

THE ECONOMICS OF STUDENT TRANSITIONS
FROM HIGH SCHOOL TO POST-SECONDARY INSTITUTIONS

by

ELIZABETH SUZANNE BRADLEY

(Under the direction of David B. Mustard)

ABSTRACT

Upon graduation from high school a student must ask many important questions: Should I enroll in college? What major should I choose? How will I finance my degree? I explore several factors that influence a student's responses to these questions. In Chapter 1, I investigate whether certain school districts are more efficient than others at enrolling students in college. I find that geography plays an important role in a district's efficiency score. Chapter 2 focuses on whether fluctuations in the business cycle sway freshman college major decisions. Students are more likely to declare majors in Technology, Biology and Education during downturns. Chapter 3 assesses how business cycles affect a freshman's financial aid package. Freshmen are more likely to receive federal aid during downturns than during more stable periods. The results from this research help economists better understand how students make decisions during the critical transition from high school to college.

INDEX WORDS: Higher Education, Student Decisions, Business Cycle Shocks, Financial Aid, Postsecondary Enrollment

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Chapter 1

Who's Harnessing HOPE? Evidence from Data Envelopment Analysis

1.1 Introduction

The HOPE Program has doled out billions of dollars to millions of Georgia students in its twenty year existence (Georgia Student Finance Commission, 2013). However, many argue that this Scholarship and Grant Program has failed to achieve one of its initial goals: to enroll qualified students into postsecondary institutions who otherwise would not be able to afford it. Critics of HOPE and other large state merit aid scholarships suggest that these types of programs are often times a transfer of tax payer dollars from the poor to the wealthy (Campbell and Finney, 2005; McCrary and Pavlak, 2002; Cornwell and Mustard, 2001). If state officials are concerned that these propositions are true and are serious about addressing the failures of the HOPE scholarship, then their first task should be to identify school districts who are sending students to college at lower than expected rates. Examining these perceived low performing districts, can help policymakers target areas that can be improved as schools facilitate gateways to higher education.

Evaluating schools and their employees using quantitative measures has become an accelerating trend in the wake of *No Child Left Behind* (NCLB), and it is not likely to lose momentum. However, schools should not be evaluated by their output measures alone, because not every school has the same amount of resources or the same type of students with which to work. Instead, we should hold schools accountable for the efficiency with which they employ the resources they are given. To clearly highlight districts that have room to enhance their postsecondary enrollment rates given the inputs they employ, state officials can assign efficiency scores to school districts based on their ability to produce college goers.

Measuring the efficiency of a non-profit institution like a school is difficult because data on input and output prices are often lacking (Johnes, 2006). Also, a school's diverse objectives are not as clearly measured as are a firm's whose primary goal is to maximize profits. Economists can apply a variety of techniques in attempt to provide comparisons of schools to their peers. This paper concentrates explicitly on one of the most easily implementable techniques used for assigning efficiency scores: data envelopment analysis (DEA). DEA provides a non-statistical and non-parametric approach, free from distributional and functional form assumptions (Johnes, 2006). This presents advantages over alternatives like the parametric distance function approach, which requires strong assumptions.¹ While both methods allow for a multiple-input, multiple output technology and do not require price data, the parametric distance function approach requires specification of a particular functional form for the technology (Coelli and Perelman, 1999). This makes DEA a much more manageable method for district administrators than more complicated econometric alternatives. The results from both types of approaches are highly correlated.

¹The disadvantages to DEA are that it is sensitive to measurement error, and variable selection. However, DEA is superior in cases with little measurement error (Ruggiero, 1996). Also, if shadow prices of the inputs are desired, the DEA method can only provide a range of these prices. Lastly, if one wants to statistically differentiate one efficiency score from another, further steps are required in the DEA analysis to establish a distribution of estimates where confidence intervals can be estimated.

DEA modeling relies on establishing the frontier of an underlying production function. This is done by defining a relationship where maximum output is achieved with a minimum set of inputs. Schools along this frontier are considered efficient. Typically, when DEA techniques are applied in the educational setting the output variables are measures like test scores and graduation rates. Bessent and Bessent (1979) conduct one of the earliest studies that uses DEA to evaluate school performance. They use the median percentile of mathematics achievement scores and the median percentile of reading achievement scores as the output variables for 55 elementary schools in an urban California school district. In addition, Abbot and Doucouliagos (2003) and Johnes (2006) apply DEA to evaluate the efficiencies of Australian and British universities, respectively, using output variables like quality of the degrees awarded, and the total number of higher degrees awarded.

This paper applies the DEA technique to different measures of school output. I evaluate schools on data collected after the students graduate (college enrollment rates), but on which school districts still have a profound influence. A series of studies out of Harvard's Center for Education Policy Research (2012) document that there is a significant "high school effect" when observing postsecondary enrollment rates of students. After taking into account student demographic and ability characteristics, the postsecondary enrollment rates by high school differ dramatically for the institutions in the Harvard studies. These findings led to a summer intervention program in Fulton County, GA, a district that desires to increase its effect on its students' college enrollment rate. The district was concerned because many of the students who said they were going to college did not actually enroll in the fall. They targeted students who revealed intentions to go to college when they graduated, and followed up with them during the summer after their senior year. They provided assistance in securing more financial aid, finding housing, registering for classes, etc.

