with different dependent variables, where many of controlling variables were not statistically significant. Increases in state and federal aid were associated with increases in the average amount of institutional grant aid given to the entire entering class (β=0.044, $p<.01$ and β=0.297, $p<.01$, respectively). The addition of admission variables in the fixed effects models reduced the effect size and increased the standard errors as in other models (see Table 4.3C). The number of applications was negatively associated with entire class average institutional aid amount, where a one percent increase in applications was associated with 14.9% decrease in the entire class average institutional award amount ($p<.05$). Also, a one percent increase in the 75th test score percent was associated with 85% increase in the entire class average institutional grant award amount ($p<.01$). However, it is important to keep in mind that a one percent increase on 75th percentile is a rather large increase in the upper quartile that test scores are bounded by a high score of 36.

Table 4.3C

Entire Class Average Institutional Grant Aid using OLS and Fixed Effects

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) Fixed Effects	(5) Fixed Effects	(6) Fixed Effects
State Appropriations	0.235	0.103	0.072	0.028	0.042	-0.014
	(0.025)**	(0.029)**	(0.037)*	(0.070)	(0.067)	(0.063)
Private Gifts	0.135	0.143	0.118	0.010	0.003	0.014
	(0.013)**	(0.013)**	(0.013)**	(0.015)	(0.014)	(0.015)
Investment Income	-0.033	-0.029	-0.018	0.009	0.005	0.006
	(0.051)	(0.050)	(0.045)	(0.030)	(0.029)	(0.024)
Population of 18-yr-olds	-0.223	-0.234	-0.183	-0.323	-0.554	0.303
	(0.023)**	(0.024)**	(0.026)**	(0.341)	(0.329)+	(0.391)
Board Budget Authority	-0.037	-0.067	-0.176			
	(0.045)	(0.044)	(0.048)**			
Large Merit Program	-0.248	-0.219	-0.051			
	(0.048)**	(0.050)**	(0.055)			
State Grant Aid Amount		-0.036	-0.094		0.044	0.039
		(0.013)**	(0.017)**		(0.011)**	(0.014)**
Federal Grant Aid Amount		0.266	0.260		0.297	0.129
		(0.025)**	(0.038)**		(0.022)**	(0.029)**
Applicants			0.030			-0.149
			(0.069)			(0.074)*
Admits			-0.129			-0.104
			(0.070)+			(0.064)
25th Test Percentile			-1.722			0.167
			(0.353)**			(0.308)
75th Test Percentile			4.318			0.850
			(0.411)**			(0.314)**
Constant	3.747	2.819	-4.037	9.133	7.053	-0.534
	(1.176)**	(1.165)*	(1.284)**	(4.087)*	(3.938)+	(4.762)
Observations	3,939	3,939	2,895	3,939	3,939	2,895
R-squared	0.136	0.161	0.218	0.126	0.192	0.162
Institution FE				YES	YES	YES
Time Effect				YES	YES	YES

Notes. Standard errors in parentheses. See Note in Table 4.3A.

** p<0.01, * p<0.05, + p<0.1

Recipient Average Institutional Aid Amount

The OLS estimates using the institutional grant recipient average amount as the dependent variable were similar to other models, where nearly all variables were significant predictors except for state appropriations, investment income, the indicator for large merit aid states, and total state grant aid amount (See Table 4.3D). Here results are reported as log-points which are a close approximation for percentage change for each variable. All of the admissions related variables were significant in the OLS model except for the 25th percentile test score. However, as with before, the OLS model does not account for the time invariant unobserved aspects associated with different institutions. In the fixed effects model, only total state grant aid (β=0.034, $p<.01$), total federal grant aid (β=0.326, $p<.01$), and population of 18 year olds (β=-0.752, $p<.05$) held statistically significant relationships with the recipient average institutional grant aid. The addition of admissions variables to the fixed effect model reduced the effect size and increased the standard errors, but none of the admission variables were significantly related to the recipient average institutional grant aid (see Table 4.3D, Column 6).

Table 4.3D

Recipient Average Institutional Grant Aid using OLS and Fixed Effects

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) Fixed Effects	(5) Fixed Effects	(6) Fixed Effects
State Appropriations	0.221	0.086	0.000	0.117	0.137	0.012
	(0.018)**	(0.020)**	(0.023)	(0.067)+	(0.064)*	(0.053)
Private Gifts	0.037	0.041	0.052	0.003	-0.005	0.003
	(0.009)**	(0.009)**	(0.008)**	(0.014)	(0.013)	(0.013)
Investment Income	-0.031	-0.027	-0.018	0.001	-0.003	0.000
	(0.037)	(0.036)	(0.028)	(0.029)	(0.028)	(0.020)
Population of 18-yr-olds	-0.070	-0.103	-0.097	-0.479	-0.752	-0.306
	(0.017)**	(0.017)**	(0.016)**	(0.329)	(0.315)*	(0.329)
Board Budget Authority	-0.018	-0.034	-0.094			
	(0.032)	(0.031)	(0.030)**			
Large Merit Program	-0.039	-0.076	0.078			
	(0.034)	(0.035)*	(0.034)*			
State Grant Aid Amount		0.020	-0.030		0.034	0.022
		(0.009)*	(0.010)**		(0.011)**	(0.011)+
Federal Grant Aid Amount		0.211	0.066		0.326	0.052
		(0.018)**	(0.024)**		(0.021)**	(0.025)*
Application			0.359			0.069
			(0.043)**			(0.062)
Admits			-0.230			0.017
			(0.043)**			(0.054)
25th Test Percentile			-0.412			0.281
			(0.219)+			(0.259)
75th Test Percentile			1.196			0.430
			(0.255)**			(0.264)
Constant	4.891	4.361	4.466	11.058	9.088	7.214
	(0.841)**	(0.824)**	(0.797)**	(3.940)**	(3.766)*	(4.004)+
Observations	3,939	3,939	2,895	3,939	3,939	2,895
R-squared	0.136	0.161	0.218	0.126	0.192	0.162
Institution FE				YES	YES	YES
Time Effect				YES	YES	YES

Notes. Standard errors in parentheses.
See Note in Table 4.3A.
** p<0.01, * p<0.05, + p<0.1

Multicollinearity Checks on Independent Variables

A series of analysis were conducted to assess the correlation of independent variables. As part of the OLS estimates, variance inflation factors (VIF) were

investigated to determine the potential presence of multicollinearity. The number of applications and admitted students were the two independent variables with the highest VIFs (12.14 and 11.07, respectively). The 25th and 75th percentile test scores are also relatively high VIFs (6.52 and 6.09, respectively). State appropriations and total federal grant aid were somewhat high but within an acceptable range (VIF 3.44 and 2.93, respectively), but in models without admissions variables these VIF drop where the VIF is 2.25 for state appropriations and 1.80 for total federal grant aid. The higher levels of VIFs for the admissions related variables suggest that some should be dropped given their higher association with other variables in the model. In addition, the independent variables were checked to see if there were any Tennessee specific changes pre- and post-TELS, but there were not any statistically significant results (see Appendix Table 4.3 and 4.4).

While these OLS and fixed effects model show some general associations between dependent and independent variables, they do not address the research questions in this study. In order to determine how Tennessee public four-year institutions changed their institutional grant aid after the TELS program was created a slightly different parameterization was needed to explicitly call out Tennessee in statistical models. A difference-in-differences estimation is an approach to explicitly parameterize Tennessee pre- and post-TELS while incorporating fixed effects as in these general associations.

Difference-in-Differences Estimation

A series of basic difference-in-difference estimations were conducted using a basic parametrization. These initial models include a dichotomous variable for

Tennessee public four-year institutions, a dichotomous variable for any post-TELS time period (e.g. 2005-2009), and the interaction of these two dichotomous variables to separately identify the unique effect at Tennessee public four-year institutions after the TELS program was implemented. These indicators are how Tennessee can be explicitly parameterized in statistical models changes in the pre- and post-TELS behavior. The first set of runs on these basic models include an institutional fixed effect and time effect. A separate model was run for each of the dependent variables: total institutional grant aid, number of institutional grant aid recipients, recipient average grant aid amount, and entire class average grant aid amount.

Results of the basic DID models are reported in Table 4.4 as log-points given the log transformation of dependent and independent variables. Log-points can be interpreted as an approximation for percentage-point change. The log-points will be discussed as an approximate percentages in text. After the TELS program was implemented, Tennessee public four-year institutions decreased the total institutional grant aid by 1.4% relative to other public four-year institutions, but the results were not statistically significant. In fact, the standard errors around this parameter were rather larger (0.205) relative to the effect size, which indicated there is some variation going on within Tennessee public four-year institution post-TELS. There was not a statistically significant effect post-TELS for Tennessee public four-year institutions in both the number of grant aid recipients and entire class average institutional aid amount. Tennessee public four-year institutions showed 19.4% increase in the number of institutional grant recipients ($p<.10$) and 2.1% decrease in the entire class average institutional grant aid amount post-TELS (n.s.). The Tennessee public four-year

institutions response to post-TELS with respect to the recipient average institutional grant aid amount but again the result was not significant. Tennessee public four-year institutions reduced their average award amount to recipients by 20.9% relative to other public institutions (n.s.).

After running these basic DID models, they were checked for autocorrelation, cross-sectional dependence, and heteroskedasticity. All of the basic DID models had the presence of autocorrelation and heteroskedasticity present based on the Lagram-Multiplier test for autocorrelation correlation and a heteroskedasticity test. Cross-section dependence was present in all of basic DID models except for the recipient average institutional grant aid amount. Given these identified issues, the models were run using Driscoll-Kraay estimator to account for autocorrelation, heteroscedasticity, and cross-sectional dependence (when present in the analysis). Other correction methods exist to handle these types of disturbance, such as panel corrected standard errors (PCSE) and feasible generalized least squares estimation, but both these methods require panels with more time periods (Beck and Katz, 1995). A series of simulations by Beck and Katz (1995) suggest that at least 20 or more time periods are needed to ensure that error corrections yield more accurate estimates. Hoechle (2007b) indicated that Driscoll-Kraay standard errors can be less than half the size of cluster-robust standard errors (e.g. standard errors correcting for heteroscedasticity and autocorrelation), but expressed some caution when the standard errors get to small. However, it should be noted that even the Driscoll-Kraay estimator is dependent on a larger number of time periods. Thus, both the Driscoll-Kraay and robust standard errors will be presented, where the estimates using robust standard errors will be more conservative than the estimates using the Driscoll-

Kraay standard errors (Hoechle, 2007b). Cross sectional dependence was not present in the recipient average so robust standard errors should be sufficient to account for heteroskedasticity and autocorrelation (Hoechle, 2007a). Table 4.4 displays the results of the basic DID models with regular standard errors and robust standard errors.

The results with corrected standard errors do not change dramatically. In general, the post-TELS coefficients change slightly and the standard errors get more efficient. For total institutional grant, the post-TELS effect in Tennessee remains negative but is still not statistically significant (β=0.014, n.s.). After accounting for the disturbances in the data to produce Driscoll-Kraay standard errors, there was an 19.5% increase in the number of institutional grant aid recipients at Tennessee public four-year institutions relative to other four-year institutions during the same time period ($p<.01$), but the standard errors are likely too efficient since they reduce two-thirds the size. The post-TELS Tennessee public four-year institutions recipient average institutional grant award amount remained the same but with slightly smaller errors (β=-0.209, $p<.05$). The post-TELS entire class average institutional grant aid fluctuated some but was still not significant (β=-0.021, ns). These basic models are generalizing the institutional response over five separate post-TELS, where an institutions response might vary from year-to-year.

Table 4.4

Basic Difference-in-Differences Specification for each Institutional Grant Aid Variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Total	Total	Total	Number	Number	Number	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN * Post	-0.014	-0.014	-0.014	0.194	0.194	0.195	-0.021	-0.021	-0.021	-0.209	-0.209
	(0.205)	(0.224)	(0.080)	(0.113)+	(0.126)	(0.048)**	(0.134)	(0.225)	(0.068)	(0.128)	(0.106)*
Post	1.081	1.081	0.564	0.613	0.613	0.307	0.748	0.748	0.400	0.465	0.465
	(0.068)**	(0.084)**	(0.126)**	(0.038)**	(0.046)**	(0.081)**	(0.045)**	(0.054)**	(0.084)**	(0.043)**	(0.053)**
Constant	13.332	13.332	13.599	5.604	5.604	5.771	6.267	6.267	6.428	7.738	7.738
	(0.048)**	(0.071)**	(0.088)**	(0.027)**	(0.036)**	(0.054)**	(0.032)**	(0.044)**	(0.054)**	(0.030)**	(0.045)**
Observations	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983
R-squared	0.112	0.112		0.119	0.119		0.125	0.125		0.057	0.057
Number of unitid	399	399	399	399	399	399	399	399	399	399	399
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
ROBUST SE		YES			YES			YES			YES
Driscoll-Kraay SE			YES			YES			YES		

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Year Specific Effects Post-TELS

Instead of grouping all post-TELS years together, a series of models show changes in institutional grant separately for each post-TELS year. Similar to before, the models were checked for autocorrelation, heteroskedasticity, and cross-sectional dependence, where results were consistent with the prior tests suggesting corrections are needed for each dependent variables model. Thus, the total institutional grant aid, number of institutional grant recipients, and entire class average models are reported using Driscoll-Kraay standard errors. As before, the recipient average institutional grant aid is reported with standard errors robust to heteroskedasticity and autocorrelation. Results for the fixed effects and corrected standard errors are reported in Table 4.5, which show the changes in the institutional grant aid dependent variables in each post-TELS years. Total institutional grant aid did not present any statistically significant differences in Tennessee public institutions for any of the post-TELS years. However, the effect in the first through third year and fifth year post-TELS was consistently negative, but not significant. The results for the fourth year post-TELS suggested that Tennessee public four-year institutions increased total institutional grant aid the fourth and fifth year post-TELS, but these results were also not significant.

The number of institutional grant aid recipients models presents some significant results post-TELS, where Tennessee public four-year institutions experience changes in the number of recipients for specific post-TELS years. The fixed effect model suggests that the number of institutional grant aid recipients increased at Tennessee public four-year institutions in each year post-TELS, but these results were not statistically significant. After correcting for autocorrelation, cross-sectional dependence, and

heteroscedasticity, the Discroll-Kraay standard errors are more efficient and produce statistically significant effects post-TELS at Tennessee public four-year institutions in each post-TELS year. With respect to number of institutional grant aid recipients, Tennessee public four-year institutions experienced a 11.4% increase in the first year ($p<.05$), 15.8% increase in the second year ($p<.01$), 20.4% increase in the third year ($p<.01$), 24.5% increase in the four year ($p<.01$), and 25.1% increase in the fifth year ($p<.01$) relative to public four-year institutions in other states for each year (see column 6 in Table 4.5).

Tennessee public four-year institutions had a lower recipient average institutional grant aid in every year post-TELS, but the third and fifth years after the TELS implementation were statistically significant. In the third year Post-TELS (2007-08), the Tennessee public four-year institution recipient average institutional grant aid amount was 30.6% lower than public institutions in other states for that same year ($p<.05$). Also, in the fifth year Post-TELS (2009-10), the Tennessee public four-year institution recipient average institutional grant amount was 25.5% lower public institutions in other states ($p<.05$). The models suggest that Tennessee public four-year institution had lower institutional grant aid recipient averages in other post-TELS years relative to non-Tennessee public institutions, but no other year produced a statistically significant result. This suggests that much of difference in recipient average institutional aid amounts from the pooled year DID model discussed earlier (see Table 4.4) is driven by the difference in the third and fifth years. The models using the entire class average did not present any significant results as before, but Tennessee post-TELS years one through three were negative and post-TELS years four and five were positive (see Table 4.5).

For some of these models specifications, the standard errors are still relatively large, which suggest this some variation within these estimate that could benefit for different model parameterization. The inclusion of additional controlling variable could potential help with improving precision, which will be explored in the next section. Also, model precision might be improve when the sample is segmented by Carnegie Classification, which will be examined in subsequent sections.

Table 4.5

Post-Years Difference-in-Differences Specification for Each Institutional Grant Aid Variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Total	Total	Total	Number	Number	Number	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN*Post Yr1	-0.022	-0.022	-0.022	0.114	0.114	0.114	-0.019	-0.019	-0.018	-0.136	-0.136
	(0.344)	(0.268)	(0.076)	(0.197)	(0.231)	(0.036)*	(0.225)	(0.250)	(0.064)	(0.211)	(0.105)
TN*Post Yr2	-0.015	-0.015	-0.014	0.158	0.158	0.158	-0.033	-0.033	-0.033	-0.172	-0.172
	(0.344)	(0.205)	(0.076)	(0.197)	(0.113)	(0.036)**	(0.225)	(0.205)	(0.064)	(0.211)	(0.102)+
TN*Post Yr3	-0.097	-0.097	-0.096	0.203	0.203	0.204	-0.075	-0.075	-0.075	-0.301	-0.301
	(0.344)	(0.246)	(0.076)	(0.197)	(0.133)	(0.036)**	(0.225)	(0.245)	(0.064)	(0.211)	(0.124)*
TN*Post Yr4	0.081	0.081	0.081	0.245	0.245	0.245	0.038	0.038	0.039	-0.164	-0.164
	(0.344)	(0.247)	(0.074)	(0.197)	(0.152)	(0.035)**	(0.225)	(0.259)	(0.064)	(0.211)	(0.122)
TN*Post Yr5	0.004	0.004	0.004	0.251	0.251	0.251	0.010	0.010	0.010	-0.250	-0.250
	(0.344)	(0.232)	(0.074)	(0.197)	(0.129)+	(0.035)**	(0.225)	(0.248)	(0.064)	(0.211)	(0.121)*
Constant	12.717	12.717	13.080	5.604	5.604	5.771	5.656	5.656	5.912	7.123	7.123
	(0.047)**	(0.069)**	(0.122)**	(0.027)**	(0.036)**	(0.054)**	(0.031)**	(0.041)**	(0.087)**	(0.029)**	(0.042)**
Observations	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983	3,983
R-squared	0.224	0.224		0.119	0.119		0.298	0.298		0.223	0.223
Number of uni	399	399	399	399	399	399	399	399	399	399	399
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE		YES			YES			YES			YES
Driscoll-Kraay SE			YES			YES			YES		

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

DID Models Including Additional Controlling Variables

Total Institutional Grant Aid with Controlling Variables

The addition of controlling variables to the basic DID model does not change the results in any substantive manner. The results show a slight down turn in total institutional grant aid after the TELS program was implemented, but as before, this is not a statistically significant effect (See Table 4.6A). In fact, the addition of the controlling variables do not increase the precision of the model, but instead increase the size of the standard errors across specifications using the Discroll-Kraay estimator. Federal grant aid was positively associated with total institutional grant aid (β=0.669, $p<.01$, respectively). As before, these model repeated but using a parameterizing where each post-TELS has its own indicator (Appendix Table 4.6B). The inclusion of the additional controlling variables increased the Discroll-Kraay standard errors suggesting the additional covariates do not provide greater precisions to the models. Here it appears Tennessee public four-year institutions lowered their total institutional grant aid in the third year post-TELS by 23.4% ($p<.01$). All other post-TELS year coefficients where negative, but not statistically significant. With the additional controlling variables, investment income and total federal grant aid were positively associated with total institutions grant aid (β=0.007, $p<.05$ and β=0.662, $p<.01$).

Table 4.6A

Total Institutional Gift Aid Difference-in-Differences with Additional Controlling Variables

	(1) Total	(2) Total	(3) Total	(4) Total
TN*Post-TELS	-0.014	-0.014	-0.099	-0.109
	(0.224)	(0.080)	(0.180)	(0.089)
Post-TELS	1.081	0.564	0.604	0.368
	(0.084)**	(0.126)**	(0.143)**	(0.060)**
State Appropriations			0.255	0.257
			(0.180)	(0.218)
Private Gifts			-0.002	-0.019
			(0.028)	(0.011)
Investment Income			0.007	0.002
			(0.003)*	(0.003)
Federal Grant Aid			0.646	0.669
			(0.155)**	(0.163)**
Population of 18-yr-olds			0.012	0.517
			(0.891)	(0.837)
Constant	13.332	13.599	-0.455	-6.167
	(0.071)**	(0.088)**	(10.040)	(6.579)
Observations	3,983	3,983	3,938	3,938
Institution FE	YES	YES	YES	YES
Time Effect	YES		YES	
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Notes. Sample identify on pages 57-62. Continuous variables are log transformed. Time effect included in robust standard error specification. Time effect is not included in the Driscoll-Kraay specification since error corrections use time lags. Robust standard errors are identified in the table.
** p<0.01, * p<0.05, + p<0.1

Number of Institutional Grant Aid Recipients with Controlling Variables

The inclusion of controlling variables for state appropriation, investment income, private gifts, federal grant aid, and population of 18-year olds reduced the effect sizes any post-TELS response at Tennessee public four-year institution while at the same time decreases the standard errors (See Table 4.7A). However, the coefficients from models with and without additional covariates are still within a single standard deviation of each other suggesting that changes are negligible. Tennessee public four-year institutions

increased the number of institutional grant aid recipients by 14.3% post-TELS when compared with all other public four-year schools nationwide ($p<.01$, see Table 4.7A, column 4). Here federal grant aid, and state population of 18-year-olds were statistically significant and positively related to the number institutional grant aid recipients (see Table 4.7A for results).

The addition of the controlling variables did increase the precision in the models that looked at each Post-TELS year separately. The standard errors in the Discroll-Kraay standard errors shrunk very slightly. Appendix Table 4.7B reports results for the number or recipients with the post-TELS years listed separately. Tennessee public four-year institutions experienced 8% increase in the first-year ($p<.05$), 15.9% increase in the second year ($p<.01$), 12.8% increase in the third year ($p<.01$), 16.1% increase in the fourth year ($p<.01$), and 19.9% increase in the fifth year ($p<.01$) relative to public institutions in other states. In addition, investment income, federal grant aid, and state population of 18-year-olds had a positive association with the number of institutional grant aid recipients ($\beta=0.01$, $p<.05$; $\beta=0.304$, $p<.01$; and $\beta=0.879$, $p<.01$, respectively).

Table 4.7A

Number of Institutional Grant Aid Recipients Difference-in-Differences with Additional Controlling Variables

	(1) Number	(2) Number	(3) Number	(4) Number
TN*Post-TELS	0.194	0.195	0.151	0.143
	(0.126)	(0.048)**	(0.110)	(0.037)**
Post-TELS	0.613	0.307	0.350	0.179
	(0.046)**	(0.081)**	(0.072)**	(0.043)**
State Appropriations			0.111	0.114
			(0.082)	(0.088)
Private Gifts			0.004	-0.011
			(0.016)	(0.009)
Investment Income			0.009	0.007
			(0.002)**	(0.003)+
Federal Grant Aid			0.290	0.308
			(0.065)**	(0.057)**
Population of 18-yr-olds			0.774	1.185
			(0.491)	(0.355)**
Constant	5.604	5.771	-9.578	-14.230
	(0.036)**	(0.054)**	(5.538)+	(3.892)**
Observations	3,983	3,983	3,938	3,938
Institution FE	YES	YES	YES	YES
Time Effect	YES		YES	
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Notes. Robust standard errors are identified in the table. See Table 4.6A for additional information
** p<0.01, * p<0.05, + p<0.1

Entire Class Average with Controlling Variables

The results of the entire class average institutional grant aid amount did not change substantially with the addition of time variant controlling variables. The standard errors on the Post-TELS response at Tennessee public four-year institutions increased with the inclusion of the other controlling variables and remain relative larger in relation to the coefficient. Thus, the post-TELS Tennessee response remains statistically insignificant and negative (see Table 4.8A). Similarly, when looking at the post-TELS

years separately, there is not any post-TELS years that provides a statistically significant result (see Appendix Table 4.8B).

Table 4.8A

Entire Class Average Institutional Grant Aid Difference-in-Differences with Additional Controlling Variables

	(1) Entire Class Avg.	(2) Entire Class Avg.	(3) Entire Class Avg.	(4) Entire Class Avg.
TN*Post-TELS	-0.021	-0.021	-0.057	-0.067
	(0.225)	(0.068)	(0.200)	(0.069)
Post-TELS	0.748	0.400	0.540	0.301
	(0.054)**	(0.084)**	(0.083)**	(0.055)**
State Appropriations			0.059	0.062
			(0.090)	(0.078)
Private Gifts			0.001	-0.011
			(0.018)	(0.009)
Investment Income			0.006	-0.001
			(0.002)**	(0.004)
Federal Grant Aid			0.333	0.358
			(0.082)**	(0.094)**
Population of 18-yr-olds			-0.646	0.093
			(0.523)	(0.674)
Constant	6.267	6.428	7.892	-0.616
	(0.044)**	(0.054)**	(6.012)	(6.251)
Observations	3,983	3,983	3,938	3,938
Number of institutions	399	399	399	399
Institution FE	YES	YES	YES	YES
Time Effect	YES		YES	
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Notes. Robust standard errors are identified in the table. See Table 4.6A for additional information
** p<0.01, * p<0.05, + p<0.1

Recipient Average with Controlling Variables

The addition of controlling variables again did not change the results dramatically (See Table 4.9A). The inclusion of the other controlling variables—state appropriations, private gifts, investment income, total federal grant aid, and population of 18 year olds—

increased the precision of the estimates by reducing the robust standard errors slightly. When including these additional controlling variables, Tennessee public four-year institutions decreased the recipient average institutional grant aid amount by 25% after the TELS program was created ($p<.01$). In this model, total federal grant aid was positively associated with the recipient average institutional grant aid amount ($\beta=0.335$, $p<.01$).

In reviewing the post-TELS years separately, the additional controlling variables improved the precision of the estimates (See Appendix Table 4.9B). Tennessee public four-year institutions reduced the recipient average institution award by 19.7% in the first year ($p<.05$), 17.8% in the second year ($p<.10$), 36.2% in the third year ($p<.01$), 24.3% in the fourth year ($p<.01$), and 27.2% in the fifth year post-TELS. These coefficients are essentially the same as the model without additional covariates, but the inclusion of the additional covariates increased the precision of the estimates. Federal grant aid was positively associated with the recipient average institutional grant aid amount ($\beta=0.355$, $p<.01$).

Table 4.9A

Recipient Average Institutional Grant Aid Difference-in-Differences with Additional Controlling Variables

	(1) Recipient Avg.	(2) Recipient Avg.	(3) Recipient Avg.	(4) Recipient Avg.
TN*Post-TELS	-0.209	-0.209	-0.250	-0.250
	(0.128)	(0.106)*	(0.123)*	(0.077)**
Post-TELS	0.465	0.465	0.254	0.254
	(0.043)**	(0.053)**	(0.049)**	(0.084)**
State Appropriations			0.153	0.153
			(0.064)*	(0.124)
Private Gifts			-0.006	-0.006
			(0.013)	(0.018)
Investment Income			-0.003	-0.003
			(0.028)	(0.002)
Federal Grant Aid			0.355	0.355
			(0.019)**	(0.098)**
Population of 18-yr-olds			-0.813	-0.813
			(0.315)**	(0.512)
Constant	7.738	7.738	9.559	9.559
	(0.030)**	(0.045)**	(3.764)*	(6.155)
Observations	3,983	3,983	3,938	3,938
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Robust SE		YES		YES

Notes. Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Different Comparison Groups

Three comparison groups were incorporated to identify a more finite set of comparison public institutions that have a similar state context as Tennessee with respect to budget authority and presence of large existing merit aid program. First, Tennessee public four-year institutions were compared with only other public institutions where a state-wide board had budget authority. Second, Tennessee public four-year institutions were compared to states that had a pre-existing large merit aid program given Dynarski's

(2004) suggestion that states with merit aid programs are likely similar on many respects. Third, Tennessee public four-year institutions were compared to other public institutions where states that had a large merit aid program and had budget authority at the board level. Throughout all the models up until now, the three dependent variables that showed some potential response post-TELS at Tennessee public four-year institutions were the total amount of institutional grant aid, number of recipients, and recipient average. More focus and discussion will be directed at these three dependent variables, but all are present from the basic models in Tables 4.10A-4.13A and post-years models in Appendix Tables 4.10B-4.13B. The findings for the entire class average are reported in Table 4.12A and Appendix Table 4.12B, but none of the results were significant as before, so they will not be discussed below.

Table 4.10A

Basic Difference-in-Differences Comparsion Groups: Total Institutional Grant Aid

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Total	Total	Total	Total	Total	Total
TN*Post-TELS	-0.014	-0.109	0.031	-0.053	0.009	-0.033	-0.029	-0.065
	(0.080)	(0.089)	(0.051)	(0.048)	(0.099)	(0.073)	(0.087)	(0.072)
Post-TELS	0.564	0.368	0.520	0.374	0.541	0.436	0.579	0.512
	(0.126)**	(0.060)**	(0.130)**	(0.089)**	(0.142)**	(0.124)**	(0.149)**	(0.164)*
State Appropriations		0.257		0.043		0.442		0.491
		(0.218)		(0.085)		(0.244)		(0.205)*
Private Gifts		-0.019		-0.027		-0.081		-0.087
		(0.011)		(0.025)		(0.026)*		(0.032)*
Investment Income		0.002		0.222		-2.546		-2.417
		(0.003)		(0.315)		(1.149)+		(1.395)
Federal Grant Aid		0.669		0.551		0.440		0.365
		(0.163)**		(0.078)**		(0.088)**		(0.082)**
Population of 18-yr-olds		0.517		0.192		-1.297		-1.717
		(0.837)		(0.922)		(1.129)		(1.526)
Constant	13.599	-6.167	13.646	-1.344	13.419	69.550	13.472	72.063
	(0.088)**	(6.579)	(0.078)**	(14.867)	(0.116)**	(34.353)+	(0.112)**	(45.026)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of Institutions	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority Comparison			YES	YES			YES	YES
Strong Merit Comparison					YES	YES	YES	YES

Notes. Robust standard errors are identified in the table. See Table 4.6A for additional information.

** p<0.01, * p<0.05, + p<0.1

Table 4.11A

Basic Difference-in-Differences Comparison Groups: Number of Institutional Grant Aid Recipients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Number	Number	Number	Number	Number	Number	Number	Number
TN*Post-TELS	0.195	0.143	0.191	0.113	0.218	0.195	0.221	0.195
	(0.048)**	(0.037)**	(0.036)**	(0.023)**	(0.066)**	(0.059)**	(0.062)**	(0.058)**
Post-TELS	0.307	0.179	0.310	0.197	0.283	0.168	0.280	0.199
	(0.081)**	(0.043)**	(0.083)**	(0.048)**	(0.067)**	(0.038)**	(0.068)**	(0.059)**
State Appropriations		0.114		0.032		0.457		0.374
		(0.088)		(0.045)		(0.165)*		(0.125)*
Private Gifts		-0.011		-0.031		-0.044		-0.050
		(0.009)		(0.015)+		(0.011)**		(0.018)*
Investment Income		0.007		0.032		-1.129		-1.550
		(0.003)+		(0.314)		(0.881)		(0.625)*
Federal Grant Aid		0.308		0.322		0.268		0.237
		(0.057)**		(0.044)**		(0.048)**		(0.055)**
Population of 18-yr-olds		1.185		1.184		0.159		-0.246
		(0.355)**		(0.418)*		(0.491)		(0.681)
Constant	5.771	-14.230	5.791	-12.647	5.603	16.565	5.610	32.193
	(0.054)**	(3.892)**	(0.052)**	(10.233)	(0.056)**	(21.548)	(0.052)**	(18.878)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of Institutions	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority Comparison			YES	YES			YES	YES
Strong Merit Comparison					YES	YES	YES	YES

Notes. Robust standard errors are identified in the table. See Table 4.6A for additional information.

** p<0.01, * p<0.05, + p<0.1

Table 4.12A

Basic Difference-in-Differences Comparison Groups: Entire Class Average Institutional Grant Aid

VARIABLES	(1) Entire Class Avg.	(2) Entire Class Avg.	(3) Entire Class Avg.	(4) Entire Class Avg.	(5) Entire Class Avg.	(6) Entire Class Avg.	(7) Entire Class Avg.	(8) Entire Class Avg.
TN*Post-TELS	-0.021	-0.067	-0.012	-0.050	-0.012	-0.020	-0.018	-0.019
	(0.068)	(0.069)	(0.052)	(0.051)	(0.069)	(0.226)	(0.066)	(0.229)
Post-TELS	0.400	0.301	0.391	0.312	0.391	0.437	0.397	0.398
	(0.084)**	(0.055)**	(0.092)**	(0.076)**	(0.081)**	(0.161)**	(0.084)**	(0.176)*
State Appropriations		0.062		-0.038		0.175		-0.121
		(0.078)		(0.047)		(0.369)		(0.350)
Private Gifts		-0.011		-0.008		-0.009		-0.023
		(0.009)		(0.020)		(0.040)		(0.039)
Investment Income		-0.001		0.021		-1.835		-0.606
		(0.004)		(0.268)		(1.308)		(0.771)
Federal Grant Aid		0.358		0.341		0.158		0.098
		(0.094)**		(0.056)**		(0.151)		(0.154)
Population of 18-yr-olds		0.093		-0.297		-2.128		-3.197
		(0.674)		(0.786)		(1.126)+		(1.074)**
Constant	6.428	-0.616	6.467	5.327	6.219	64.184	6.211	56.835
	(0.054)**	(6.251)	(0.051)**	(12.575)	(0.055)**	(30.764)*	(0.046)**	(26.498)*
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of Institutions	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE/Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority Comparison			YES	YES			YES	YES
Strong Merit Comparison					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Table 4.13A

Basic Difference-in-Differences Comparison Groups: Recipient Class Average Institutional Grant Aid

VARIABLES	(1) Recipient Avg.	(2) Recipient Avg.	(3) Recipient Avg.	(4) Recipient Avg.	(5) Recipient Avg.	(6) Recipient Avg.	(7) Recipient Avg.	(8) Recipient Avg.
TN*Post-TELS	-0.209	-0.250	-0.160	-0.145	-0.211	-0.216	-0.249	-0.246
	(0.106)*	(0.077)**	(0.107)	(0.091)	(0.124)+	(0.112)+	(0.125)+	(0.121)*
Post-TELS	0.465	0.254	0.181	0.150	0.398	0.343	0.400	0.382
	(0.053)**	(0.084)**	(0.052)**	(0.055)**	(0.130)**	(0.139)*	(0.150)**	(0.163)*
State Appropriations		0.153		0.013		-0.068		0.002
		(0.124)		(0.060)		(0.224)		(0.265)
Private Gifts		-0.006		0.008		-0.011		-0.015
		(0.018)		(0.022)		(0.037)		(0.037)
Investment Income		-0.003		0.668		-0.569		0.078
		(0.002)		(0.364)+		(1.161)		(0.855)
Federal Grant Aid		0.355		0.160		0.063		0.012
		(0.098)**		(0.071)*		(0.134)		(0.144)
Population of 18-yr-olds		-0.813		-1.523		-1.905		-2.229
		(0.512)		(0.535)**		(1.070)+		(1.082)*
Constant	7.738	9.559	7.816	7.863	7.676	41.925	7.719	31.613
	(0.045)**	(6.155)	(0.036)**	(9.468)	(0.100)**	(29.758)	(0.113)**	(27.217)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
R-squared	0.057	0.140	0.060	0.075	0.076	0.093	0.104	0.133
Number of Institutions	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority Comparison			YES	YES			YES	YES
Strong Merit Comparison					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Total Institutional Grant Aid Different Comparison Groups

In all previous models, there was only a statistically significant effect in the third year post-TELS when including other controlling variables (see Appendix Table 4.10B, Column 2). In the overall comparison, Tennessee public four-year institutions reduced their total institutional grant aid by 23.4% in the third year ($p<.05$). This negative effect held in the budget authority comparison and large merit state comparison (see Appendix Table 4.10B, Column 4). The third post-TELS total institutional grant aid effect was -9.4% in the budget comparison ($p<.05$) and -12.4% in the large merit comparison ($p<.05$). While the effects are smaller in the budget and merit comparison groups than in the overall comparison, they suggest that overall comparison results are still relatively consistent. In addition, Tennessee public four-year institutions differed from the public four-year institutions in merit comparison group in the fourth year ($\beta=0.193$, $p<.01$).

Number of Recipients in Different Comparison Groups

Tennessee post-TELS generalized effect holds up in each of the comparison groups. Of the three different comparison groups, the budget authority comparison group appears to present a better comparison group since it presents more precise estimates (see Table 4.11A, Column 4). Tennessee public institutions increased their the number of institutional grant aid recipients by 11.4% post-TELS relative to other public institutions subject to governing board with budget authority ($p<.01$). When compared to other states with larger merit aid programs, Tennessee public four-year institutions increased the number of institution aid recipients by 19.5% ($p<.01$). The smallest comparison group

was with other large merit aid states where governing entities had budget authority (e.g. budget-merit comparison group). In the budget-merit, Tennessee public four-year institutions had 19.5% increase in the number of institutional aid recipients post-TELS ($p<.01$). However, when comparing these Tennessee post-TELS coefficients, they are all within a single standard deviation of the overall comparison. Table 4.11A shows all of the basic model specifications when the number of institutional grant aid recipients was used as the dependent variable.