The goal of this paper is to present a straightforward method identifying Georgia districts that are doing well at enrolling students in college, given their resources, and those which are

lagging behind. Geographic patterns emerge that are associated with efficient districts versus the inefficient districts. Districts with the lowest efficiency scores are more likely to be rural districts, and not in the Atlanta Metro area. Identifying these patterns is helpful for future interventions like the one seen in Fulton County, and should potentially be targeted towards these rural districts. I also find that the correlation is low between students who qualify for the HOPE scholarship and a district's efficiency score. This result is consistent with previous studies that show that the HOPE Scholarship does little to ensure that students on the college-going margin actually enroll in school.

Little research exists on students' transitions from high school to college, because few datasets track students' college enrollment decisions from high school. Data from 2006-2007 provided by special request from the Georgia Governor's Office of Student Achievement (GOSA) merge student-level data on college enrollment from the National Student Clearinghouse (NSC) and student-level data on high school enrollments from the Georgia Department of Education (GaDOE). High school district-level data come from the Common Core Data (CCD) from the National Center for Education Statistics (NCES) and Georgia's district report cards made available by the GaDOE.

Section 1.2 briefly outlines the DEA technique that this study uses. Section 1.3 describes the input and output data used in each step of the DEA evaluation. Section 1.4 presents the five specific models used in this study. Section 1.4 also reports the two-step results that assess how efficiently school districts enroll students into postsecondary institutions given the resources with which they have to work and the students with which they are endowed. This section also presents results based on more traditional DEA measures for school districts (SAT Composite Scores and Graduation rates) so we can compare the DEA results for the postsecondary institutions to these measures, and assuage concerns that postsecondary enrollment rates may be too far removed from districts' locus of control. We will see that

the sets of schools that are defined as most efficient and least efficient by DEA standards are very similar no matter the output measure.

1.2 Data Envelopment Analysis and Transitions to Higher Education

Data envelopment analysis (DEA) is a non-parametric linear programming technique first developed by Charnes, Cooper, and Rhodes (1978) to estimate the efficiency of producers or any type of decision-making units (DMUs). For the purposes of this paper the school districts in Georgia will be the DMUs of interest.

Unlike typical statistical approaches, which would evaluate each school district relative to the average district, DEA will compare each school district with only the most efficient peers using a frontier approach. Frontier techniques establish an efficiency bound composed of the DMUs with the best observable weighted output-input ratios. Then, efficiency scores are assigned to the remaining DMUs in the sample, compared to their performance with the DMUs on the frontier. Johnes (2006) explains, “The weights used are not assigned a priori but are reflect the unit at its most efficient relative to all others in the dataset.” This technique operates under the assumption that if a given school district can produce y units of output with x inputs, then any other district should also be able to do so. Therefore, if another district is producing relatively the same amount of output with more inputs or less output with the same amount of inputs then it is operating inefficiently relative to its peers (Anderson, 1996).

It is now common in DEA applications to carry out the analysis in two steps, following Simar and Wilson (2007). The goal of the two-step approach is to identify environmental factors that explain efficiency, even those that are not under direct control of the school system. Typically, the first step involves computing DEA efficiency scores. The second step

regresses these scores on a vector of demographic and environmental covariates using OLS or Tobit maximum likelihood (Raposo et al., 2011).

In this study, however, the main goal is to provide state officials with a ranking of how well school districts produce college-going students using the resources that are under their direct control. Thus, I follow Raposo et al. (2011), who reverses the two-step approach developed by Simar and Wilson (2007). In my analysis, I estimate OLS residuals in the first step and compute DEA efficiency measures in the second. This allows for demographic and environmental factors, which are determinants of postsecondary enrollment rates, to be accounted for initially because the school has no control over these variables. Then, the second step computes efficiency scores based purely on the resources controlled by the districts.

1.2.1 Step One

Step one of this DEA procedure considers the observable district demographic, socioeconomic, and environmental characteristics that affect the likelihood its students enroll in postsecondary institutions. There is a vast literature that outlines how characteristics like race, gender, income, student ability, and parental education influence the likelihood that students will enroll in some form of higher education (Bettinger and Long, 2009; Leslie and Brinkman, 1987; Savoca, 1990; Schwartz, 1986; and Mortenson and Wu, 1990). A basic OLS regression characterizes the first step:

$$Y_k = \beta Z_k + \epsilon_k \tag{1.1}$$

where Z is a vector of average student characteristics in district k , and Y is the percentage of high school seniors enrolling in some form of postsecondary schooling. The error term ϵ_k encompasses the unobservable factors that would influence a district's postsecondary

enrollment percentage. The predicted residuals from the first step are used as the output variable in step two.²

1.2.2 Step Two

There are several variations of the DEA model that are dependent upon the underlying production relationship of the inputs and the outputs: input vs. output-oriented, constant vs. variable returns to scale. The input-oriented approach assumes that outputs are fixed and inputs can be altered. However, output orientation is most logical when examining school districts if the goal is to increase postsecondary enrollment rates, because many inputs are fixed, at least in the short-run. It is not always possible to change a school's inputs, like teacher and administrator experience or state mandated spending formulas. Conversely, a school district may affect the performance and motivation of its students and improve on its current outputs.