The model specification with each post-TELS year examined separately follow similar patterns as earlier models (see Appendix Table 4.11B). As before, the inclusion of other controlling variables does improve the precision of the estimates in the post-years specification. Each of the comparison groups are presented with and without other controlling variables for the post-years specification in Appendix Table 4.11B, but only the results with additional controls will be discussed since the additional controls increased precision. The pattern of Tennessee increasing the number of institutional grant aid recipients in each post-TELS year holds across all three sub-comparison groups. However, the budget comparison presents the most precise estimates of all comparison groups. When compared to other public institutions subject to a governing entity with budget authority, Tennessee public four-year institutions increased the number of recipients of institutional grant aid in each post-TELS year: 8.2% first year ($p<.01$), 13.5% second year ($p<.01$), 13.4% third year ($p<.01$), 11.1% fourth year ($p<.01$), and 15.4% fifth year post-TELS ($p<.01$). The post-TELS effects are similar between the budget comparison and overall comparison, where z-tests do not indicate any significant difference.

The results from the merit and merit-budget comparison demonstrate smaller effect sizes, but the standard errors are larger than the budget comparison (see column 6 and 8 in Appendix Table 4.11B). The large merit comparison specification still showed Tennessee public four-year institutions increased their number of institutional grant aid recipients in the second through fifth Post-TELS years: 16.4% second year ($p<.01$), 18.4% third year ($p<.01$), 32.7% fourth year ($p<.01$), and 27.5% fifth year ($p<.01$). In the budget-merit comparison, Tennessee public four-year institutions had increases in the number of institutional grant aid recipients in the second through fifth years Post-TELS (second 19.1%, $p<.01$; third 23.8%, $p<.01$; fourth 28.9%, $p<.01$; fifth 24.0%, $p<.05$). Throughout these models using different comparisons, the model comparing Tennessee public four-year institutions to other public institutions subject to governing board with budget authority presents the most precise post-years estimates.

Recipient Average Institutional Aid with Different Comparison Groups

The findings from the different comparison groups suggest that Tennessee public four-year institutions may have decreased the recipient average institutional award amount post-TELS after controlling for other covariates, but few of the results were statistically significant. The Tennessee public four-year institutions did not present statistically significant and different response post-TELS when compared to other public institutions with budget authority, where the effect size was smaller and standard errors were larger than the overall comparison (see Table 4.13A). In addition, the Tennessee post-TELS effect size was slightly smaller in the merit comparison group than in the overall comparison, but the standard errors were also slightly higher, which renders the effect marginally significant ($\beta=-0.216$, $P<.10$). In the combined budget-merit

comparison, it appears that Tennessee public four-year institutions reduced their recipient average institutional grant aid by 24.6% ($p<.05$), which was similar to the effect size in the overall comparison group. However, the standard errors on the point estimates were slightly larger in the budget-merit specification than in the overall specification. The overall comparison group using all other public four-year institutions produced the most precise estimates and yielded results similar to the three sub-group comparisons, which indicate that overall comparison is sufficient for interpretation of the results.

The post-years specifications on the recipient average model followed similar patterns throughout the different comparison groups (see Appendix Table 4.13B). When Tennessee public four-year institutions were compared to all other public institutions, the findings suggested Tennessee public four-year institutions reduced their recipient average in nearly every year. However, only the third year effect held across the three comparison sub-groups: -22.1% in budget authority comparison ($p<.05$), -29.3% in merit comparison ($p<.05$), and -28.8 in the budget-merit comparison ($p<.05$). As the comparison groups got smaller in size, the standard errors increased. In addition, the fifth year effect held in the merit and budget-merit comparison groups ($\beta=-0.311$, $p<.05$ and $\beta=-0.314$, $p<.05$, respectively).

Summary of Overall Models and Robustness Checks

The results for the overall models and sub-group comparisons are consistent and similar suggesting that Tennessee public four-year institutions are responding by increasing the number of institutional grant aid recipients, decreasing the recipient average award amount, and varying total funding for institutional grant aid. The

comparison sub-groups ensure that the effects are not driven or dependent on the comparison group of institutions, where most effects related to the number of institutional grant aid recipients and average institutional award amount to recipients hold up in the different sub-groups. Some results slipped into marginal significance, but that can be expected given the sub-groups have a much smaller sample size which reduce statistical power.

Beyond checking different comparison groups, a series of robustness checks were conducted to further examine the difference-in-difference estimation and findings. First, a placebo test was conducted to determine if there were any pre-TELS aspects that may drive a change in results. A year between 2000 and 2005 was selected a random to see if the dependent change across an artificial threshold. Table 4.14 displays the result so of the placebo test. There were not any statistically significant results from the placebo test, which indicates other factors are not driving the Tennessee change in any of the institutional grant aid dependent variables. In addition, pre-TELS trends in the dependent variable were checked using Mora and Reggio's (2014) DQD protocols, which determined there were not any pretreatment dynamics or trends and suggested the standard DID model was appropriate.

Table 4.14

Placebo Test on Pre-TELS Time Periods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Total	Total	Total	Number	Number	Number	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.
TN*Post-Fake Time	-0.170	-0.170	-0.328	-0.003	-0.003	-0.053	-0.097	-0.097	-0.177	-0.168	-0.168	-0.279
	(0.341)	(0.306)	(0.252)	(0.179)	(0.188)	(0.163)	(0.207)	(0.286)	(0.252)	(0.209)	(0.162)	(0.146)+
Post-Fake Time	0.620	0.620	-0.033	0.268	0.268	-0.035	0.456	0.456	0.143	0.349	0.349	-0.007
	(0.079)**	(0.100)**	(0.130)	(0.041)**	(0.050)**	(0.066)	(0.048)**	(0.057)**	(0.071)*	(0.048)**	(0.061)**	(0.080)
Constant	12.720	12.720	-6.673	5.606	5.606	-8.065	5.658	5.658	-2.075	7.125	7.125	1.566
	(0.056)**	(0.061)**	(33.590)	(0.029)**	(0.032)**	(21.017)	(0.034)**	(0.038)**	(20.592)	(0.034)**	(0.037)**	(19.468)
Observations	1,990	1,990	1,974	1,990	1,990	1,974	1,990	1,990	1,974	1,990	1,990	1,974
R-squared	0.048	0.048	0.212	0.035	0.035	0.146	0.065	0.065	0.190	0.039	0.039	0.188
Number of unitid	399	399	399	399	399	399	399	399	399	399	399	399
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Additional Covariates			YES			YES			YES			YES
Robust SE		YES	YES		YES	YES		YES	YES		YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Second, the basic specification of the DID with additional covariates was rerun, but one of the nine Tennessee institutions was dropped from the analysis to confirm the consistency of results with changes in the treated sample. The recipient average post-TELS findings were consistent across the leave-one-out analysis, which indicate that a single Tennessee institution is not biasing the results. It appears dropping Tennessee Technical University changed the results by more than a standard deviation in the total institutional grant aid (z-test=1.17), number of recipients (z-test=1.45), and entire class average (z-test=1.45). While these z-test results do not pass any critical levels, they do suggest that Tennessee is biasing the results in a different direction. Tables 4.15 report the results when Tennessee Technical University was dropped from the analysis in Column 10. Without Tennessee Tech, the other Tennessee public four-year institutions reduced total institutional grant aid by 26.1% ($p<.05$) versus the original finding of only -10.9% (n.s.). Tennessee Tech was also pulling the effect toward zero in the entire class average where the other Tennessee public four-year institutions (excluding Tennessee Tech) reduced the entire class average by 22.5% ($p<.05$) versus the original -6.7% when Tennessee Tech was included in the analysis (n.s.). In addition, it appears Tennessee Tech was driving the overall increase in the number of institutional grant aid recipients: 4.8% (n.s.) excluding Tennessee Tech and 14.3% including Tennessee Tech ($p<.01$).

Table 4.15

Leave One Out Analysis Basic Difference-in-Difference Post-TELS Tennessee Response

	(1) Overall Model	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total Institutional Grant Aid	-0.109	-0.128	-0.099	-0.118	-0.068	-0.079	-0.152	-0.021	-0.056	**-0.261**
	(0.089)	(0.090)	(0.107)	(0.115)	(0.090)	(0.070)	(0.110)	(0.089)	(0.071)	**(0.095)***
Number of Recipients	0.143	0.135	0.141	0.151	0.168	0.172	0.111	0.193	0.166	**0.048**
	(0.037)**	(0.033)**	(0.048)*	(0.044)**	(0.026)**	(0.054)*	(0.043)*	(0.047)**	(0.040)**	**(0.054)**
Entire Class Average	-0.067	-0.108	-0.015	-0.081	-0.035	-0.077	-0.106	0.042	-0.000	**-0.225**
	(0.069)	(0.067)	(0.089)	(0.091)	(0.065)	(0.056)	(0.085)	(0.079)	(0.071)	**(0.084)***
Recipient Average	-0.250	-0.263	-0.238	-0.268	-0.234	-0.250	-0.261	-0.213	-0.220	-0.307
	(0.077)**	(0.084)**	(0.088)**	(0.083)**	(0.083)**	(0.085)**	(0.084)**	(0.075)**	(0.080)**	(0.060)**
Observations	3,939	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929
Number of unitid	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE or Discroll-Kraay	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes. Bolded values greater than one standard deviation different from overall model. Driscoll-Kraay used for all dependent variables except the recipient average (see Appendix Table 4.15 for Robust SE specification for all).

Models by Carnegie Classification

Tennessee Doctoral Extensive (DR1)

The basic or generalized DID model with corrections for heteroscedasticity and autocorrelation suggest that Tennessee public Doctoral/Research Extensive institutions (DR1)—University of Tennessee and University of Memphis—responded by changing the average institutional award amount. Table 4.16A shows the basic difference-in-differences results when looking at only public Doctoral/Research Extensive institutions across the US. Between 2005 and 2009, Tennessee public DR1s increased the number of institutional grant aid recipients by 20.5% when compared to all public DR1s with additional controls ($P<.01$). In reviewing the post-TELS years separately (See Appendix Table 4.16B), it appears that Tennessee public DR1s increased the number of institutional grant aid recipients by 20.1% in the first year ($p<.05$), 11.3% in the second year (n.s.), 22.3% in the third year ($p<.01$), 37.1% in the four year ($p<.01$), and 11.8% in the fifth year ($p<.05$) when compared to all other public DR1s nationally. The other dependent variables—total, entire class average, and recipient average institutional grant aid—followed similar partners as the other overall models, but none of the results were statistically significant.

Table 4.16A

Doctoral Extensive (DR1) Carnegie Classification Basic Difference-in-Differences

VARIABLES	(1) Total	(2) Total	(3) Number	(4) Number	(5) Entire Class Avg.	(6) Entire Class Avg.	(7) Recipient Avg.	(8) Recipient Avg.
TN*Post-TELS	-0.181	-0.039	0.106	0.205	-0.189	-0.082	-0.288	-0.244
	(0.472)	(0.201)	(0.197)	(0.039)**	(0.478)	(0.278)	(0.276)	(0.205)
Post-TELS	0.870	0.608	0.612	0.406	0.662	0.494	0.256	0.200
	(0.078)**	(0.101)**	(0.068)**	(0.083)**	(0.078)**	(0.107)**	(0.042)**	(0.062)**
Constant	14.958	6.966	6.731	-2.645	6.951	4.756	8.231	9.616
	(0.055)**	(7.543)	(0.048)**	(7.215)	(0.055)**	(7.464)	(0.029)**	(6.694)
Observations	1,010	999	1,010	999	1,010	999	1,010	999
R-squared	0.387	0.434	0.293	0.341	0.269	0.298	0.154	0.169
Number of Institution	101	101	101	101	101	101	101	101
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES		YES		YES		YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Tennessee Doctoral Intensive (DR2)

A separate series of generalized DID and post-year specific models were run using Driscoll-Kraay standard errors to correct for heteroscedasticity, autocorrelation, and cross-sectional dependence on the public Doctoral/Research Intensive institutions (DR2), which include the following Tennessee institution: East Tennessee State University, Middle Tennessee State University, and Tennessee State University (see Table 4.17A). Here the generalized DID fixed models with additional controls would have suggested that Tennessee DR2 institutions would respond post-TELS with a 55.4% decrease in total institutional grant aid ($p<.01$), 24.3% decrease in the number institutional gran aid recipients, 34.5% decrease in entire class average institutional grant aid ($p<.05$), and 31.6% decrease in recipient average grant aid ($p<.01$). These results were consistent in the Driscoll-Kraay and robust standard error specification (see Appendix Table 4.17A). The model separating each post-TELS year separately will further examine these generalized results.

The post-TELS models examining each post-TELS year separately suggest that Tennessee DR2 made substantive change their total institutional grant aid (see Appendix Table 4.17B), where Tennessee public DR2s reduced total institutional grant aid by 74.6% in the first year ($p<.01$), 46.3% in the second year ($p<.01$), 61.1% in the third year ($p<.01$), 45.5% in the fourth year ($p<.01$), and 29.6% in the fifth year ($p<.05$) post-TELS compared to other public DR2s nationally. Tennessee public DR2s reduced their entire class average institutional in post-TELS first through third year, where the first year was largest decline at -45.8% ($p<.01$). Given these findings, it is not surprising that

Tennessee public DR2s decreased their recipient average institutional grant aid by 30.3% in the second year ($p<.01$), 46.9% in the third year ($p<.01$), 30% in the fourth year ($p<.01$), and 28.2% in the fifth year ($p<.01$) post-TELS when compared with other DR2s nationally. While there was not a generalized difference between Tennessee public DR2s in the grouped post-TELS years, it appears Tennessee public DR2s decreased the number of institutional grant aid recipients by 65.2% in the first-year ($p<.01$) and 16.5% in the second year post-TELS.

Table 4.17A

Doctoral Intensive (DR2) Carnegie Classification Basic Difference-in-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Number	Number	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN*Post-TELS	-0.328	-0.554	-0.067	-0.243	-0.218	-0.345	-0.263	-0.316
	(0.171)+	(0.107)**	(0.139)	(0.098)*	(0.165)	(0.123)*	(0.094)*	(0.083)**
Post-TELS	0.786	0.664	0.438	0.342	0.613	0.536	0.350	0.325
	(0.210)**	(0.182)**	(0.115)**	(0.080)**	(0.141)**	(0.127)**	(0.097)**	(0.106)*
Constant	13.708	9.178	5.832	2.392	6.557	-2.877	7.879	6.794
	(0.159)**	(19.799)	(0.088)**	(10.054)	(0.094)**	(13.715)	(0.074)**	(12.269)
Observations	610	601	610	601	610	601	610	601
Number of Institution	61	61	61	61	61	61	61	61
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES		YES		YES		YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Tennessee Masters Colleges and Universities I (MCU1)

The basic and post-years DID models were run looking just at the Master's College and Universities I (MCU1) to see if there was variation in the institutional response occurring within this subgroup that was being masked by the specification comparing Tennessee to all other public four-year institutions. Given the results of the leave-one-out analysis, the results are reported with and without Tennessee Tech, which will show the overall response of Tennessee MCU1s and only those of Austin Peay, UT-Chattanooga, and UT-Martin using Driscoll-Kraay standard errors (see Table 4.18A, Panel A and B). Unlike the previous analysis, the inclusion of the additional covariates do not improve the precision of the models looking at total institutional grant aid and entire-class/recipient average institutional grant aid. Thus, the models without additional covariates with be discussed herein. Tennessee MCU1s increased total institutional grant aid by 20.2% post-TELS but much of this effect is driven by Tennessee Tech since when dropped the Tennessee MCU1 post-TELS effect is 17.4% and not statistically significant (both excluding additional covariates). Similarly, the post-TELS effect for number of recipients after including additional covariates was 37% ($p<.01$) using all Tennessee MCU1s but diminishes to 15% (n.s.) when dropping Tennessee Tech from MCU1s. The Tennessee entire class average post-TELS effect was not significant when including all Tennessee MCU1s and after Tennessee Tech was dropped the remaining three Tennessee public MCU1s decreased the entire class average institutional grant aid by 3.3% ($p<.05$, excluding additional covariates). The Tennessee response with the recipient average post-TELS was -17% ($p<.10$) for all Tennessee public MCU1s and -32.5% after dropping Tennessee Tech ($p<.05$). While both sets of results with and without Tennessee Tech

present the reality what occurs with Tennessee's MCU1s, the results excluding Tennessee Tech better describe that prevail pattern of MCU1 post-TELS response. Appendix Table 4.18A presents the results using robust standard errors in lieu of Discroll-Kraay standar errors, where the reduction in recipient average was consistent across specifications.

The models assessing the post-TELS years separately describe how Tennessee MCU1s responded in each year. Results are reported with and without Tennessee Tech included in Appendix Tables 4.18B-4.18C. The results excluded Tennessee Tech will be described more fully, where models without additional covariates had better precision except in the case of the number of institutional grant recipients. The three remaining Tennessee MCU1s, Austin Peay, UT-Chattanooga, and UT-Martin, decreased in total institutional grant in every year, but only the third (β=-0.24, $p<.05$), fourth (β=-224, $p<.19$) and fifth year post-TELS (β=-0.248, $p<.05$, see Appendix Table 4.18C, Column 1). There was a brief spike in the number of institutional grant aid recipients in the first year at an increase of 24.5% ($p<.05$) but began to taper in subsequent years (see Appendix Table 4-18C, Column 4). The entire class average institutional grant decreased in post-TELS years two through five with smallest decrease at 22.5% ($p<.05$) in the second year and largest decrease in the fifth year at 41.6% ($p<.01$). Similarly, the recipient average decreased in every post-TELS year between 2005 and 2009: 35.9% in the first year ($p<.01$), 29.4% in the second year ($p<.05$), 35.2% in the third year ($p<.01$), 24.6% in the fourth year ($p<.01$), and 37.3% in the fifth year post-TELS ($p<.01$).

Table 4.18A

Master's Colleges and Universities One (MCU1) Carnegie Classification Basic Difference-in-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Number	Number	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
Panel A: All MCU1								
TN*Post-TELS	0.202	0.040	0.370	0.297	0.108	0.024	-0.170	-0.258
	(0.085)*	(0.132)	(0.052)**	(0.053)**	(0.088)	(0.116)	(0.084)+	(0.126)+
Post-TELS	0.552	0.310	0.282	0.129	0.365	0.255	0.268	0.181
	(0.116)**	(0.051)**	(0.071)**	(0.031)**	(0.073)**	(0.046)**	(0.048)**	(0.027)**
Constant	12.898	-15.822	5.264	-22.039	6.104	-2.075	7.646	6.679
	(0.078)**	(9.296)	(0.044)**	(5.118)**	(0.044)**	(7.636)	(0.035)**	(4.298)
Panel B: Excluding Tennessee Technical University								
TN*Post-TELS	-0.174	-0.329	0.150	0.079	-0.303	-0.384	-0.325	-0.407
	(0.105)	(0.152)+	(0.106)	(0.087)	(0.100)*	(0.127)*	(0.105)*	(0.163)*
Post-TELS	0.552	0.096	0.282	0.028	0.365	0.145	0.268	0.065
	(0.116)**	(0.133)	(0.071)**	(0.048)	(0.073)**	(0.052)*	(0.048)**	(0.094)
Constant	12.898	-2.868	5.265	-16.393	6.106	3.445	7.645	14.078
	(0.078)**	(8.743)	(0.044)**	(4.432)**	(0.044)**	(7.520)	(0.035)**	(4.904)*
Observations	2,363	2,338	2,363	2,338	2,363	2,338	2,363	2,338
Number of Institution	237	237	237	237	237	237	237	237
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	NO	NO	NO	NO	NO	NO	NO	NO
Additional Controlling Variables		YES		YES		YES		YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Summary of Findings

Tennessee public four-year institutions did respond post-TELS by reducing the recipient average institutional grant aid. It was found that Tennessee Technical University was potentially an outlier that was pulling the results up for the institutional grant aid total amount, number of recipients, and entire class average. After removing Tennessee Technical University, the remaining eight institutions did reduce their total

institutional grant and entire class average institutional grant amount post-TELS. Figure 4.5 shows a summary of the post-TELS responses for Tennessee public four-year institutions with and without Tennessee Technical University. However, the results by Carnegie Classification suggest that much of the reduction in institutional grant post-TELS was concentration in Tennessee Doctoral Intensive and Master's Colleges/Universities.

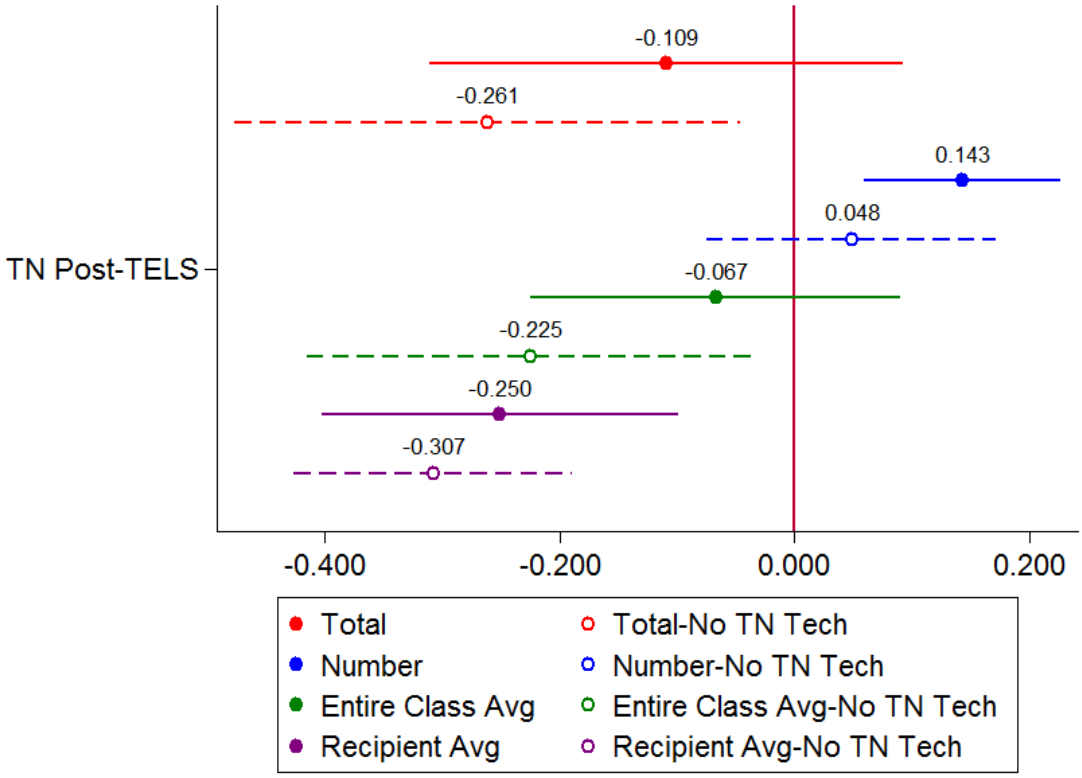

Figure 4.5. Summary of institutional grant aid responses post-TELS at Tennessee public four-year institutions.

Conclusions

The series of models suggest that Tennessee public four-year institutions did respond by changing their institutional grant aid with the creation of the TELS program. The best evidence from this chapter will be summarized here. First, Tennessee public four-year institutions reduced their recipient average, which was the single finding that held across specifications. This suggests that Tennessee public four-year institutions reduced their average award amount by 22.1%, when converting log-points to percentages, which is nearly a $929 dollar decline (constant dollars). However, additional analysis by Carnegie Classification suggested that Tennessee Doctoral Intensive and Master's College/Universities where driving much of the reduction. Second, the leave-one-out analysis suggested that Tennessee Tech was an outlier biasing the results. After removing Tennessee Tech, the remaining institutions reduced total institutional grant aid amount post-TELS. Third, the models examining Tennessee public four-year institutions separately by Carnegie Classification suggested some differential responses to the TELS program. For instance, Tennessee public Doctoral Extensive institutions increased the number of institution grant aid recipients post-TELS, where increases occurred in most post-TELS years. However, Tennessee public Doctoral Intensive institutions decreased institutional grant aid post-TELS across all parameterization of the dependent variable. Similarly, Tennessee public Master's Colleges and Universities 1 reduced their entire class average and recipient average institutional grant aid post-TELS.

CHAPTER 5
DISCUSSION

Introduction

This chapter begins with a summary discussion of the findings for each research question. Second, a section putting these findings in the context of existing literature will be presented. Third, this study's contributions to literature will be discussed. Fourth, conclusions from this study will be reviewed. Lastly, a series of implications for theory, research, and policy will be addressed followed by some avenues for future research.

Discussion of Finding by Research Question

Did increased state merit aid funding induce Tennessee public four-year institutions to change their total expenditures on institutional grants given to first-time, full-time students when compared to similar institutions in other states?

The preliminary difference-in-differences models suggested that Tennessee public four-year institutions did not behave in a consistent and different manner than other public four-year institutions nationally. Even though the budget comparison provided a better comparison group with more precise standard errors, it still was not enough to yield statistically significant and different post-TELS results between Tennessee and other public four-year institutions. The leave-one-out analysis was conducted to determine if a single Tennessee public institution was potentially biasing the results, which suggested that the Tennessee Technical University was responding antithetically post-TELS relative to the other eight Tennessee public four-year institutions. When

Tennessee Tech was dropped from the analysis, the remaining eight public Tennessee public four-year institutions reduced their institutional grant aid by 26.1% between 2005 and 2009 ($p<.05$), where they decreased total institutional grant aid in every year post-TELS. These overall results suggest that other eight Tennessee public four-year institutions were reducing their total institutional grant aid after the TELS program was implemented in 2005.

The total institutional grant analysis within each Carnegie Classification provide even further evidence of nuanced responses by Tennessee public four-year institutions. Tennessee public DR1s showed a slight decrease in total institutional grant aid post-TELS but it was not statistical significant from other public DR1s nationally (β=-0.039, n.s.). However, Tennessee DR2s and MCU1s appeared to respond post-TELS relative their counterparts within their Carnegie Classification. Tennessee DR2s reduced total institutional grant aid by 55.4% post-TELS when compared to other public DR2s nationally ($p<.01$). After excluding Tennessee Tech, the other Tennessee MCU1s reduced total institutional grant aid by 17.4% post-TELS when compared to other public MCU1s nationally (n.s.). Thus, it is clear that much of the overall decrease found in total institutional grant is driven by Tennessee DR2s.

Did increased state merit aid funding induce Tennessee public four-year institutions to change the number of first-time, full-time students receiving institutional awards when compared to similar institutions in other states?

The initial overall generalized difference-in-differences models suggested that Tennessee public four-year institutions increased the number of institutional grant aid

recipients by 14.3% when compared with all other public four-year institutions nationally ($p<.01$). However, the leave-one-out analysis suggested that Tennessee Technical University was an outlier and might bias the results upward. When Tennessee Tech was removed from the analysis, the other eight Tennessee public four-year institutions increased their number of institutional grant aid recipients by only 4.8% when compared to all public four-year institutions nationally (n.s.).

The generalized and separate post-TELS years DID models were applied to each Carnegie Classification. Tennessee public DR1s increased their number of institutional grant aid recipients by 20.5% post-TELS when compared to other public DR1s nationally ($p<.05$), where the increase was in nearly every post-TELS year. Tennessee public DR2s actually reduced their number of institutional grant aid recipients by 24.3% post-TELS when compared to other DR2s nationally ($p<.05$). Tennessee DR2s experienced a dramatic decrease in the number of institutional grant aid recipients in the first year but this began to taper in subsequent years. Tennessee MCU1s increased their number of institutional grant aid recipients by 29.7%, ($p<.01$) but this diminished to 7.9% (n.s.) after excluding Tennessee Tech from the analysis.

Did increased state merit aid funding induce Tennessee public four-year institutions to change their <u>entire class average institutional award amount</u> for first-time, full-time students when compared to similar institutions in other states?

The models with all Tennessee public four-year institutions together suggested that Tennessee did not respond post-TELS in a systematic, different way than other public four-year institutions nationally. Post-TELS Tennessee public four-year

institutions reduced the entire class average by 6.7% relative to all other public four-year institutions nationally (n.s.). However, the leave-one-out analysis indicated that Tennessee Technical University was potentially biasing the results upward. Without Tennessee Tech included in the analysis, the other eight Tennessee public four-year institutions reduced the entire class average by 22.5% post-TELS when compared with all other public institutions nationally ($p<.05$).

As with the other research questions, the difference-in-differences models were run separately for each Carnegie Classification. Tennessee DR1s reduced their entire class average institutional grant aid by 8.2%, but this was not statistically significant. Tennessee DR2s decreased their entire class average institutional grant aid by 34.5% when compared with other public DR2s nationally ($p<.05$). When Tennessee Tech was excluded, the other Tennessee MCU1s reduced their entire class average institutional grant aid by 30.3% without additional controls ($p<.05$) and 38.4% with additional controls ($p<.05$). The inclusion of additional covariates did not improve the precision of the estimates in the MCU1 analysis.

Did increased state merit aid funding induce Tennessee public four-year institutions to change their recipient average institutional award amount for first-time, full-time students when compared to similar institutions in other states?

The Tennessee post-TELS changes in recipient average institutional grant aid was one of the more consistent findings, where results were either marginally or statistically significant across model specifications. The early generalized DID model using all Tennessee public four-year institutions suggested that they reduced the recipient average

post-TELS relative to all other public four-year institutions nationally by 20.9% without additional covariates ($p<.05$) and 25% with additional covariates ($p<.01$). The models with post-TELS years parameterized separately suggested that Tennessee public four-year institutions reduced their recipient average in every year with largest decrease occurring in the third year, with a 36.2% decrease in the recipient average award amount. The leave-one-out analysis suggested the Tennessee institutions did not differ in their post-TELS response since all post-TELS coefficients were with a standard deviation of the overall model. Consequently, the overall models were sufficient in reporting Tennessee post-TELS responses.

The difference-in-differences analysis within each Carnegie Classification helped illuminate where Tennessee public four-year institutions are responding differently relative to institutions more similarly situated. Tennessee DR1s did reduce their recipient average institutional award but not in a manner different than other public DR1s nationally (β=-0.244, n.s.). Tennessee DR2s did reduce their recipient average institutional award amount by 31.6% post-TELS relative to other public DR2s nationally ($p<.01$). Tennessee MCU1s also reduced their recipient average institutional award amount by 17% with Tennessee Tech ($p<.10$) and 32.5% without Tennessee Tech included ($p<.05$). While it appears much of the post-TELS response is driven by the DR2s, these Tennessee specific post-TELS coefficients across Carnegie Classifications do not differ from the overall model.

Study Findings in the Context of Existing Literature

Limited research exists examining how state financial aid influences institutional grant aid with the exception of a few studies (e.g. Curs & Dar, 2010a; 2010b; Long, 2002; 2004), which make it difficult to make direct comparisons with the findings in this study. The findings from this study suggested that Tennessee public institutions may have responded differently post-TELS. Mainly, Tennessee Technical University was an outlier, which pulled the results in another direction. Eight Tennessee public institutions (excluding Tennessee Technical University) reduced their total institutional grant aid, entire class average, and recipient average but did not have a discernable change in the number of institutional grant aid recipients. This general response of Tennessee institutions reducing institutional aid support aligns with private institution behavior when the Georgia HOPE scholarship program was created, where average institutional per FTE declined (Long, 2004). Institutional grant aid at public institutions was not an outcome measured in Long's (2004) DID study, so more direct corollaries do not exist. However, an earlier iteration of Long's (2002) study on the Georgia HOPE Scholarship found that two public four-year institutions (e.g. University of Georgia and Albany State College) reduced their average institutional awards per FTE by 57 percent when the Georgia HOPE scholarship was created. Curs and Dar (2010a) found that increases in average state grant aid were associated with an increase in average institutional grants in their fixed effects regression models. However, when Curs and Dar (2010b) disaggregated state grant aid into need and merit based aid, the association in fixed effect regression models between state merit aid and average institutional grant aid was not significant. Turner (2012) found that public and private institutions reduced institutional

grant for students eligible for the federal education tax credits. The mixed results in other research is likely a byproduct of different study designs and methods. For instance, Curs and Dar (2010a; 2010b) examined average state grant aid but did not explicitly account for states with large merit aid programs. Data availability at the time would have limited Long's ability to study institutional aid responses for first-time undergraduate students. The findings of this study fill a void in the research on how public institutions change institutional grant aid in response to state merit aid programs.

Given the structure of available data, where institutional aid could not be disaggregated into need- and merit-based aid or be measured at the student level, this study cannot contribute to the literature addressing equity in financial aid awarding. Tennessee was one of the first states to provide a broader mix of merit- and need-based criterion as part of their state merit aid program, which could have provided a greater opportunity to study its effect had Tennessee been collecting comprehensive student level data before and after the creation of the TELS program. In addition, since comprehensive student level award data did not exist before the TELS, this study could not assess the effect of the TELS program on racial/ethnic, geographic, and socioeconomic diversity at Tennessee public institutions. A series of assessments by Heller (2002; 2004) reviewed state merit aid and come to the general conclusion that state merit aid programs are likely not enhancing equity. Dynarski (2000) found that the Georgia state merit aid mostly went to students who would have already attended college in the first place suggesting that it is not contributing to access and equity. There is a need for additional research on how state merit aid effects the equity of institutional grant aid awarding.

Contributions to the Literature

This study provides three distinct contributions to the literature on financial aid in higher education. First, this study more acutely measures institutional aid responses at public four-year institutions by focusing on institutional aid for first-time, full-time students, which localizes the institutional response more closely to those students eligible for the state merit aid programs. Prior studies focused more on private nonprofit institutional responses to state merit aid programs (Long, 2004) or looked at total institutional aid given to all student levels, which included graduate students distinctly not eligible for the state awards or undergraduate students not eligible because they entered before the merit aid program was created (Long, 2002). This study examined the institutional aid response with the TELS program at all Tennessee public four-year institutions, which is the first study to focus specifically on Tennessee four-year public institutions and their multifaceted institutional aid responses. In addition, this study examined how these public four-year institutions responded within the context of their Carnegie Classification, by comparing Tennessee institutions to other public institutions within a similar Carnegie Classification.

Second, this study combined principal agent and resource dependence theories to provide a more comprehensive set of institutional responses. Many other studies on institutional grant aid responses to federal or state aid did not use principal agent or resource dependence theory, but rather focused on proving/disproving the Bennett hypothesis (Long, 2004; McPherson & Shapiro,1993; Turner, 2012). However, the Bennett hypothesis is not a well-developed theory by itself since it assumes institutions respond solely to changes in federal financial aid ignoring the complex operation and

governance structures within public higher education. Principal agent theory provides a more comprehensive landscape of the governance and operation in public higher education by defining roles, context and actions, but by itself would still suggest that public institutions would behave opportunistically and seek their own self-interest. However, institutions are complex entities that may not behave opportunistically even if left unmonitored. The inclusion of resource dependence theory helps describe the complex nature of institutions, where they may increase their willingness to pay for students receiving the TELS award in order to maintain or increase net revenue.

The combination of principal agent and resource dependence theories can help explain the results of this study. The Tennessee DR2 public institutions responded post-TELS as principal agent theory would have suggested by reducing total, entire class average, and recipient average institutional grant aid as well as decreasing the number of institutional grant aid recipients. Alternatively, Tennessee public DR1 institutions increased the number of institutional grant aid recipients and in some years Post-TELS increased total institutional grant (n.s.). Presumably, both Tennessee public DR1 and DR2 institutions were acting in their own self-interest, but one set choose to opportunistically decrease institutional grant and the other choose a modest expansion of institutional grant aid access. These differing responses highlight the inadequacy of principal agent theory by itself, since this theory would have suggested that Tennessee public DR1 institutions should have behaved like the Tennessee public DR2 institutions because institutions were not being monitored by the state. However, the inclusion of resource dependence theory, in concert with principal agent theory, suggest that institutions will work to maintain or increase a given resource (Pfeffer & Salanick, 2003),

which in this case could be enrollment, tuition revenue, prestige, or market share (e.g. Bowen, Kurtzweil, & Tobin, 2005; Brewer, Gates, & Goldman, 2009; Hillman, 2012). While both theories suggest an institution will act in its own self-interest, the combination show that monitoring is not essential for productive responses, such as giving institutional aid to more students. This study's pairing of principal agent and resource dependence theories help to explain increases and decreases in institutional grant aid.