When choosing the type of returns-to-scale to use in a model one must consider how a change in the inputs of the production function will subsequently change its outputs. Choosing a variable returns to scale specification allows for there to be a different returns to scale relationship at different levels of inputs. Imagine two extreme cases: one school has so few teachers that by hiring one additional teacher they could potentially double the number of students that enroll in college. Alternatively, a school could have so many teachers that hiring an additional faculty member has no effect on the number of students who enroll in college. Assuming a constant returns to scale model would impose the assumption that hiring an additional teacher is going to increase the output levels of each of those districts by the same proportional amount. Therefore, I choose an output-oriented, variable returns

²Some of these residuals will be negative. The second step requires that the output variables to be normalized to positive values while still maintaining the linear distance between the residuals.

to scale DEA model and summarize the equations that are necessary for this framework.³ The model can be mathematically described as follows:

$$\max_{\eta_k, \lambda} \eta_k \quad (1.2)$$

$$\text{subject to } \sum_{j=1}^n \lambda_j x_{ij} \leq x_{ik}, \text{ for } i = 1, \dots, m \quad (1.3)$$

$$\eta_k \epsilon_{rk} - \sum_{j=1}^n \lambda_j \epsilon_{rj} \leq 0, \text{ for } r = 1, \dots, s \quad (1.4)$$

$$\sum_{j=1}^n \lambda_j = 1 \quad (1.5)$$

$$\lambda_j \geq 0, \text{ for } j = 1 \quad (1.6)$$

where s is then number of outputs in the production function and m is the number of inputs. Next, $\eta_k = 1/\theta_k$, where $0 \leq \theta \leq 1$. θ_k is the efficiency score fit by DEA. It can be interpreted as the percentage of current inputs needed to achieve current level of output for district k , if k is operating efficiently relative to the most efficient school districts in the sample. For example if $\theta = 0.86$ then the district only needs 86% of its resources to achieve the same level of output to be operating at the same level as its most efficient peers. ϵ_{rk} is the residual for district k for output r obtained from the first step; x_{ik} is the amount of input i used by school district k ; and λ is some optimal weight on the inputs and the outputs that falls out of the maximization problem.

1.2.3 Drawbacks of DEA

While DEA is an excellent method to directly compare the performance of peer organizations, it does have some drawbacks and limitations. Any form of measurement error can cause considerable problems, given that DEA is an extreme point technique and sensitive

³This model is also called the output oriented Banker-Charnes-Cooper (BCC) model, as they were the first to characterize a DEA variable returns to scale model.

to outliers. In addition, because DEA measures efficiency only relative to other DMUs in the sample, it cannot tell us about absolute levels of efficiency. Finally, since this is a non-statistical technique there are no standard errors or confidence intervals that are produced by the computation. Thus, there are no means to distinguish whether the efficiency estimates for each institution are statistically different from one another (Anderson, 1996). To address this problem Simar and Wilson (1998) propose a bootstrapping technique that will create a distribution of efficiency estimators that asymptotically resembles the true distribution of θ_k and allows for hypothesis testing (Raposo et al., 2011). The bootstrapped efficiency scores appear in Appendix Tables A.6-A.10. The results section compares the baseline DEA efficiency scores to the bootstrapped scores.

1.3 Data

I use the district level as the unit of observation because the resources discussed in this paper are allocated at the district level. Also, demographic data is most easily mapped to the district level rather than to individual schools. Of the 180 school districts in Georgia, fourteen lacked required data for the analysis. These districts either did not have high schools in the district⁴, or had missing data in their school report cards for the variables of interest.⁵

The cross-sectional district level data for the 2006-2007 school year will be the focus for this paper. This school year represents a stable period in the Georgia economy and for school budgets, and the method of analysis used does not support comparisons of efficiency scores across time. First, I discuss the output variables used in the model. Then, as in Raposo et al. (2011), I distinguish between the two types of input variables: 1) district characteristics which the district cannot effect, and 2) inputs that the district directly controls.

⁴Baker County, Clay County, Quitman County, and Webster County.

⁵Atlanta City, Banks County, Chattahoochee County, Colquitt County, Heard County, Henry County Pelham County, Talbot County, Taliaferro County, Terrell County.

1.3.1 Output Variables

The main output of interest is the postsecondary enrollment rate of 12th grade high school graduates. These rates are obtained from data provided by special request from the Georgia Governor’s Office of Student Achievement (GOSA). The data merge student-level observations from Georgia high schools to university data from the National Student Clearinghouse (NSC). This rate includes the students who enroll in any postsecondary institution: two-year, four-year, in-state, out-of-state, public and private. The rates also include students who did not matriculate into college immediately following high school graduation, but later did. The postsecondary enrollment rate encompasses many of the achievement and productivity goals for which a high school’s curriculum is designed. Schools have options when designing this curriculum, choosing instructional methods, and spending their money. In addition, the degree to which faculty and administrators are held accountable for student performance differs by district.

I also examine the percentage of high school graduates in each district who enroll initially into a four-year institution. This rate is also calculated using the Georgia GOSA data. Admission to a four-year institution is more competitive and school districts with higher efficiency scores in this area are likely participating in more ”college-linking” activities outlined in Hill (2008), like assistance with financial aid applications. In addition, four-year degrees contribute to better employment and wage opportunities over a lifetime (Kane and Rouse, 1995). Furthermore, Dougherty (1994) finds that enrolling directly into a four-year institution, instead of enrolling in a two-year institution and then transferring, increases a student’s likelihood of completing a four-year bachelor’s degree.

In addition, I evaluate districts in terms of two more typical of output measures: SAT composite score,⁶ and cohort graduation rate⁷. One critique of simply relying on postsec-

⁶SAT Verbal and SAT Math scores combined.

⁷This rate is calculated by using the percentage of the 9th grade cohort that graduates from high school. Therefore the rate accounts for dropouts.

ondary enrollment rates as the output variable of interest is that districts no longer have direct control over students and their decisions once they graduate from high school. Presumably, the SAT Composite efficiency score and the Graduation Rate efficiency score should be similar to that of the postsecondary enrollment rate efficiency score because success in these areas requires efficient use of similar resources. The models that focus on these measures as the output variable will be used as a robustness check to compare their efficiency scores to the postsecondary enrollment efficiency scores.

Table 1.1 provides summary statistics for each output measure. The mean postsecondary enrollment rate for the districts is 60.09 with Fayette County enrolling the most students at 80.61 percent and Greene County enrolling the fewest students into college at 35.53 percent. The wide gap in postsecondary enrollment rates is not surprising given the vast differences in Fayette and Greene Counties. Fayette County is considered an Atlanta-Metro school district and boasts the second highest median household income in the state at \$77,491 according to the 2010 Census. Greene County is a district located in the Rural Piedmont district of Georgia. The median family income in Greene County is ranked in the top half of Georgia counties at \$38,613, however this ranking is deceiving because many retirees make their home in Greene County at Lake Oconee, but they do not have children enrolled in school. Families that live in Greene County and enroll students in school generally live below the poverty line.

The mean four-year enrollment rate for Georgia districts in 2007 is 26.77 with Fayette County again enrolling the most students into four-year institutions at 61.94 percent and Atkinson County enrolling the smallest percentage with only 6.45 percent of the 2007 cohort going to four-year colleges. Atkinson County is also a rural school district located in South Georgia within the Coastal Plain region. The median family income in this district is \$28,917 which ranks 142 out of 159 counties in Georgia.

The school district with the highest SAT Composite score is Rome City Schools averaging a score of 1101, while students taking the SAT in Hancock County only averaged 741. Rome City schools are located in Floyd County in the Northwest corner of Georgia. This district is very demographically diverse with a racial breakdown of 39% black, 22% Hispanic, and 32% white, and 66% of students qualify for free and reduced lunch. Hancock County is located next to Greene County, Georgia in the Rural Piedmont district, also near Lake Oconee. The mean SAT score for Georgia districts was 957.47.

With an impressive 96.7 percent of its 2007 cohort graduating from high school, Trion City Schools had the highest rate of high school graduates while Stewart County only graduated 42.9 percent of its class of 2007 cohort. On average, districts achieved a 70.96 percent graduation rate. Trion City Schools are located in Chattooga County which is very near Rome City Schools. The students in Trion City are 92% white, which does not match the diversity profile of the neighboring Rome City district. Stewart County is in West Georgia very near Columbus. It is a low income county with a median family income of \$28,677.

Tables 1.6-1.9 show the top 25 districts and the bottom 25 districts in the state based on these four raw output percentage measures. The highest achieving districts have a larger set of resources than their peers, but this does not necessarily mean they are using those resources efficiently. Alternatively, the districts which have the lowest output percentages are much more economically disadvantaged than the average Georgia school district. Tables 1.6-1.9 also have the results for the DEA estimation which is discussed later and determines which of the Georgia districts are taking their scarce resources and using them most efficiently.

1.3.2 Student and Family Demographic Data

Student and family demographic data are obtained from two main sources: 1) the District Report Card from the Georgia Department of Education (GaDOE), and 2) the Common Core of Data (CCD) from the National Center for Education Statistics (NCES). These variables affect the outputs, but are beyond the school districts' control. Table 1.2 reports

the summary statistics for these variables. The demographic variables of interest include gender, race, income, ability and parental education measures, all determinants of the output variables previously mentioned. In 2007 females were more likely to enroll in college than males (Bettinger and Long, 2009). Whites are more likely to enroll in college than Hispanics and Blacks (Leslie and Brinkman, 1987; Savoca, 1990). Likewise, increases in family income, parental education, and student ability levels increase the likelihood that students enroll in college (Bettinger and Long, 2009; Schwartz, 1986; and Mortenson and Wu, 1990).

The percentage of males, Asians, Blacks, Hispanics and Whites in this context can all be defined as the percentage of enrolled students for each respective category in the school district. These data come from the Georgia District Report Cards. The percentage of students who exceed expectations on the 8th grade Math Criterion-Referenced Competency Test (CRCT) and the English CRCT also come from the District Report Cards. These scores capture a measure of cohort ability before the students enroll in high school. The percentages of students who qualify for free and reduced lunch proxies for a measure of family income, and the percentage of adults with a college degree reflects a measure of parental education in the district. NCES provides access to these variables through the CCD.

There is great variability in these demographic statistics from district to district. For example, the percentage of white students in a district is lowest at 1 percent in Hancock County and highest at 99 percent in Chickamauga City Schools. This wide range across districts can also be found for the free and reduced lunch, adults with college degree, and ability measures.

Other demographic variables in Table 1.2 include the percentage of migrant students, and the percentage of student's with disabilities, both taken from District Report Card Data. Whether or not there is a college in the district could also influence a student's postsecondary enrollment decision (Tinto, 1973; Olivas, 2005). A student might only attend college if he

or she can live at home and commute because of family or work responsibilities. Only 37.3 percent of school districts have a postsecondary institution within their jurisdictions.