Third, this study identified a comparison group that can be used in other studies on institutional financial aid and more broadly on public institution finances. The budget comparison group in this study provided more efficient estimates (e.g. smaller standard errors), which suggest that less variation existed in this subgroup than in the overall comparison group. This study defined the budget comparison group as all public institutions subject to consolidated governing boards and coordinating boards with consolidated budget authority. Other studies that included a governance element to their study only included consolidated governing boards (e.g. Tandberg, 2013) or both governing boards and coordinating boards as separate parameters/variables (e.g. Curs & Dar, 2010a). However, when looking at institutional financial aid or other institutional finances, it seems more appropriate to isolate those governing entities that have budget authority since they have the ability to review and approve institutional budgets. In the case of this study, governing entities with budget responsibilities would have some authority over the institutional financial aid budget, which did provide a more precise subgroup to compare Tennessee public four-year institutions. Given the increased precision in the budget comparison in this study, it is worth consideration for other

studies that address institutional financial aid to focus beyond only consolidated governing boards and include all governing entities that budget authority.

Conclusions

First, this study found that Tennessee public four-year institutions changed their institutional grant aid behavior after the TELS program was created. The methodological approach allowed for a more nuanced set of findings to examine changes in institutional grant aid with respect to the total amount, number of recipients, entire class average and recipient average. When grouped together, the Tennessee public four-year institutions increased the number of institutional aid recipients and decreased the average award given to recipients. At the same time, there were not any discernable differences in the total institutional grant or the entire class average institutional grant at Tennessee public four-year institutions relative to other public four-year institutions nationally. This suggests that Tennessee public four-year institutions expanded the access of their institutional grant aid to more first-time, full-time students by providing smaller awards to recipients. This study builds on and expands prior research by including more aspects of institutional grant aid, where prior studies have focused only on average institutional aid (e.g. Long, 2004). The four institutional aid variables provide a more comprehensive set of institutional responses to state merit aid.

Second, the examination of these institutional grant aid variables within Carnegie Classification was incredibly instructive and shows how each institution may have responded differently to the creation of the TELS program. Research using DID techniques in higher education did not segment their analysis to look separately at

institutions within different Carnegie Classification (e.g. Long, 2004; Hillman, Tandberg & Gross, 2014). Tennessee public Doctoral Extensive institutions only had a discernable difference in the number of institutional grant aid recipients, where they increased the number of recipients post-TELS when compared to other similar institutions nationally. On its face, the expansion of institutional aid grant recipients would suggest a productive response to the TELS program. However, this study could not determine if the recipient expansion was given to students with financial need or in-state residents, so it is difficult to assess who benefited from the expansion. The Tennessee Doctoral Intensive and Master's Colleges/Universities (excluding Tennessee Technical University) decreased their institutional grant aid in nearly every category. This finding suggested that Tennessee Doctoral Intensive and Master's Colleges/Universities were utilizing the TELS program as a means to subsidize their institutions, which would indicate more of an opportunistic response to the TELS program. However, if an institution can spend less in institutional aid to achieve the same outcome, then is it really an opportunistic response? The answer to this questions is one for future research into how institutions that capture subsidies from financial aid spend those resources. Given the difference found within each Carnegie Classification, this study demonstrates the importance of moving beyond just sector distinctions (e.g. public four-year sector) and look within institutions on Carnegie Classification.

Third, for all that this study can suggest based on its findings, it still cannot directly address anything regarding how institutional and state grant aid changes the equity and access to Tennessee higher education. The available data in IPEDS and within Tennessee were not sufficient to examine institutional aid disaggregated into

merit- and need-based aid. Dynarski's (2000) analysis of Georgia indicated that most state merit aid went to students who would already go to college, which suggests the program did not expand access. If the same is true in Tennessee, then any institutions reducing or redistributing institutional grant aid could be a productive response if it improves equity, access, or reduces educational expenses. In particular if the institutional grant aid was better targeted in way to benefit outcomes that Bowen and associates (2005) define as effective uses of institutional aid, such as ensuring institutions enroll at capacity and enhance quality. However, the data does not exist to provide any confirmation on who benefited from the public Tennessee Doctoral Extensive institutions expanding access to institutional grant aid or how the other public Tennessee institutions reallocated their reduced spending on institutional grant aid. These aspects cannot be addressed with existing quantitative data, but could be an area for future research.

Implications for Theory

This study integrated principal agent and resource dependence theories, which provided a more comprehensive set of institutional responses to the creation of a state merit aid program. Many studies examining institutional financial aid or tuition price changes sought to prove or disprove the Bennett hypothesis (Long, 2004; McPherson & Shapiro, 1993; Turner, 2012). However, the Bennett hypothesis assumes a monolithic, opportunistic response, where institutions will increase tuition price or reduce institutional aid when students receive more generous federal or state financial aid. In addition, studies relying solely on principal agent theory may not provide a full set of institutional responses to state financial aid policy. This study developed multiple

potential responses that Tennessee public four-year institutions might take post-TELS by pulling together principal agent theory, resource dependence theory, and existing literature. The theoretical framework in this study suggested that institution might increase, maintain or decrease their institution grant in response to the TELS program.

The results of this study affirm parts of principal agent and resource dependence theory while suggesting that they should be used in concert with each other on financial aid policy research. This study's results with respect to Doctoral Intensive (DR2) and Master's Colleges/Universities 1 (excluding Tennessee Technical University) affirm the agency problem (e.g. moral hazard) in principal agent theory, where institutions will behave opportunistically if left unmonitored. However, principal agent theory by itself does not explain why Tennessee Doctoral Extensive (DR1) institutions increased the number of institutional grant aid recipients post-TELS. Kivisto (2008) acknowledges principal agent theory's weakness of assuming only a self-interested, opportunistic response. The findings of this study affirm this weakness in the principal agent theory since some Tennessee institutions, such as public DR1 institutions, did not reduce institutional grant aid post-TELS. This study's findings suggest that principal agent theory should be paired with another theory to explain why an institution might behave productively even if not monitored by the principal. In the context of financial aid studies, resource dependence theory provides a suitable match to explain why institutions might increase its generosity or willingness to pay for students receiving a state grant. Resource dependence theory suggests institutions will seek to maintain and increase resources/revenue, where they may adapt their policies/practices to obtain/sustain new funding (e.g. Froelich, 1999; Pfeffer & Salanick, 2003). Tennessee public DR1

institutions' increase in the number institutional grant aid recipients could have been an effort to maintain or expand their market share of enrollment, tuition revenue, or TELS recipients. These differing responses by Tennessee public institutions post-TELs suggest that principal agent theory needs a companion theory to explain non-opportunistic responses even through the principal does not impose monitoring. In the context of studies on financial aid, resource dependence theory provides an appropriate complement to principal agent theory. Thus, future studies on financial aid and other public financing in higher education should consider combining principal agent and resource dependence theories.

Implications for Research

This study explored different comparison groups to ensure findings were consistent when held up against different comparison groups. Beyond the comparison with other public four-year institutions nationally, this study compared Tennessee public four-year institutions to others subject to a governing or coordinating board with budget authority and states with a large merit aid program. The other public four-year institutions subject to a governing or coordinating board with budget authority provided more precise estimates for nearly all dependent variables. The public four-year institutions subject to a governing entity with budget authority might provide a better subgroup for other research on financial aid or higher education finance. Typically, research studies have only focused on institutions with a consolidated governing board (e.g. Tandberg, 2013). However, the statewide governing entities with budget authority includes more states and institutions, but still localizes the group to those entities that

review and approve budgets. Research on higher education budget and finances should consider including statewide coordinating boards with budget authority since they are similar to consolidated boards as both review and approve institutional/system budgets.

Beyond examining different comparison groups, this study looked within different public four-year institutions to see if there were different responses based on Carnegie Classification. The DID models that include all Carnegie Classification together still had large standard errors on the Tennessee specific variables, which suggest that there was more variation within the public institutions. The disaggregation by Carnegie Classification allow for one way of segmenting the responses and variation by more similar institutions. Separate models were run for each Carnegie Classification to ensure that the corrections for estimation disturbances (e.g. autocorrelation, cross-sectional dependence, and heteroscedasticity) were more localized to each type of public four-year institution. Carnegie Classifications still serve as a means to segment public four-year institutions and remains relevant for future research.

Implications for Policy

The findings of this study can help inform future policy on state financial aid programs. This study demonstrated that some institutions, namely Tennessee Doctoral Intensive and Masters's Colleges/Universities, reduced their institutional grant aid when the TELS program was created. During the policy process, Tennessee lawmakers were so focused on the award criteria (e.g. GPA, test scores, and financial need) and which institutions were eligible (Ness, 2008), which may have left little room for policies and regulations on institutional behavior. The initial legislation was entirely student focused in establishing the application process and eligibility criteria, where there were not any

parameters on monitoring or regulating institutions (Tenn. Code Ann. § 49-9-901-940). With the TELS program providing $1.6 billion in its first six years, the Tennessee state government should have put in place some monitoring protocols that cut across public and private institutions. Thus, future policy on state financial aid should consider the effects of the policy on institutions in addition to students. Monitoring of institutions is one way of ensuring state objectives are being met, but there are others ways for the state to ensure their funding is utilized as intended.

As an alternate to monitoring as a solution for the agency problem, state governments and institutions at the outset of a new policy could collaborate more to ensure new funding or policies meet both the state government and public institution interests. Given that some Tennessee institutions reduced their institutional awards, state lawmakers and institutions could have worked together more to ensure state merit aid funds were packaged in a way that supported students who needed it most to enroll in college or change college choices (e.g. stay in-state for college). By analyzing historic trends in packaging, the state government and institutions could have identified populations of students needing more financial support to achieve both state and institutions objectives. This would have allowed for state merit- and need-based funding to be more targeted to those student who need it most to influence student behavior. Instead, state merit aid is likely more a blunt policy instrument that is inefficiently allocating aid to students since merit aid recipient would likely already enroll in college (e.g. Bowen et al., 2005; Dynarski, 2000; Farrell, 2004; Heller, 2004). Instead of funding students, states could opt to fund institutions directly with block

grant/appropriation for financial aid, where institutions could select and award financial aid that align with each institutions mission and still serves state goals.

There are a number of common goals/objectives shared by states and public institutions. In fact, many of the state goals in creating merit aid programs were already shared by public institutions. With respect to undergraduate education, these common goals could include access to higher education, affordability, enrolling large shares of state residents, educational attainment, and efficiency in operation. These goals align with those commonly referenced in the creation of state merit aid programs, which were to reward academic talent, encourage the best and brightest to stay in state, and increase access and attainment (Heller, 2002). Financial aid provides a tool to serve these goals, but states and institutions need to align their awarding criteria and funding mechanism to achieve these common goals while efficiently using public resources. Prior to the TELS program, public institutions were already providing grants and scholarships to entering students between $1.8 and $2.5 million per year (2013 constant dollars), and yet this was not addressed in the TELS creation. It is possible that Tennessee institutions were already rewarding academic achievement in high school through scholarships, since many institutions provide such scholarships to attract talented students (e.g. Bowen et al., 2005; Ehrenburg, Zhang, & Leven, 2005). State and institutions need to assess financial aid and educational tax benefits provided to students to ensure an equitable distribution of benefits to serve their common goals. More synchronization between states and public institutions could ensure goals are met while public resources are spent more efficiently.

Recommendations for Future Research

This study focused on institutional responses to the creation of a large state merit aid program, where observations were made at the institution level. This study explored the possibility of obtaining student level data, but Tennessee did not collect student level statewide data before the TELS program. In addition, the data collected post-TELS was incredibly limited, which made it difficult to observe institutional responses at the student level. Thus, future research is warranted to further investigate institutional responses to state merit aid by analyzing student level data, which would allow for many extensions of the research questions examined in this study. For instance, with adequate student level data, future research could determine if institutions change merit- or need-based aid differentially after the creation of a large state merit aid program. In addition, future research could determine if certain types of students are treated differently after a state merit aid program is created. The availability of student level data could enhance future research on institutional responses to state merit aid.

Second, future research is needed to examine why Tennessee Technical University responded differently than the other eight Tennessee public four-year institutions post-TELS. Certainly, student level data could help determine why Tennessee Tech was behaving differently enough to bias the results upward. For instance, student level data could help determine if Tennessee Tech had issues with enrollment or was trying to build its prestige through attracting better qualified students. However, a qualitative analysis looking specifically at Tennessee Tech could also provide insight into the rationale for it responding differently post-TELS. In particular, a case study on Tennessee Tech could address the enrollment and financial situation pre- and

post-TELS as well as address the potential motivation for pursuing a different path than the other Tennessee institutions. More investigation into Tennessee Tech could shed light on aspects of their principal-agent relationship with the state that may have contributed to their response. Tennessee Technical University provides a great line of inquiry for additional research on institutional financial aid.

Third, additional research is needed to further probe the differential responses found by Carnegie Classification. This study identified that public Tennessee Doctoral Extensive (DR1) institutions increased their number of institutional grant aid recipients. However, since the data was collected at the institution level, there is not a way to determine if these Tennessee DR1s provided more institutional grant aid to in-state versus out-of-state students or low- versus high-income students. Or, did these DR1 institutions not need the additional financial resources since they may have had access to other revenue streams (e.g. nonresident tuition revenue, research funding, or other donative funding)? In the case of the public Tennessee Doctoral Intensive and Master's College/Universities, it is possible that these Tennessee institutions did not need to spend as much on institutional grant aid to recruit students, which could be better identified with student level from prospective students. Or did these institutions need to cut institutional aid funding in order to fund other parts of institutions? In other words, how did they use any reduction in institutional grant aid funding to cross-subsidize other parts of their operation? Future research could address these and other questions with better quantitative data, such as student level data or through qualitative analysis.

Fourth, the focus of this study was on institutional financial aid, but future research could examine changes in tuition price at Tennessee public institutions. Tuition

at public institutions can be a problematic area of research since tuition setting authorities and philosophies vary by state and institution (Carlson, 2013). In addition, tuition and state appropriations can be jointly determined or at the very least interrelated, where tuition is set in response to state appropriation of vice versa. This makes tuition a difficult variable to examine as a dependent variable and might lead to reverse causality. A difference-in-differences estimation strategy could be used to analyze tuition responses, but it would require careful attention to the tuition setting processes in treatment and control groups. Future research examining potential tuition responses to the TELS program is warranted and would help frame the findings from this study.

Fifth, this study explored a few different modes of comparing Tennessee public four-year institutions with other public four-year institutions in the United States. The different comparison groups helped validate the overall findings by showing that they are relatively similar regardless of the various comparison groups. In addition, this study found interesting differences in institutional responses within Tennessee public four-year institutions when examined by Carnegie Classification. However, future research could explore different methods of developing a comparison group that match institutions more closely to similar institutions on multiple aspects. This study took steps to move from a broad comparison group to relatively small comparison groups in an effort to show results did not change much across comparison groups. While this study took steps to explore comparison groups, there is always more work that can be done to improve a comparison group and reduce pre-treatment variation, such as through synthetic controls (Abadie, Diamond, Hainmueller, 2010), which would take parts of states and construct hypothetical counterfactual comparison states/institutions. Also, there are other

quantitative research methods relevant to this line of inquiry, including DID model alternatives to the parallel path assumption, which were not needed for this study but should be consider in future research. Mora and Reggio (2014) propose alternatives to flexibly account pre-treatment trends and address changes in growth and acceleration of the dependent variable that differ between treated and control groups. In addition, qualitative research methods could help address questions on how and why some Tennessee public institutions reduced their institutional grant aid. For instance, case studies on Tennessee public institutions could help to unpack this institutional decision-making that determined responses to the state merit aid program.

APPENDIX A:

Tennessee State Context

A brief exposition on Tennessee is warranted to contextualize the state economic, demography, political, higher education governance and higher education market. These five domains will help explain how and why Tennessee created a scholarship program and what it means for the principal agent contract that exists between the state and public four-year institutions.

First, leading up to the enactment of the Tennessee state lottery and merit aid program, the state's economic position was in flux. In particular, state revenue was not adequately covering state expenditures, which in part was due to a lack of state income tax and growing public healthcare expenses (Ness, 2008). Leading up to the passage of TELS program, state appropriations for Tennessee public institutions was declining and tuition was increasing in price (Ness, 2008). The state lottery revenue was viewed by many political actors, including colleges and universities, as the only additional funding they might garner from the constrained state budget (Ness, 2008). In a case study on Tennessee, Ness (2008) noted, "the high education community realized that this lottery revenue was the only source of new money their sector would claim for years to come" (pp. 119). Given the limit state resources, public institutions might maximize the new revenue from the TELS program by reducing institutional aid. This makes Tennessee an interesting state to investigate given how higher education leaders perceived the TELS award as the only new funding they would receive for a few years.

Second, the demography in Tennessee followed relative similar patterns as other states. Herein, all population values are based on the author's calculation using data from

the US Census Bureau. The overall total population in Tennessee grew from just under five million in 1990 to over six million in 2009. This growth was similar to the average of the remaining 49 states. The Tennessee population of traditional college aged students (18 to 24 year olds) remained over half a million during this time period. However, between 2001 and 2009, there was some fluctuation in the traditional college age population, where it peaked at just over 576,000 in 2005 followed by a modest decline to just under 549,000 in 2006, but increased again to over 585,000 in 2009. The share of Tennessee population 65 and older grew by nearly one percent between 2001 and 2009, which was a larger and faster rate of increase than other states. Since prior research found associations between state population aspects and state financial support for public higher education (e.g. McLendon et al., 2009), Tennessee's population changes are an important aspect to consider when comparing it to other states on higher education finance and policy.

Third, the political environment in Tennessee is another aspect to consider in the state context. The Tennessee political environment leading up to the creation of a lottery funded state merit aid program was chronicled by Ness (2008) in his qualitative investigation in numerous states that adopted similar scholarship programs. The governor's office in Tennessee has substantive executive powers and it was held by a Republican from 1994 to 2002, which coincided with the passage of the state education lottery referendum (Ness, 2008). On average, Republicans represented 42% of the House and 46% of the Senate in Tennessee between 1989 and 2009 (Council of State Government, 2011). Legislative interest in a state lottery first developed in the early-1980's, but its funds were not thought to be directed toward higher education until after

Georgia enacted its HOPE scholarship in 1993 (Ness, 2008). However, real political traction for the state lottery to fund higher education didn't develop until 2002 when referendum was put on state ballots, which develop in part from a state budget crisis (Ness, 2008). While it was a voter referendum that authorized state lottery revenue to fund higher education, it was the state legislature that finalized the details of the Tennessee Education Lottery Scholarship (TELS) program (Ness, 2008). The details of the TELS program were discussed in a joint House and Senate taskforce that included higher education leaders for institutions and system governing/coordinating entities (Ness, 2008).