1.3.3 School and Teacher Characteristics

The inputs in the second step of the analysis are those over which the school has more autonomy than the input variables in the first step. These variables are also drawn from the Georgia District Report Cards and the CCD. Summary statistics for school and teacher characteristics are included in Table 1.3. The teacher, support, and administrator salaries, education levels, and years of experience are all important factors in determining postsecondary enrollment rates of their students. On average, the higher the salary, education level, and years of experience of its faculty, the higher the college enrollment rate, SAT scores, and graduation rate of a district, because the quality of the faculty will be higher.

Student-teacher ratios are also important inputs to consider. The more students per teacher the less individualized attention a student will receive (Borus and Carpenter, 1984), which will have an adverse effect on all of the output variables of interest. Likewise, the fewer students there are per high school counselor the more beneficial it is for the students.

Teacher gender and race characteristics are also available on the district report cards. On average 19.6 % of teachers in the districts are male. The average racial breakdown of teachers is 14.6% black, 84.4% white and 1% other. However, these characteristics are not included as inputs in the models, because school systems are legally not allowed to discriminate in the hiring process based on gender and race. Conversely, they are allowed to consider a potential employees education level and work experience.

1.4 Models and Results

Table 1.4 provides an overview of the analysis. I fit five models, one corresponding to each output, and one combining postsecondary enrollment rates, SAT scores, and graduation rates. The inputs in both stages of estimation are the same for each model.

1.4.1 First-Step Results

The first step of the models returns OLS coefficient estimates reported in Table 1.5, with each output variable from the models used as a dependent variable. The percentage of black students, the percentage of free and reduced lunch students, and the percentage of adults in the district with a college degree are the strongest determinants of the output variables.

Ceteris paribus, as the percentage of black students in a district increases, students are more likely to enroll in college and four-year institutions. While, on average, black students are less likely to enroll in college than white students, after controlling for other factors that influence college enrollment, blacks are actually more likely to attend college than whites. This is similar to the result seen in Perna (2000). However, *ceteris paribus* as the black population in a district increases students' SAT scores fall, on average.

The percentage of students in a district who are eligible for free and reduced lunch is associated with low college enrollment rates, and the effects are statistically significant at the 5-percent level. While the percentage of adults with a college degree does not have a statistically significant effect on a district's postsecondary enrollment rates in general, district increases in this variable do have a significantly positive effect on four-year institution enrollment rates, SAT scores, and high school graduation rates.

The residuals from each of these OLS models are then carried into the second stage to be used for the efficiency score estimates.

1.4.2 Second-Step Results

Step two of the DEA estimation procedure uses the residuals from the OLS estimation in the first step and the district-controlled input variables outlined in Table 1.4. Appendix Tables A.1-A.5 report the efficiency scores for each district and for Models 1-5, respectively. If a district has an efficiency score of 1.00 then it is considered among the most efficient districts relative to its peers. The ranges of efficiency scores are most similar for Models 1, 2, 4, and

5: Model 1's DEA efficiency scores range from 0.84-1.00, Model 2's scores are from 0.87-1, Model 4's from 0.86-1.00, and Model 5's from 0.89-1.00. The range of efficiency scores is much wider for for Model 3 with the SAT Composite score as its output variable, 0.26-1.00. The variances of the residuals carried from the first-step to the second-step differ greatly between these groups of models. The model that uses SAT Composite as the output variable has the largest variance of its residuals at 1303.49, while the other output variables display residual variances between 41 and 46. These differences help explain why the efficiency score ranges for Models 1, 2, 4, and 5 are much tighter than the range for the SAT Composite model.

Table 1.6 reports the top 25 districts by postsecondary enrollment percentage and four-year institution enrollment percentage. Also included in the table are those districts' efficiency scores and HOPE eligibility rankings. We are interested in whether the percentage of students that qualify for HOPE contributes to a districts efficiency score. If it appears that schools with higher HOPE eligibility ranking are those schools that are most efficient then the HOPE scholarship might be contributing to a district's ability to send its students to college. This would be good news for policy makers who designed HOPE to ensure students on the margin of going to college had a means to enroll. If, however, these measures are not strongly correlated then other district specific factors are contributing to postsecondary enrollment rates.

When examining the efficiency scores compared to the output variable rankings it is clear that not all of the top 25 districts based on output percentages are considered the most efficient of their peers. For example, Decatur City and Cherokee County received an efficiency score of 0.94, which suggests these districts only needing 94% of their inputs to produce their current level of output. The correlation coefficient between the output variable of interest and the efficiency score is 0.47 for Model 1 and 0.29 for Model 2. Similarly, the HOPE eligibility ranking does not seem to be the deciding factor in determining a system's efficiency at enrolling students in college. The correlation coefficient for HOPE eligibility

and the efficiency score for Model 1 is 0.12 and 0.08 for Model 2. Macon County ranks 123 out of 166 in the number of its students who are HOPE eligible, yet it is a frontier district for Model 1, receiving an efficiency score of 1.00. On the contrary, Decatur City has an efficiency score of 0.94 yet ranks 13th in the number of its students who are HOPE eligible. Students in Macon County are lower income and more likely to be minority students on average than those in Decatur City Schools. This suggests that Macon county is doing a better job with the resources with which it is endowed compared to Decatur City Schools.