Fifth, closely related to Tennessee's political environment with respect to public higher education are the governance structures/systems put in place to oversee and coordinate operation of Tennessee's public four-year institutions. Public higher education in Tennessee is governed by two boards, the University of Tennessee System and Tennessee Board of Regents. The governor has the authority to make appointments to any open position on both boards and non-appointed members come from the Governor's cabinet. The members of the boards must be distribute to represent each electoral jurisdiction in Tennessee. The University of Tennessee System includes 17 members representing each of the congressional districts, two faculty, two students, and five ex-officio members of the Governor's cabinet (Tennessee Code Annotated, § 49-9-202(a)). The Tennessee Board of Regents includes 14 members (12 lay members, one faculty, and one student) and the remaining four non-voting members include the governor and members of his/her cabinet (Tennessee Code Annotated, § 49-8-201). In addition, the Tennessee Higher Education Commission (THEC) serves a coordinating

agency to approve programs and provide advice/guidance to the state legislature (Ness, 2008). The governor appoints members to THEC as well. Appointments to the governing boards can last for up to six years, which stretch beyond a governor's term, but the gubernatorial power to make appointments affords the governor with substantial control over higher education. These boards and agency centralize coordinating and governing of public higher education in Tennessee.

Sixth, aspects of the higher education industry are important aspect to consider when assess state policy especially the public higher education landscape. Within Tennessee, there nine public four-year institutions split between the two state governing boards. The University of Tennessee System controls three campuses in Knoxville, Chattanooga, and Martin, but also includes a health science center. The Tennessee Board of Regents governs six public four-year institutions, thirteen community colleges, and 27 applied technical colleges. Total enrollment at all these Tennessee public institutions combined was over 208,000 in fall 2000 and grew sixteen percent by fall 2012 to just over 235,000 students (US Depart of Education, 2013). Tennessee four-year public institutions enrolled 61 percent of students attending any public four- or two-year degree-granting institution (US Depart of Education, 2013). While still the largest share of colleges enrollments, public four-year institution enroll 42 percent of students attending any public, nonprofit, or for-profit degree granting institution, so other sectors and institutional types have substantive role in Tennessee as well (US Depart of Education, 2013). Yet, Tennessee public four-year institutions represent the largest enrollment share across institutional types and sectors.

All of these economic, demographic, and political, higher education governance, and higher education industry aspects were operating when Tennessee adopted a lottery and implemented a statewide merit aid program. Tennessee was one of the more recent states to adopt a state-wide merit aid program. The impetus for the Tennessee merit scholarship program was a voter referendum in 2002 (Ness, 2008; Ness & Noland, 2007). The most contentious part of the debates on implementing a merit aid program were if private nonprofit institutions were eligible to receive scholarship recipients, which they were allowed in the end (Ness, 2008). The program was enacted in 2003 to utilize state lottery revenue to fund scholarships for Tennessee residents to attend college in-state (Ness, 2008). The Tennessee Education Lottery Scholarship (TELS) program was initially implemented for the 2004-05 academic year. In its first year, Tennessee provided scholarships for 40,195 recipients with roughly $93.4 million in award funding (Tennessee Higher Education Commission, 2011; Tennessee Education Lottery, 2005). As of 2011, the TELS program funded 532,000 students for a cumulative total $1.6 billion in scholarship funding (Tennessee Higher Education Commission, 2011). In order to get to these funding levels, Tennessee set up its merit aid award program using a slightly different model than other states.

As the most recent state merit aid program, Tennessee had quite a few other merit aid scholarship programs to review when creating the TELS program. However, the TELS program was based primarily on the Georgia HOPE Scholarship model, but with some noticeable differences (Ness & Noland, 2007). In particular, Tennessee included more flexibility and multi-tiered awards based on academic and financial need criterion to allow for more access to state awards. Initially, graduating high school students

needed to have at least a 3.0 GPA or 19 ACT composite test score to receive the base award or Tennessee HOPE scholarship of $3,000 per year in college. In addition, students with at least 3.75 and 29 ACT composite score would receive the General Assembly Merit Scholarship (GAMS), which provided an additional $1,000 annually. Aspire Awards were a second supplemental award available to families with incomes below $36,000 and where students met the base HOPE scholarship academic requirements, which made available an additional $1,000. In order to provide access for the neediest families (e.g. family AGI less than $36,000), an Access Award was created for students who did not meet the other award criterion but who had at least 2.75 GPA and 18 ACT composite test score, which provide $2,000 for the first year of college. While these were the award criteria and amounts at implementation in 2004-05, policymakers in Tennessee increased the awards periodically to ensure the scholarships kept pace with tuition and fee increases at colleges. Table 1 displays the selected years of the award program to highlight some of the changes in award amounts. Another important facet of the state merit aid programs is the scholarship renewal criteria. From 2004-05 to 2007-08, renewal of the HOPE, GAMS, and Aspire awards required a cumulative 3.0 college GPA. Beginning in fall 2008, Tennessee created alternate avenues for students who fell below the 3.0 cumulative GPA as a means for students to maintain funding and attempt to get back on the traditional academic track.

Table 1

Tennessee Education Lottery Scholarship Award Summary for Selected Years

Award Type	Criteria Type		2004-05 Institutional Type		2008-09 Institutional Type		2010-11 Institutional Type	
			4-yr	2-yr	4-yr	2-yr	4-yr	2-yr
Hope	Academic	3.0 HS GPA or 19 ACT	$3,000	$1,500	$4,000	$2,000	$4,000	$2,000
	Financial	N/A						
GAMS	Academic	3.75 HS GPA and 29 ACT	$4,000 (base+ $1,000)	$2,500 (base+ $1,000)	$5,000 (base+ $1,000)	$3,000 (base+ $1,000)	$5,000 (base+ $1,000)	$3,000 (base+ $1,000)
	Financial	N/A						
Aspire	Academic	3.00 HS GPA or 19 ACT	$4,000 (base+ $1,000)	$2,500 (base+ $1,000)	$5,500 (base+ $1,500)	$3,500 (base+ $1,500)	$5,500 (base+ $1,500)	$3,500 (base+ $1,500)
	Financial	AGI < $36,000						
Access Award	Academic	2.75-2.99 HS GPA and 18-20	$2,000	$1,250	$2,750	$1,750	$2,750	$1,750
	Financial	AGI < $36,000						
Wilder-Naifeh	Academic	N/A		$1,250		$2,000		$2,000
	Financial	N/A						

Ness & Noland, 2007; Gentry, 2007; Tennesse Higher Education Commission, 2011

The TELS program was more multifaceted than other state merit programs, where it provided multiple paths for students to receive awards based on academic achievement and financial need. While the Tennessee merit aid program was modeled on the Georgia HOPE scholarship, TELS offered more access points to funding than the Georgia HOPE program at their respective implementation years (Ness, 2008). When the Georgia HOPE scholarship was implemented in 1993, their only academic criterion to determine eligibility was a 3.0 GPA in high school. Tennessee's merit scholarships allowed students to receive some funding for various level of achievement based high school GPA or ACT test scores. In addition, the TELS program included need based

components, which created lower academic entry points to the scholarship for the states' neediest students/families. These advances in student criterion for merit are interesting in that show how state program learned from earlier iteration of other state merit aid programs. However, Tennessee did not impose any restrictions on colleges and universities could set tuition and room/board prices or allocate institutional aid as part of the TELS program implementation.

APPENDIX TABLES

These appendix table provide additional to those reported in Chapter Four, where the follow the same number scheme as those in the chapter but with the suffix “B” instead of “A.”

Appendix Table 4.1B

Descripitive Statistics (Logged Transformed)

	N	Mean	Stad. Dev.	Min	25th Percentile	75th Percentile	Max
Total institutional grant aid	3983	13.9	1.8	0.0	13.1	15.0	17.6
Number of institutional grant aid recipients	3983	5.9	1.2	0.0	5.3	6.8	8.7
Entire class average institutional grant aid (includes non-recipients)	3983	6.6	1.2	0.0	6.1	7.4	9.3
Recipient average institutional grant aid (includes only recipients)	3983	8.0	0.8	0.0	7.7	8.4	9.7
State appropriations	3939	18.1	0.9	14.3	17.5	18.8	20.6
Private gifts	3962	14.8	1.8	12.5	13.2	16.1	19.9
Investment income	3963	21.4	0.3	0.0	21.4	21.4	22.0
Total state grant aid	3983	13.8	1.8	0.0	13.2	14.8	17.2
Total federal grant aid	3983	14.2	0.9	0.0	13.7	14.8	16.4
Population of 18-year-olds	3983	11.5	0.9	8.9	11.0	12.1	13.2

Appendix Table 4.2B

Descripitive Statistics (Logged Transformed), by State and Time

	TN Pre-TELS (2000-		Other States Pre-		TN Post-TELS		Other StatesPost-		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Total institutional grant aid	13.99	0.18	13.59	0.04	14.55	0.10	14.15	0.04	13.88	0.03
Number of institutional grant aid recipients	5.76	0.14	5.77	0.03	6.27	0.10	6.08	0.03	5.93	0.02
Entire class average institutional grant aid (includes non-recipients)	6.66	0.15	6.42	0.03	7.04	0.07	6.82	0.03	6.63	0.02
Recipient average institutional grant aid (includes only recipients)	8.24	0.07	7.83	0.02	8.28	0.03	8.08	0.02	7.96	0.01
State appropriations	18.17	0.11	18.13	0.02	18.20	0.11	18.13	0.02	18.13	0.01
Private gifts	15.34	0.22	14.89	0.04	14.92	0.19	14.66	0.04	14.78	0.03
Investment income	21.40	0.00	21.40	0.00	21.41	0.00	21.39	0.01	21.40	0.01
Total state grant aid	12.94	0.11	13.59	0.04	15.51	0.11	13.98	0.04	13.79	0.03
Total federal grant aid	14.23	0.11	14.04	0.02	14.60	0.05	14.30	0.02	14.18	0.01
Populations of 18 year olds	11.26	0.00	11.50	0.02	11.31	0.00	11.55	0.02	11.52	0.01

Appendix Table 4.3

Independent Variable Changes Across TELS Time Threshold

	(1) State Appropriation	(2) State Appropriation	(3) Private Gifts	(4) Private Gifts	(5) Investment Income	(6) Investment Income	(7) Fed. Grant Aid	(8) Fed. Grant Aid
TN*Post-TELS	0.039	0.039	-0.184	-0.184	0.011	0.011	0.115	0.115
	(0.032)	(0.021)+	(0.155)	(0.129)	(0.074)	(0.011)	(0.107)	(0.173)
Post-TELS	-0.018	-0.018	-0.748	-0.748	-0.064	-0.064	0.731	0.731
	(0.011)+	(0.016)	(0.052)**	(0.068)**	(0.025)**	(0.054)	(0.036)**	(0.049)**
Constant	18.138	18.138	15.494	15.494	21.402	21.402	13.809	13.809
	(0.008)**	(0.008)**	(0.036)**	(0.050)**	(0.017)**	(0.005)**	(0.025)**	(0.041)**
Observations	3,939	3,939	3,962	3,962	3,963	3,963	3,983	3,983
R-squared	0.050	0.050	0.238	0.238	0.004	0.004	0.151	0.151
Number of institution	399	399	399	399	399	399	399	399
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE		YES		YES		YES		YES

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Table 4.4

Admissions Variable Changes Across TELS Time Threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Applicants	Applicants	Admits	Admits	25th Test Percentile	25th Test Percentile	75th Test Percentile	75th Test Percentile
TN*Post-TELS	-0.030	-0.030	0.063	0.063	0.015	0.015	-0.004	-0.004
	(0.049)	(0.074)	(0.054)	(0.101)	(0.008)+	(0.014)	(0.008)	(0.010)
Post-TELS	0.379	0.379	0.248	0.248	0.030	0.030	0.016	0.016
	(0.021)**	(0.028)**	(0.023)**	(0.027)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**
Constant	8.340	8.340	8.016	8.016	2.951	2.951	3.210	3.210
	(0.018)**	(0.024)**	(0.020)**	(0.023)**	(0.003)**	(0.004)**	(0.003)**	(0.003)**
Observations	2,977	2,977	2,976	2,976	2,960	2,960	2,960	2,960
R-squared	0.332	0.332	0.231	0.231	0.087	0.087	0.044	0.044
Number of institutions	385	385	385	385	384	384	384	384
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE		YES		YES		YES		YES

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.6B

Total Institutional Grant Aid Post-Years Difference-in-Differences Specification

	(1) Total	(2) Total	(3) Total	(4) Total
TN*Post-TELS Yr1	-0.026	-0.026	-0.117	-0.117
	(0.269)	(0.078)	(0.236)	(0.102)
TN*Post-TELS Yr2	-0.018	-0.018	-0.019	-0.019
	(0.206)	(0.078)	(0.193)	(0.082)
TN*Post-TELS Yr3	-0.102	-0.101	-0.228	-0.234
	(0.246)	(0.078)	(0.191)	(0.094)*
TN*Post-TELS Yr4	0.077	0.077	-0.073	-0.084
	(0.247)	(0.075)	(0.208)	(0.098)
TN*Post-TELS Yr5	-0.001	-0.001	-0.060	-0.075
	(0.232)	(0.075)	(0.170)	(0.079)
State Appropriations			0.255	0.241
			(0.180)	(0.218)
Private Gifts			-0.002	-0.024
			(0.028)	(0.011)+
Investment Income			0.007	0.007
			(0.003)*	(0.002)*
Federal Grant Aid			0.646	0.662
			(0.155)**	(0.166)**
Population of 18-yr-olds			0.014	0.121
			(0.892)	(0.657)
Post-TELS Yr1	0.646	0.379	0.390	0.266
	(0.089)**	(0.090)**	(0.104)**	(0.028)**
Post-TELS Yr2	0.691	0.424	0.487	0.365
	(0.088)**	(0.090)**	(0.093)**	(0.032)**
Post-TELS Yr3	0.860	0.593	0.577	0.453
	(0.086)**	(0.090)**	(0.112)**	(0.031)**
Post-TELS Yr4	0.877	0.610	0.497	0.368
	(0.090)**	(0.086)**	(0.136)**	(0.043)**
Post-TELS Yr5	1.081	0.814	0.603	0.473
	(0.084)**	(0.086)**	(0.143)**	(0.052)**
Constant	13.332	13.599	-0.482	-1.271
	(0.071)**	(0.088)**	(10.050)	(5.030)
Observations	3,983	3,983	3,938	3,938
R-squared	0.112		0.214	
Number of unitid	399	399	399	399
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
XTREG	YES		YES	
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.7B

Number of Institutional Grant Aid Recipients Post-Years Difference-in-Differences Specification

	(1) Number	(2) Number	(3) Number	(4) Number
TN*Post-TELS Yr1	0.114	0.114	0.079	0.080
	(0.231)	(0.036)*	(0.219)	(0.030)*
TN*Post-TELS Yr2	0.158	0.158	0.159	0.159
	(0.113)	(0.036)**	(0.109)	(0.029)**
TN*Post-TELS Yr3	0.203	0.204	0.134	0.128
	(0.133)	(0.036)**	(0.117)	(0.032)**
TN*Post-TELS Yr4	0.245	0.245	0.171	0.161
	(0.152)	(0.035)**	(0.137)	(0.033)**
TN*Post-TELS Yr5	0.251	0.251	0.212	0.199
	(0.129)+	(0.035)**	(0.111)+	(0.033)**
State Appropriations			0.111	0.099
			(0.082)	(0.087)
Private Gifts			0.004	-0.014
			(0.016)	(0.009)
Investment Income			0.009	0.010
			(0.002)**	(0.003)*
Federal Grant Aid			0.290	0.304
			(0.065)**	(0.057)**
Population of 18-yr-olds			0.770	0.879
			(0.492)	(0.243)**
Post-TELS Yr1	0.331	0.165	0.209	0.104
	(0.046)**	(0.055)*	(0.055)**	(0.025)**
Post-TELS Yr2	0.395	0.229	0.288	0.184
	(0.046)**	(0.055)**	(0.050)**	(0.024)**
Post-TELS Yr3	0.496	0.329	0.341	0.236
	(0.047)**	(0.055)**	(0.059)**	(0.024)**
Post-TELS Yr4	0.530	0.364	0.304	0.193
	(0.051)**	(0.053)**	(0.070)**	(0.027)**
Post-TELS Yr5	0.612	0.446	0.349	0.239
	(0.046)**	(0.053)**	(0.072)**	(0.030)**
Constant	5.604	5.771	-9.536	-10.404
	(0.036)**	(0.054)**	(5.545)+	(2.926)**
Observations	3,983	3,983	3,938	3,938
R-squared	0.119		0.191	
Number of unitid	399	399	399	399
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.8B

Entire Class Average Institutional Grant Aid Post-Years Difference-in-Differences Specification

	(1) Entire Class Avg.	(2) Entire Class Avg.	(3) Entire Class Avg.	(4) Entire Class Avg.
TN*Post-TELS Yr1	-0.024	-0.023	-0.070	-0.069
	(0.250)	(0.066)	(0.227)	(0.075)
TN*Post-TELS Yr2	-0.038	-0.037	-0.033	-0.033
	(0.205)	(0.066)	(0.194)	(0.067)
TN*Post-TELS Yr3	-0.081	-0.081	-0.131	-0.136
	(0.245)	(0.066)	(0.214)	(0.073)+
TN*Post-TELS Yr4	0.034	0.034	-0.042	-0.051
	(0.260)	(0.065)	(0.236)	(0.076)
TN*Post-TELS Yr5	0.004	0.004	-0.007	-0.020
	(0.248)	(0.065)	(0.218)	(0.068)
State Appropriations			0.059	0.041
			(0.090)	(0.076)
Private Gifts			0.001	-0.016
			(0.018)	(0.009)+
Investment Income			0.006	0.006
			(0.002)**	(0.003)*
Federal Grant Aid			0.333	0.346
			(0.083)**	(0.098)**
Population of 18-yr-olds			-0.647	-0.510
			(0.524)	(0.511)
Post-TELS Yr1	0.431	0.269	0.306	0.210
	(0.054)**	(0.055)**	(0.061)**	(0.021)**
Post-TELS Yr2	0.472	0.310	0.379	0.284
	(0.055)**	(0.055)**	(0.057)**	(0.026)**
Post-TELS Yr3	0.564	0.402	0.443	0.346
	(0.054)**	(0.055)**	(0.065)**	(0.028)**
Post-TELS Yr4	0.592	0.431	0.459	0.357
	(0.058)**	(0.053)**	(0.079)**	(0.039)**
Post-TELS Yr5	0.747	0.586	0.539	0.436
	(0.055)**	(0.053)**	(0.083)**	(0.038)**
Constant	6.267	6.428	7.893	6.792
	(0.044)**	(0.054)**	(6.020)	(4.370)
Observations	3,983	3,983	3,938	3,938
R-squared	0.125		0.188	
Number of unitid	399	399	399	399
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Robust SE	YES		YES	
Driscoll-Kraay SE		YES		YES

Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.9B

Recipient Average Institutional Grant Aid Post-Years
Difference-in-Differences Specification

	(1) Recipient Avg.	(2) Recipient Avg.	(3) Recipient Avg.	(4) Recipient Avg.
TN*Post-TELS Yr1	-0.140	-0.140	-0.197	-0.197
	(0.222)	(0.105)	(0.213)	(0.094)*
TN*Post-TELS Yr2	-0.176	-0.176	-0.178	-0.178
	(0.222)	(0.102)+	(0.213)	(0.095)+
TN*Post-TELS Yr3	-0.306	-0.306	-0.362	-0.362
	(0.222)	(0.125)*	(0.213)+	(0.084)**
TN*Post-TELS Yr4	-0.168	-0.168	-0.243	-0.243
	(0.222)	(0.122)	(0.213)	(0.103)*
TN*Post-TELS Yr5	-0.255	-0.255	-0.272	-0.272
	(0.222)	(0.121)*	(0.213)	(0.081)**
State Appropriations			0.153	0.153
			(0.064)*	(0.124)
Private Gifts			-0.006	-0.006
			(0.013)	(0.018)
Investment Income			-0.003	-0.003
			(0.028)	(0.002)
Federal Grant Aid			0.355	0.355
			(0.019)**	(0.098)**
Population of 18-yr-olds			-0.807	-0.807
			(0.315)*	(0.513)
Post-TELS Yr1	0.311	0.311	0.179	0.179
	(0.043)**	(0.057)**	(0.044)**	(0.062)**
Post-TELS Yr2	0.291	0.291	0.196	0.196
	(0.043)**	(0.055)**	(0.044)**	(0.057)**
Post-TELS Yr3	0.361	0.361	0.234	0.234
	(0.043)**	(0.055)**	(0.045)**	(0.066)**
Post-TELS Yr4	0.341	0.341	0.192	0.192
	(0.043)**	(0.055)**	(0.051)**	(0.080)*
Post-TELS Yr5	0.466	0.466	0.254	0.254
	(0.043)**	(0.053)**	(0.049)**	(0.084)**
Constant	7.738	7.738	9.490	9.490
	(0.030)**	(0.045)**	(3.768)*	(6.163)
Observations	3,983	3,983	3,938	3,938
R-squared	0.057	0.057	0.140	0.140
Number of unitid	399	399	399	399
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Robust SE		YES		YES
Driscoll-Kraay SE				

Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.10B

Post-Years Difference-in-Differences Comparison Groups: Total Institional Grant Aid

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Total	Total	Total	Total	Total	Total
TN*Post-TELS Yr1	-0.026	-0.117	0.038	-0.013	-0.111	-0.162	-0.122	-0.172
	(0.078)	(0.102)	(0.050)	(0.050)	(0.082)	(0.086)+	(0.081)	(0.076)+
TN*Post-TELS Yr2	-0.018	-0.019	0.041	0.037	-0.021	-0.008	-0.027	-0.003
	(0.078)	(0.082)	(0.050)	(0.047)	(0.082)	(0.068)	(0.081)	(0.058)
TN*Post-TELS Yr3	-0.101	-0.234	-0.028	-0.094	-0.084	-0.124	-0.044	-0.061
	(0.078)	(0.094)*	(0.050)	(0.037)*	(0.082)	(0.049)*	(0.081)	(0.047)
TN*Post-TELS Yr4	0.077	-0.084	0.072	-0.059	0.280	0.193	0.120	0.039
	(0.075)	(0.098)	(0.050)	(0.043)	(0.082)**	(0.061)*	(0.081)	(0.072)
TN*Post-TELS Yr5	-0.001	-0.075	0.030	-0.013	-0.017	-0.044	-0.069	-0.089
	(0.075)	(0.079)	(0.050)	(0.037)	(0.082)	(0.064)	(0.081)	(0.071)
State Appropriations		0.241		-0.002		0.433		0.237
		(0.218)		(0.078)		(0.135)*		(0.175)
Private Gifts		-0.024		-0.037		-0.084		-0.097
		(0.011)+		(0.028)		(0.029)*		(0.040)*
Investment Income		0.007		1.094		-0.917		-0.182
		(0.002)*		(0.236)**		(1.297)		(1.806)
Federal Grant Aid		0.662		0.486		0.395		0.287
		(0.166)**		(0.082)**		(0.096)**		(0.097)*
Population of 18-yr-olds		0.121		-0.613		-1.590		-2.774
		(0.657)		(0.856)		(1.347)		(1.864)
Post-TELS Yr1	0.379	0.266	0.314	0.212	0.463	0.369	0.474	0.409
	(0.090)**	(0.028)**	(0.078)**	(0.043)**	(0.124)**	(0.094)**	(0.121)**	(0.093)**
Post-TELS Yr2	0.424	0.365	0.366	0.327	0.428	0.386	0.434	0.404
	(0.090)**	(0.032)**	(0.078)**	(0.036)**	(0.124)**	(0.078)**	(0.121)**	(0.082)**
Post-TELS Yr3	0.593	0.453	0.520	0.413	0.576	0.515	0.536	0.551
	(0.090)**	(0.031)**	(0.078)**	(0.054)**	(0.124)**	(0.124)**	(0.121)**	(0.155)**
Post-TELS Yr4	0.610	0.368	0.615	0.514	0.407	0.332	0.567	0.651
	(0.086)**	(0.043)**	(0.078)**	(0.089)**	(0.124)**	(0.182)	(0.121)**	(0.247)*
Post-TELS Yr5	0.814	0.473	0.783	0.573	0.830	0.698	0.883	0.899
	(0.086)**	(0.052)**	(0.078)**	(0.088)**	(0.124)**	(0.186)**	(0.121)**	(0.229)**
Constant	13.599	-1.271	13.646	-9.182	13.419	38.855	13.472	42.181
	(0.088)**	(5.029)	(0.078)**	(9.683)	(0.117)**	(35.024)	(0.113)**	(48.010)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of unitid	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority			YES	YES			YES	YES
Strong Merit					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.11B

Post-Years Difference-in-Differences Comparison Groups: Number of Institutional Grant Aid Recipients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Number	Number	Number	Number	Number	Number	Number	Number
TN*Post-TELS Yr1	0.114	0.080	0.118	0.082	0.063	0.034	0.062	0.030
	(0.036)*	(0.030)*	(0.024)**	(0.017)**	(0.031)+	(0.022)	(0.031)+	(0.022)
TN*Post-TELS Yr2	0.158	0.159	0.156	0.135	0.163	0.164	0.188	0.191
	(0.036)**	(0.029)**	(0.024)**	(0.018)**	(0.031)**	(0.030)**	(0.031)**	(0.032)**
TN*Post-TELS Yr3	0.204	0.128	0.217	0.134	0.210	0.184	0.256	0.238
	(0.036)**	(0.032)**	(0.024)**	(0.024)**	(0.031)**	(0.028)**	(0.031)**	(0.032)**
TN*Post-TELS Yr4	0.245	0.161	0.228	0.111	0.367	0.327	0.335	0.289
	(0.035)**	(0.033)**	(0.024)**	(0.022)**	(0.031)**	(0.024)**	(0.031)**	(0.028)**
TN*Post-TELS Yr5	0.251	0.199	0.237	0.154	0.288	0.275	0.263	0.240
	(0.035)**	(0.033)**	(0.024)**	(0.024)**	(0.031)**	(0.033)**	(0.031)**	(0.036)**
State Appropriations		0.099		0.011		0.523		0.329
		(0.087)		(0.044)		(0.120)**		(0.119)*
Private Gifts		-0.014		-0.036		-0.043		-0.053
		(0.009)		(0.016)+		(0.012)**		(0.021)*
Investment Income		0.010		0.331		-0.784		-0.659
		(0.003)*		(0.167)+		(0.493)		(0.416)
Federal Grant Aid		0.304		0.300		0.263		0.209
		(0.057)**		(0.047)**		(0.053)**		(0.066)*
Population of 18-yr-olds		0.879		0.824		0.207		-0.578
		(0.243)**		(0.367)+		(0.559)		(0.818)
Post-TELS Yr1	0.165	0.104	0.161	0.097	0.216	0.145	0.217	0.166
	(0.055)*	(0.025)**	(0.051)*	(0.025)**	(0.056)**	(0.031)**	(0.052)**	(0.029)**
Post-TELS Yr2	0.229	0.184	0.231	0.201	0.224	0.184	0.200	0.173
	(0.055)**	(0.024)**	(0.051)**	(0.020)**	(0.056)**	(0.024)**	(0.052)**	(0.023)**
Post-TELS Yr3	0.329	0.236	0.316	0.229	0.323	0.212	0.277	0.223
	(0.055)**	(0.024)**	(0.051)**	(0.029)**	(0.056)**	(0.036)**	(0.052)**	(0.057)**
Post-TELS Yr4	0.364	0.193	0.380	0.247	0.242	0.056	0.273	0.200
	(0.053)**	(0.027)**	(0.051)**	(0.044)**	(0.056)**	(0.056)	(0.052)**	(0.101)+
Post-TELS Yr5	0.446	0.239	0.460	0.278	0.409	0.224	0.435	0.347
	(0.053)**	(0.030)**	(0.051)**	(0.046)**	(0.056)**	(0.059)**	(0.052)**	(0.094)**
Constant	5.771	-10.404	5.791	-14.291	5.603	7.505	5.610	18.177
	(0.054)**	(2.926)**	(0.052)**	(7.047)+	(0.056)**	(12.744)	(0.053)**	(13.479)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of unitid	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority			YES	YES			YES	YES
Strong Merit					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.12B

Post-Years Difference-in-Differences Comparison Groups: Entire Class Average Institutional Grant Aid

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.	Entire Class Avg.
TN*Post-TELS Yr1	-0.023	-0.069	0.006	-0.016	-0.052	-0.090	-0.048	-0.070
	(0.066)	(0.075)	(0.052)	(0.053)	(0.061)	(0.070)	(0.061)	(0.067)
TN*Post-TELS Yr2	-0.037	-0.033	-0.011	0.004	-0.035	-0.017	-0.029	0.006
	(0.066)	(0.067)	(0.052)	(0.051)	(0.061)	(0.064)	(0.061)	(0.063)
TN*Post-TELS Yr3	-0.081	-0.136	-0.055	-0.064	-0.083	-0.096	-0.032	-0.031
	(0.066)	(0.073)+	(0.052)	(0.048)	(0.061)	(0.057)	(0.061)	(0.060)
TN*Post-TELS Yr4	0.034	-0.051	0.011	-0.051	0.144	0.095	0.097	0.049
	(0.065)	(0.076)	(0.052)	(0.052)	(0.061)*	(0.056)	(0.061)	(0.065)
TN*Post-TELS Yr5	0.004	-0.020	-0.012	-0.001	-0.035	-0.035	-0.078	-0.070
	(0.065)	(0.068)	(0.052)	(0.049)	(0.061)	(0.058)	(0.061)	(0.068)
State Appropriations		0.041		-0.078		0.163		-0.173
		(0.076)		(0.039)+		(0.114)		(0.159)
Private Gifts		-0.016		-0.018		-0.028		-0.036
		(0.009)+		(0.023)		(0.014)+		(0.026)
Investment Income		0.006		0.965		-1.248		-0.286
		(0.003)*		(0.168)**		(1.622)		(2.174)
Federal Grant Aid		0.346		0.273		0.211		0.136
		(0.098)**		(0.062)**		(0.076)*		(0.082)
Population of 18-yr-olds		-0.510		-1.062		-2.054		-3.113
		(0.511)		(0.699)		(0.783)*		(1.258)*
Post-TELS Yr1	0.269	0.210	0.240	0.178	0.298	0.270	0.294	0.275
	(0.055)**	(0.021)**	(0.050)**	(0.032)**	(0.056)**	(0.055)**	(0.046)**	(0.044)**
Post-TELS Yr2	0.310	0.284	0.284	0.258	0.308	0.307	0.302	0.305
	(0.055)**	(0.026)**	(0.050)**	(0.027)**	(0.056)**	(0.045)**	(0.046)**	(0.037)**
Post-TELS Yr3	0.402	0.346	0.376	0.326	0.404	0.441	0.353	0.462
	(0.055)**	(0.028)**	(0.051)**	(0.044)**	(0.056)**	(0.071)**	(0.046)**	(0.088)**
Post-TELS Yr4	0.431	0.357	0.453	0.453	0.320	0.396	0.368	0.595
	(0.053)**	(0.039)**	(0.050)**	(0.074)**	(0.056)**	(0.105)**	(0.046)**	(0.152)**
Post-TELS Yr5	0.586	0.436	0.602	0.512	0.625	0.642	0.668	0.805
	(0.053)**	(0.038)**	(0.050)**	(0.071)**	(0.056)**	(0.108)**	(0.046)**	(0.138)**
Constant	6.428	6.792	6.467	-4.550	6.219	50.632	6.211	49.706
	(0.054)**	(4.369)	(0.051)**	(7.847)	(0.055)**	(34.476)	(0.046)**	(44.307)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
Number of unitid	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority			YES	YES			YES	YES
Strong Merit					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.13B

Post-Years Difference-in-Differences Comparison Groups: Recipient Average Institutional Grant Aid

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Recipient Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.	Recipient Avg.
TN*Post-TELS Yr1	-0.140	-0.197	-0.078	-0.094	-0.172	-0.193	-0.182	-0.204
	(0.105)	(0.094)*	(0.107)	(0.099)	(0.121)	(0.120)	(0.126)	(0.131)
TN*Post-TELS Yr2	-0.176	-0.178	-0.116	-0.097	-0.184	-0.170	-0.215	-0.196
	(0.102)+	(0.095)+	(0.104)	(0.097)	(0.121)	(0.112)	(0.126)+	(0.123)
TN*Post-TELS Yr3	-0.306	-0.362	-0.245	-0.221	-0.294	-0.293	-0.301	-0.288
	(0.125)*	(0.084)**	(0.126)+	(0.109)*	(0.141)*	(0.125)*	(0.145)*	(0.137)*
TN*Post-TELS Yr4	-0.168	-0.243	-0.157	-0.161	-0.087	-0.112	-0.216	-0.229
	(0.122)	(0.103)*	(0.122)	(0.108)	(0.186)	(0.176)	(0.141)	(0.142)
TN*Post-TELS Yr5	-0.255	-0.272	-0.207	-0.155	-0.316	-0.311	-0.332	-0.314
	(0.121)*	(0.081)**	(0.122)+	(0.101)	(0.138)*	(0.133)*	(0.140)*	(0.140)*
State Appropriations		0.153		0.012		-0.072		-0.007
		(0.124)		(0.060)		(0.224)		(0.270)
Private Gifts		-0.006		0.008		-0.011		-0.016
		(0.018)		(0.022)		(0.037)		(0.037)
Investment Income		-0.003		0.667		-0.612		-0.016
		(0.002)		(0.365)+		(1.199)		(0.944)
Federal Grant Aid		0.355		0.161		0.063		0.012
		(0.098)**		(0.072)*		(0.134)		(0.145)
Population of 18-yr-olds		-0.807		-1.517		-1.893		-2.226
		(0.513)		(0.536)**		(1.075)+		(1.085)*
Post-TELS Yr1	0.311	0.179	0.198	0.141	0.393	0.371	0.406	0.397
	(0.057)**	(0.062)**	(0.053)**	(0.060)*	(0.132)**	(0.159)*	(0.149)**	(0.189)*
Post-TELS Yr2	0.291	0.196	0.180	0.148	0.349	0.337	0.384	0.374
	(0.055)**	(0.057)**	(0.053)**	(0.056)**	(0.133)*	(0.142)*	(0.151)*	(0.168)*
Post-TELS Yr3	0.361	0.234	0.248	0.209	0.399	0.448	0.408	0.476
	(0.055)**	(0.066)**	(0.045)**	(0.059)**	(0.133)**	(0.176)*	(0.151)**	(0.202)*
Post-TELS Yr4	0.341	0.192	0.279	0.296	0.311	0.430	0.443	0.601
	(0.055)**	(0.080)*	(0.046)**	(0.081)**	(0.184)+	(0.272)	(0.152)**	(0.250)*
Post-TELS Yr5	0.466	0.254	0.367	0.326	0.577	0.647	0.596	0.717
	(0.053)**	(0.084)**	(0.047)**	(0.084)**	(0.134)**	(0.238)**	(0.150)**	(0.271)*
Constant	7.738	9.490	7.816	7.800	7.676	42.799	7.719	33.741
	(0.045)**	(6.163)	(0.036)**	(9.483)	(0.100)**	(30.559)	(0.113)**	(28.842)
Observations	3,983	3,938	2,426	2,395	680	680	600	600
R-squared	0.057	0.140	0.060	0.076	0.077	0.094	0.104	0.133
Number of unitid	399	399	243	243	68	68	60	60
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES
Budget Authority			YES	YES			YES	YES
Strong Merit					YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Table 4.15

Leave One Out Analysis Basic Difference-in-Difference Post-TELS Tennessee Response

	(1) Overall Model	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total Institutional Grant Aid	-0.099	-0.119	-0.086	-0.110	-0.058	-0.070	-0.143	-0.012	-0.044	**-0.252**
	(0.180)	(0.200)	(0.204)	(0.201)	(0.197)	(0.199)	(0.196)	(0.179)	(0.193)	**(0.120)***
Number of Recipients	0.151	0.143	0.152	0.158	0.176	0.179	0.119	0.200	0.175	**0.056**
	(0.110)	(0.123)	(0.124)	(0.123)	(0.121)	(0.120)	(0.119)	(0.112)+	(0.121)	**(0.071)**
Entire Class Average	-0.057	-0.098	-0.001	-0.071	-0.025	-0.067	-0.096	0.052	0.013	**-0.215**
	(0.200)	(0.220)	(0.217)	(0.224)	(0.222)	(0.224)	(0.220)	(0.192)	(0.212)	**(0.148)**
Recipient Average	-0.250	-0.263	-0.238	-0.268	-0.234	-0.250	-0.261	-0.213	-0.220	-0.307
	(0.077)**	(0.084)**	(0.088)**	(0.083)**	(0.083)**	(0.085)**	(0.084)**	(0.075)**	(0.080)**	(0.060)**
Observations	3,939	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929
Number of unitid	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Discroll-Kraay SE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Additional Controlling Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes. Bolded values greater than one standard deviation different from overall model.