Table 1.7 reports the Bottom 25 output rankings for the postsecondary enrollment rates and the four-year enrollment rates alongside the efficiency scores and the HOPE eligibility rankings. Clearly, there are some frontier schools like McIntosh, Towns, and Treutlan Counties who are considered in the bottom 25 districts on these output measure rankings, but are operating efficiently relative to their peers. These are all districts in rural and low income portions of Georgia. These schools have fewer inputs to work with, but are doing the best with what they have. There are also districts in Table 1.7 with high HOPE eligibility rankings like Miller County which is ranked 3. If HOPE ranking was driving postsecondary enrollment rates then Miller County would have a much higher raw postsecondary enrollment ranking and DEA efficiency score.

Table 1.8 reports the Top 25 districts output rankings, efficiency scores, and the HOPE eligibility rankings for the SAT Composite and the high school Graduation Rate outputs. The set of schools included in this table is very similar to those included in Table 1.6. Because the set of efficient districts are similar for Models 1, 2, 3, and 4 this helps assuage concerns with using postsecondary enrollment rates as an output variable. Again, we see that school that have the highest raw output scores for SAT Scores and Graduation Rates are not always the most efficient districts according to the DEA. For example, Oconee County has the fourth highest average SAT score but has one of the lowest efficiency scores at 0.62. While Oconee County students perform well on the SAT, they have more resources than

many other districts. Many families in this district are high income and highly educated because of the proximity of the district to the University of Georgia. Therefore, the low efficiency score suggests that the SAT scores in this district should actually be higher than they currently are for the district to be considered efficient.

Table 1.9 reports the Bottom 25 districts based on the SAT and Graduation Rate output variables. While the efficiency score ranges are much different for each of these output variables, the set of schools in the Bottom 25 for each output level is quite similar. Seven schools for the SAT Score model and six schools for the graduation model are in the Bottom 25 based on raw output numbers but are considered efficient.

Table 1.10 reports the efficiency scores in a different way by ranking the Bottom 25 efficiency score districts for Models 1, 3, and 4.⁸ A very similar set of school districts emerges across these groups. Thirteen out of the 25 districts listed with the Bottom 25 efficiency score for Model 1 are also in either the Bottom 25 for Model 3 or Model 4.

The Bottom 25 districts for Models 1, 3 and 4 are an extremely similar set of districts by geographical characteristics. Only five school systems that are listed in the Bottom 25 for Model 1, Model 3, and Model 4 are from Atlanta Metro School districts. Of the five districts that are from the Atlanta Metro area all of them are on the fringes of the Atlanta metro border. Furthermore, four of those five Atlanta Metro districts are classified as rural school districts according to school district local codes obtained from the CCD.

Additionally, a majority of the schools that are included in the set of Bottom 25 efficiency scores in Table 1.10 are considered rural districts by the CCD local classifications: 17 out of 25 for Model 1, 20 out of 25 for Model 3, and 14 out of 25 for Model 4. Therefore, it would be beneficial to perform the efficiency analysis for Atlanta Metro districts only, and rural districts only. There appears to be unobserved heterogeneity across the districts with different location classifications.

⁸The previous tables ranked the Top 25 and Bottom 25 districts based on raw outputs.

1.4.3 Bootstrap Estimates

Section 1.2 highlights some drawbacks to DEA. Traditional DEA does not return standard errors and confidence intervals which allow for hypothesis testing. Simar and Wilson (1998) outline a bootstrapping technique to combat this problem. Appendix Tables A.6-A.10 report bias corrected bootstrapped efficiency scores using 2000 repetitions to generate the 95% confidence intervals.

By comparing the confidence intervals, we can determine whether to estimated efficiency scores are statistically different from one another. For example, in Table A.6 we see that for Model 1 Appling County has a bias corrected efficiency score of 0.92. Atkinson County has a bias corrected efficiency score of 0.95. However, the two districts efficiency scores are not statistically different from one another at the 5% level because their 95% confidence intervals overlap. Next, if we compare Appling County to Bacon County's 0.91 bias corrected efficiency score, we can statistically distinguish between the two districts' scores. Appling County's 95% confidence interval lower bound is 0.9179 while Bacon County's upper bound is 0.9145. Simar and Wilson's bootstrapping technique restricts the efficiency scores to be less than 1.00 which also creates a wider distribution for the districts considered most efficient.

Another, benefit of bootstrapping efficiency scores and standard errors is that it creates more distinguishable tiers of efficiency scores instead of just raw rankings of schools. For example, Appendix Table A.11 ranks the Bottom 25 districts for Model 1 based on their bias corrected efficiency scores. It also displays the ranking of these districts when the efficiency score is not bias corrected.⁹ We see the set of districts in the Bottom 25 is virtually the same. The advantage of the bootstrapped scores though is that now we can distinguish between districts in the Bottom 25. Greene County scores the lowest using both methods. Furthermore, the bootstrapped confidence intervals show that Greene County's efficiency score is statistically different from every other district in the sample. On the contrary, the

⁹This information can be found in Table 1.10.

efficiency score for Stewart County is statistically indistinguishable from Decatur, Putnam, Charlton, Hart, Miller, Wheeler, and Tattnall Counties. Therefore, we can place these districts in the same tier in terms of relative efficiency at enrolling students in postsecondary institutions. Greene County stands alone in the lowest tier.

If policymakers use DEA to evaluate the efficiency of school districts, they should consider using bootstrapping methods to place districts in tiers and not simply use arbitrary ranking cutoffs to determine which districts meet the designated threshold. On average, the higher we move up the efficiency score rankings the further is the distance to find a district that is statistically distinguishable.