Appendix Table 4.15A

Leave One Out Number of Institutional Grant Aid Recipients Post-Years Difference-in-Differences Specification

	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total	(6) Total	(7) Total	(8) Total	(9) Total	(10) Total
TN*Post-TELS Yr1	-0.118	-0.153	-0.116	-0.133	-0.063	0.029	-0.163	-0.068	-0.093	-0.305
	(0.101)	(0.102)	(0.120)	(0.127)	(0.101)	(0.079)	(0.120)	(0.100)	(0.078)	(0.103)*
TN*Post-TELS Yr2	-0.018	-0.007	-0.028	-0.058	0.063	0.016	-0.025	0.044	0.021	-0.189
	(0.082)	(0.081)	(0.099)	(0.115)	(0.081)	(0.061)	(0.100)	(0.082)	(0.063)	(0.088)+
TN*Post-TELS Yr3	-0.231	-0.245	-0.220	-0.201	-0.192	-0.223	-0.307	-0.137	-0.172	-0.378
	(0.091)*	(0.089)*	(0.115)+	(0.113)	(0.092)+	(0.073)*	(0.110)*	(0.089)	(0.074)*	(0.095)**
TN*Post-TELS Yr4	-0.079	-0.131	-0.067	-0.075	-0.079	-0.082	-0.134	0.064	-0.000	-0.207
	(0.094)	(0.095)	(0.117)	(0.125)	(0.094)	(0.068)	(0.114)	(0.088)	(0.076)	(0.097)+
TN*Post-TELS Yr5	-0.068	-0.077	-0.023	-0.091	-0.037	-0.103	-0.099	0.019	-0.004	-0.193
	(0.076)	(0.076)	(0.094)	(0.101)	(0.074)	(0.057)	(0.094)	(0.076)	(0.065)	(0.082)*
Constant	-2.539	-2.520	-2.558	-2.589	-2.496	-2.493	-2.502	-2.516	-2.543	-2.574
	(5.336)	(5.330)	(5.340)	(5.344)	(5.333)	(5.323)	(5.333)	(5.333)	(5.321)	(5.341)
Observations	3,939	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929
Number of groups	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Additional Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Discroll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.15B

Leave One Out Number of Institutional Grant Aid Recipients Post-Years Difference-in-Differences Specification

	(1) Number	(2) Number	(3) Number	(4) Number	(5) Number	(6) Number	(7) Number	(8) Number	(9) Number	(10) Number
TN*Post-TELS Yr1	0.075	0.044	0.076	0.052	0.105	0.268	0.011	0.090	0.072	-0.046
	(0.032)*	(0.031)	(0.042)	(0.042)	(0.028)**	(0.052)**	(0.041)	(0.033)*	(0.028)*	(0.044)
TN*Post-TELS Yr2	0.158	0.181	0.149	0.144	0.209	0.175	0.134	0.187	0.175	0.066
	(0.030)**	(0.028)**	(0.039)**	(0.039)**	(0.024)**	(0.053)**	(0.037)**	(0.032)**	(0.026)**	(0.043)
TN*Post-TELS Yr3	0.129	0.130	0.124	0.163	0.140	0.127	0.084	0.191	0.159	0.039
	(0.032)**	(0.029)**	(0.043)*	(0.039)**	(0.026)**	(0.054)*	(0.039)+	(0.033)**	(0.029)**	(0.045)
TN*Post-TELS Yr4	0.164	0.126	0.153	0.204	0.176	0.121	0.140	0.244	0.224	0.087
	(0.032)**	(0.030)**	(0.043)**	(0.041)**	(0.026)**	(0.054)+	(0.039)**	(0.033)**	(0.029)**	(0.045)+
TN*Post-TELS Yr5	0.206	0.214	0.224	0.206	0.227	0.182	0.206	0.267	0.218	0.112
	(0.031)**	(0.029)**	(0.041)**	(0.037)**	(0.023)**	(0.055)**	(0.035)**	(0.034)**	(0.028)**	(0.045)*
Constant	-9.973	-9.962	-10.001	-10.009	-9.933	-10.012	-9.949	-9.954	-9.957	-10.022
	(2.861)**	(2.858)**	(2.861)**	(2.882)**	(2.862)**	(2.853)**	(2.862)**	(2.861)**	(2.862)**	(2.864)**
Observations	3,939	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929
Number of groups	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Additional Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Discroll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.15C

Leave One Out Entire Class Average Institutional Grant Aid Post-Years Difference-in-Differences Specification

	(1) Entire Class Avg.	(2) Entire Class Avg.	(3) Entire Class Avg.	(4) Entire Class Avg.	(5) Entire Class Avg.	(6) Entire Class Avg.	(7) Entire Class Avg.	(8) Entire Class Avg.	(9) Entire Class Avg.	(10) Entire Class Avg.
TN*Post-TELS Yr1	-0.070	-0.117	-0.019	-0.107	-0.025	0.037	-0.107	-0.003	-0.032	-0.259
	(0.074)	(0.073)	(0.093)	(0.095)	(0.070)	(0.057)	(0.089)	(0.079)	(0.068)	(0.083)*
TN*Post-TELS Yr2	-0.032	-0.045	-0.001	-0.062	0.034	-0.026	-0.038	0.040	0.016	-0.210
	(0.065)	(0.061)	(0.085)	(0.090)	(0.060)	(0.051)	(0.079)	(0.071)	(0.066)	(0.077)*
TN*Post-TELS Yr3	-0.135	-0.175	-0.078	-0.127	-0.099	-0.151	-0.208	-0.017	-0.064	-0.291
	(0.071)+	(0.066)*	(0.094)	(0.088)	(0.066)	(0.058)*	(0.083)*	(0.074)	(0.072)	(0.081)**
TN*Post-TELS Yr4	-0.050	-0.129	0.005	-0.034	-0.055	-0.100	-0.106	0.109	0.042	-0.183
	(0.074)	(0.072)	(0.095)	(0.097)	(0.069)	(0.055)	(0.088)	(0.076)	(0.073)	(0.083)+
TN*Post-TELS Yr5	-0.019	-0.051	0.061	-0.039	-0.005	-0.110	-0.042	0.108	0.063	-0.150
	(0.066)	(0.062)	(0.086)	(0.084)	(0.059)	(0.054)+	(0.076)	(0.071)	(0.073)	(0.078)+
Constant	4.058	4.083	4.007	3.989	4.114	4.092	4.100	4.084	4.056	4.012
	(5.211)	(5.198)	(5.205)	(5.209)	(5.207)	(5.193)	(5.203)	(5.203)	(5.193)	(5.217)
Observations	3,939	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929	3,929
Number of groups	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Additional Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Discroll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.15D

Leave One Out Recipient Average Institutional Grant Aid Post-Years Difference-in-Differences Specification

	(1) Recipient Avg.	(2) Recipient Avg.	(3) Recipient Avg.	(4) Recipient Avg.	(5) Recipient Avg.	(6) Recipient Avg.	(7) Recipient Avg.	(8) Recipient Avg.	(9) Recipient Avg.	(10) Recipient Avg.
TN*Post-TELS Yr1	-0.197	-0.200	-0.197	-0.191	-0.172	-0.245	-0.177	-0.160	-0.169	-0.262
	(0.094)*	(0.105)+	(0.107)+	(0.104)+	(0.101)+	(0.091)**	(0.102)+	(0.097)	(0.101)+	(0.078)**
TN*Post-TELS Yr2	-0.178	-0.190	-0.180	-0.205	-0.147	-0.161	-0.160	-0.146	-0.156	-0.257
	(0.095)+	(0.105)+	(0.107)+	(0.102)*	(0.101)	(0.104)	(0.104)	(0.100)	(0.103)	(0.065)**
TN*Post-TELS Yr3	-0.362	-0.378	-0.347	-0.368	-0.334	-0.353	-0.394	-0.332	-0.333	-0.420
	(0.084)**	(0.091)**	(0.096)**	(0.093)**	(0.088)**	(0.093)**	(0.087)**	(0.087)**	(0.089)**	(0.070)**
TN*Post-TELS Yr4	-0.243	-0.256	-0.223	-0.280	-0.255	-0.204	-0.272	-0.180	-0.223	-0.294
	(0.103)*	(0.113)*	(0.116)+	(0.108)**	(0.113)*	(0.106)+	(0.109)*	(0.091)*	(0.113)*	(0.100)**
TN*Post-TELS Yr5	-0.272	-0.289	-0.246	-0.296	-0.263	-0.285	-0.302	-0.246	-0.219	-0.304
	(0.081)**	(0.088)**	(0.089)**	(0.086)**	(0.089)**	(0.089)**	(0.084)**	(0.085)**	(0.071)**	(0.083)**
Constant	9.490	9.488	9.483	9.473	9.518	9.524	9.499	9.496	9.521	9.502
	(6.163)	(6.163)	(6.163)	(6.165)	(6.164)	(6.163)	(6.163)	(6.163)	(6.164)	(6.165)
Observations	3,938	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928
R-squared	0.140	0.140	0.140	0.140	0.140	0.141	0.140	0.141	0.141	0.140
Number of unitid	399	398	398	398	398	398	398	398	398	398
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Additioanl Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
UNITID LEFT OUT		220862	221759	220075	220978	221838	219602	221740	221768	221847

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.16B

Doctoral Extensive (DR1) Carnegie Classification Post-Years Difference-in-Differences

VARIABLES	(1) Total	(2) Total	(3) Number	(4) Number	(5) Entire Class Avg.	(6) Entire Class Avg.	(7) Recipient Avg.	(8) Recipient Avg.
TN*Post-TELS Yr1	-0.092	0.031	0.115	0.201	-0.162	-0.075	-0.207	-0.170
	(0.423)	(0.196)	(0.240)	(0.078)*	(0.443)	(0.274)	(0.183)	(0.124)
TN*Post-TELS Yr2	-0.192	-0.045	0.003	0.113	-0.226	-0.118	-0.195	-0.158
	(0.339)	(0.069)	(0.099)	(0.123)	(0.339)	(0.136)	(0.245)	(0.174)
TN*Post-TELS Yr3	-0.231	-0.102	0.139	0.223	-0.236	-0.137	-0.370	-0.325
	(0.519)	(0.208)	(0.192)	(0.062)**	(0.515)	(0.286)	(0.330)	(0.250)
TN*Post-TELS Yr4	-0.045	0.098	0.270	0.371	-0.027	0.082	-0.315	-0.274
	(0.582)	(0.296)	(0.269)	(0.075)**	(0.594)	(0.382)	(0.315)	(0.240)
TN*Post-TELS Yr5	-0.345	-0.178	0.006	0.118	-0.295	-0.163	-0.351	-0.296
	(0.506)	(0.255)	(0.196)	(0.053)*	(0.507)	(0.321)	(0.313)	(0.247)
Constant	14.958	6.865	6.731	-2.660	6.951	4.703	8.231	9.530
	(0.055)**	(7.573)	(0.048)**	(7.236)	(0.055)**	(7.490)	(0.029)**	(6.723)
Observations	1,010	999	1,010	999	1,010	999	1,010	999
R-squared	0.388	0.434	0.294	0.342	0.269	0.298	0.155	0.169
Number of unitid	101	101	101	101	101	101	101	101
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES		YES		YES		YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.17A

Doctoral Intensive (DR2) Carnegie Classification Basic Difference-in-Differences Using Robust Standard Errors

	(1)	(2)	(3)	(4)
VARIABLES	Total	Number	Entire Class Avg.	Recipient Avg.
TN*Post-TELS	-0.466	-0.207	-0.277	-0.263
	(0.150)**	(0.096)*	(0.132)*	(0.078)**
Post-TELS	1.176	0.548	0.971	0.632
	(0.440)**	(0.238)*	(0.224)**	(0.228)**
Constant	28.830	11.824	12.932	16.951
	(35.451)	(18.806)	(19.531)	(18.838)
Observations	601	601	601	601
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Additional Controlling	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES
Driscoll-Kraay SE	NO	NO	NO	NO

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.17B

Doctoral Intensive (DR2) Carnegie Classification Post-Years Difference-in-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Number	Number	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN*Post-TELS Yr1	-0.550	-0.746	-0.493	-0.652	-0.374	-0.458	-0.057	-0.098
	(0.136)**	(0.127)**	(0.066)**	(0.072)**	(0.130)*	(0.106)**	(0.078)	(0.072)
TN*Post-TELS Yr2	-0.409	-0.463	-0.109	-0.165	-0.346	-0.363	-0.303	-0.303
	(0.136)*	(0.114)**	(0.066)	(0.071)*	(0.130)*	(0.108)**	(0.078)**	(0.061)**
TN*Post-TELS Yr3	-0.464	-0.611	-0.001	-0.147	-0.343	-0.406	-0.466	-0.469
	(0.136)**	(0.101)**	(0.066)	(0.071)+	(0.130)*	(0.120)**	(0.078)**	(0.051)**
TN*Post-TELS Yr4	-0.117	-0.445	0.117	-0.150	-0.059	-0.251	-0.238	-0.300
	(0.136)	(0.118)**	(0.066)	(0.079)+	(0.130)	(0.120)+	(0.078)*	(0.058)**
TN*Post-TELS Yr5	-0.098	-0.296	0.152	-0.015	0.033	-0.060	-0.253	-0.282
	(0.136)	(0.099)*	(0.066)*	(0.072)	(0.130)	(0.128)	(0.078)*	(0.052)**
Constant	13.708	29.419	5.832	12.563	6.557	13.800	7.879	16.760
	(0.160)**	(19.873)	(0.088)**	(9.598)	(0.095)**	(13.284)	(0.074)**	(13.897)
Observations	610	601	610	601	610	601	610	601
Number of groups	61	61	61	61	61	61	61	61
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES			YES	YES		YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.18A

Master's Colleges and Universities One (MCU1) Carnegie Classification Basic Difference-in-Differences Using Robust Standard Errors

VARIABLES	(1) Total	(2) Number	(3) Entire Class Avg.	(4) Recipient Avg.
Panel A: All MCU1				
TN*Post-TELS	0.040	0.299	0.029	-0.259
	(0.380)	(0.228)	(0.418)	(0.155)+
Post-TELS	0.384	0.201	0.296	0.177
	(0.124)**	(0.063)**	(0.076)**	(0.079)*
Constant	-17.236	-21.740	3.729	5.101
	(10.482)	(6.145)**	(7.055)	(7.219)
Panel B: Excluding Tennessee Technical University				
TN*Post-TELS	-0.339	0.075	-0.383	-0.413
	(0.258)	(0.161)	(0.289)	(0.100)**
Post-TELS	0.014	0.036	0.151	-0.031
	(0.156)	(0.079)	(0.096)	(0.097)
Constant	-16.681	-21.526	3.927	5.448
	(10.364)	(6.112)**	(7.020)	(7.120)
Observations	2,338	2,338	2,338	2,338
Number of Institution	237	237	237	237
Institution FE	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Additional Controlling	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES
Driscoll-Kraay SE	NO	NO	NO	NO

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.18B

Master's Colleges and Universities One (MCU1) Carnegie Classification Post-Years Difference-in-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Number	Number	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN*Post-TELS Yr1	0.351	0.194	0.517	0.461	0.266	0.186	-0.167	-0.270
	(0.075)**	(0.142)	(0.039)**	(0.033)**	(0.068)**	(0.107)	(0.084)+	(0.142)+
TN*Post-TELS Yr2	0.272	0.200	0.375	0.348	0.192	0.153	-0.103	-0.147
	(0.075)**	(0.111)	(0.039)**	(0.034)**	(0.068)*	(0.095)	(0.084)	(0.118)
TN*Post-TELS Yr3	0.124	-0.097	0.331	0.221	0.079	-0.026	-0.209	-0.318
	(0.075)	(0.129)	(0.039)**	(0.035)**	(0.068)	(0.105)	(0.084)*	(0.131)*
TN*Post-TELS Yr4	0.152	-0.090	0.258	0.154	0.015	-0.113	-0.106	-0.242
	(0.070)+	(0.131)	(0.040)**	(0.037)**	(0.065)	(0.107)	(0.080)	(0.132)
TN*Post-TELS Yr5	0.109	-0.014	0.369	0.296	-0.014	-0.068	-0.264	-0.312
	(0.070)	(0.099)	(0.040)**	(0.035)**	(0.065)	(0.089)	(0.080)**	(0.107)*
Constant	12.898	-17.375	5.264	-22.596	6.104	2.764	7.646	5.839
	(0.078)**	(10.139)	(0.044)**	(5.099)**	(0.044)**	(7.467)	(0.035)**	(5.145)
Observations	2,363	2,363	2,363	2,363	2,363	2,363	2,363	2,363
Number of groups	237	237	237	237	237	237	237	237
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES		YES		YES		YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Appendix Table 4.18C

Master's Colleges and Universities One (MCU1) Carnegie Classification Post-Years Difference-in-Differences Excluding Tennessee Tech

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total	Total	Number	Number	Entire Class Avg.	Entire Class Avg.	Recipient Avg.	Recipient Avg.
TN*Post-TELS Yr1	-0.054	-0.210	0.304	0.245	-0.165	-0.247	-0.359	-0.457
	(0.104)	(0.165)	(0.102)*	(0.077)*	(0.093)	(0.124)+	(0.106)**	(0.178)*
TN*Post-TELS Yr2	-0.105	-0.211	0.189	0.146	-0.225	-0.282	-0.294	-0.356
	(0.104)	(0.145)	(0.102)+	(0.080)	(0.093)*	(0.119)*	(0.106)*	(0.161)+
TN*Post-TELS Yr3	-0.240	-0.439	0.112	0.010	-0.321	-0.415	-0.352	-0.448
	(0.104)*	(0.152)*	(0.102)	(0.078)	(0.093)**	(0.123)**	(0.106)**	(0.168)*
TN*Post-TELS Yr4	-0.224	-0.468	0.024	-0.085	-0.388	-0.516	-0.246	-0.381
	(0.101)+	(0.161)*	(0.103)	(0.079)	(0.091)**	(0.126)**	(0.102)*	(0.174)+
TN*Post-TELS Yr5	-0.248	-0.347	0.122	0.060	-0.416	-0.455	-0.373	-0.407
	(0.101)*	(0.128)*	(0.103)	(0.080)	(0.091)**	(0.109)**	(0.102)**	(0.146)*
Constant	12.898	-12.836	5.265	-21.039	6.106	4.138	7.645	8.881
	(0.078)**	(9.701)	(0.044)**	(5.051)**	(0.044)**	(7.660)	(0.035)**	(4.695)+
Observations	2,353	2,329	2,353	2,329	2,353	2,329	2,353	2,329
Number of groups	236	236	236	236	236	236	236	236
Institution FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controlling Variables		YES		YES		YES		YES
Driscoll-Kraay SE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

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