1.5 Conclusion

Over the past two decades the state of Georgia has concentrated resources to increase the share of its high school students enrolling in postsecondary institutions. While the HOPE scholarship, has been successful to a certain extent, it has been criticized because many believe that the program could do a better job at encouraging the marginal student to enroll in college. These data envelopment analysis results reveal that schools who are efficient at enrolling students in postsecondary institutions are not necessarily those that have the most students who qualify for HOPE aid. There are other factors at play.

The DEA efficiency scores for the entire state of Georgia suggest that even after accounting for the inputs the districts employ, there are some geographic similarities between the districts that have low efficiency scores. Rural districts that are not in the Atlanta Metro area are more likely to be in bottom tier of efficient districts than any other type, when postsecondary enrollment is the output variable.

Several scenarios could account for this result. For instance, a larger fraction of careers in urbanized areas requires college degrees than those in the more rural districts. Therefore, students from urban areas might be more likely to pursue postsecondary opportunities than those who can find jobs in their communities without a college education. For example, the

granite industry has a strong foothold in Elbert County, which is considered a rural school district by the CCD local classification. It is extremely difficult to persuade a high school student to forgo a \$16.00 an hour wage without a college degree, and instead enroll in school. These types of opportunities may not be available in the more urbanized districts, and so college seems like a better option in the short-run for those students.

As Georgia policymakers attempt to harness the techniques that lead to higher college enrollment, they must identify the schools are performing the best on these measures and those that are struggling. The more information that policymakers can bring to the table when designing ways to increase Georgia students' college enrollment rates, the fewer the resources that they will waste in pursuit of this goal.

1.6 Tables and Figures

Table 1.1: Summary Statistics by Output Variables

Variables	Mean	Min	Max
Postsecondary Enroll(%)	60.09 (8.52)	35.53	80.61
4-year Enroll (%)	26.77 (11.82)	6.45	61.94
SATC	957.47 (63.49)	741	1101
Graduation (%)	70.96 (9.17)	42.9	96.7
$N=166$			

Notes: Standard Deviations in parentheses.

Table 1.2: Summary Statistics by Demographic Variables

Variables	Mean	Min	Max
Males Enrolled (%)	50.75 (3.83)	27.27	60.61
Asian (%)	1.03 (1.33)	0.00	10.00
Black (%)	34.12 (24.55)	0.00	98.00
Hispanic (%)	6.55 (8.90)	0.00	65.00
White (%)	56.18 (23.91)	1.00	99.00
Free and Reduced Lunch (%)	57.11 (16.78)	14.00	94.00
Adults with College Degree (%)	12.81 (7.02)	4.70	49.90
Math CRCT Exceeded (8th)	6.29 (7.43)	0.15	65.85
English CRCT Exceeded (8th)	12.57 (12.82)	0.29	86.49
Students with Disabilities(%)	12.85 (2.83)	7.00	23.00
Migrants(%)	0.53 (1.26)	0.00	8.00
College in County(%)	37.28 (48.50)	0.00	1.00
$N=166$			

Notes: Standard Deviation in parentheses.

Table 1.3: Summary Statistics by School and Teacher Characteristics

Variables	Mean	Min	Max
Master's Deg. or Higher (%) (Teacher)	57.38 (7.66)	27.91	75.45
Master's Deg. or Higher (%) (Admin)	97.07 (4.54)	72.96	100.00
Master's Deg. or Higher (%) (Support)	93.73 (8.17)	49.89	100.00
Yrs of Exper. (Teacher)	13.55 (1.67)	9.32	18.10
Yrs. of Exper. (Admin)	21.93 (2.52)	14.37	31.60
Yrs. of Exper. (Support)	16.78 (2.53)	10.55	23.18
Avg. Daily Salary (Teacher)(\$)	257.58 (10.94)	231.19	294.24
Avg. Daily Salary (Admin) (\$)	370.16 (21.90)	320.24	464.92
Avg. Daily Salary (Support) (\$)	295.18 (14.36)	256.08	331.34
Secondary Teachers per 100 Students	10.11 (1.12)	7.32	15.55
Counselors per 100 12th graders	2.29 (0.45)	0.78	4.02
$N=166$			

Notes: Standard Deviations in parentheses.

Table 1.4: Model Outline of Output and Input Variables

Model No. and Output Variables	Input Variables: Stage 1	Input Variables: Stage 2
1: Postsecondary Enrollment	CRCT Math Exceed Expectation (%)	Average Daily Salary (Admin)
2: Four-Year Enrollment	CRCT English Exceed Expectation (%)	Average Daily Salary (Support)
3: SAT Composite	Male Enrollees (%)	Average Daily Salary (Teacher)
4: Graduation Rate	Asian (%)	Masters Degree or Higher (Admin)
5: Postsecondary, SATC, and Grad Rate	Black (%)	Masters Degree or Higher (Support)
	Native American (%)	Masters Degree or Higher (Teacher)
	Multiracial (%)	Average Years of Experience (Admin)
	Free Lunch Eligible (%)	Average Years of Experience (Support)
	Students w/ Disabilities (%)	Average Years of Experience (Teacher)
	Migrants (%)	Secondary Teachers per 100 Students
	Adults with College Degrees (%)	Counselors per 100 12th graders
	College in County	

Notes: The Input Variables for Stage 1 and for Stage 2 are the same for all of the models.

Table 1.5: First Stage Results: OLS of Output Measures on Student and Family Characteristics

Demographic Variables	College Enroll (%)	Four Year Enroll (%)	SAT Composite	Grad Rate (%)
MathCRCT (8th grade)	-5.96 (15.84)	1.34 (13.76)	22.27 (63.26)	17.09 (17.06)
EnglishCRCT (8th grade)	20.92* (11.66)	6.67 (12.21)	41.77 (44.33)	11.92 (12.74)
Male	6.25 (21.94)	-13.67 (19.39)	-66.97 (99.04)	8.49 (14.60)
Asian	0.33 (0.57)	-0.04 (0.54)	3.76 (2.64)	-0.32 (0.33)
Black	0.16*** (0.04)	0.23*** (0.04)	-1.28*** (0.25)	0.01 (0.05)
Hispanic	0.10 (0.07)	0.14 (0.07)	0.19 (0.42)	.17** (0.08)
Native American	-2.43 (2.49)	4.45 (5.99)	-24.59** (11.17)	6.01** (2.45)
Multiracial	-0.28 (0.42)	2.07*** (0.58)	1.81 (3.13)	0.10 (0.45)
Free Lunch	-0.37*** (0.07)	-0.38*** (0.07)	-0.73** (0.36)	-0.31*** (0.07)
Disabled Students	-0.21 (0.24)	-0.12 (0.23)	0.83 (1.38)	-0.18 (0.20)
Migrants	0.04 (0.54)	-0.98** (0.47)	-1.31 (2.35)	-0.27 (0.46)
Adults with College Degree	0.06 (0.11)	0.64*** (0.13)	2.88*** (0.56)	0.21** (0.09)
College in County	2.56* (1.41)	0.40 (1.37)	16.30** (7.49)	-1.14 (1.16)
Constant	70.82*** (13.72)	35.42*** (11.92)	1008.81*** (58.30)	80.63*** (8.17)
No. of Obs	166	166	166	166

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.
Robust standard errors in parentheses.

Table 1.6: Top 25 District Rankings: Postsecondary Enrollment Rates and Four-Year Enrollment Rates

Postsecondary Rank	Postsecondary(%)	Score	HOPE	Four-Year Rank	Four-Year(%)	Score	HOPE
1. Fayette County	80.61	0.97	2	1. Fayette County	61.94	0.97	2
2. Glascock County	79.31	1.00	107	2. Fulton County	61.94	0.97	15
3. Lee County	79.00	1.00	76	3. Decatur City	58.58	0.89	13
4. Schley County	78.69	0.99	49	4. Carrollton City	58.53	1.00	17
5. Trion City	77.77	0.97	42	5. Columbia County	58.13	1.00	34
6. Chickamauga City	77.69	1.00	6	6. Cobb County	54.58	1.00	18
7. Oconee County	77.68	0.98	1	7. Forsyth County	52.49	0.99	4
8. Columbia County	77.66	1.00	34	8. Bryan County	49.48	1.00	69
9. Carrollton City	76.50	1.00	17	9. Muscogee County	47.40	0.96	115
10. Decatur City	75.15	0.94	13	10. Oconee County	47.37	0.91	1
11. Forsyth County	74.96	0.97	4	11. Rome City	46.30	0.98	33
12. Fulton County	73.99	1.00	15	12. Marietta City	46.13	0.95	111
13. Cobb County	72.36	1.00	18	13. Peach County	44.81	1.00	38
14. Macon County	71.42	1.00	123	14. Lincoln County	44.55	1.00	8
15. Houston County	71.33	0.99	115	15. Coweta County	43.88	0.98	51
16. Lowndes County	71.01	0.97	128	16. Cherokee County	43.76	0.93	121
17. Bremen City	70.69	0.96	133	17. Bibb County	42.911	1.00	142
18. Wilkes County	69.66	0.99	90	18. Gwinnett County	42.88	0.94	44
19. Grady County	69.52	0.99	88	19. Rockdale County	42.37	0.94	88
20. Dodge County	69.34	1.00	16	20. Chatham County	41.80	0.99	152
21. Jefferson City	69.23	0.98	107	21. Houston County	41.08	0.97	115
22. Habersham County	69.16	0.98	12	22. Harris County	40.88	0.94	34
23. Tift County	68.50	0.99	48	23. Wilkes County	40.45	0.98	90
24. Montgomery County	68.18	0.99	70	24. DeKalb County	39.99	0.92	82
25. Cherokee County	68.05	0.94	121	25. Richmond County	39.76	0.95	88

Notes: This table ranks the top 25 districts based only on the output measures and compares them to the efficiency scores produced by the DEA procedure and their HOPE eligibility ranking.

Table 1.7: Bottom 25 Rankings: Postsecondary Enrollment Rates and Four-Year Enrollment Rates

Postsecondary Rank	Postsecondary (%)	Score	HOPE	Four-Year Rank	Four-Year (%)	Score	HOPE
142. Miller County	51.39	0.91	3	142. Tift County	14.75	0.89	117
143. Hart County	51.27	0.90	28	143. Brooks County	14.53	0.92	165
144. Jasper County	51.16	1.00	102	144. Jackson County	14.47	0.93	82
145. Clayton County	51.06	1.00	126	145. Ben Hill County	14.12	0.92	139
146. Murray County	51.04	0.96	29	146. Laurens County	13.99	0.91	29
147. Carroll County	51.03	0.92	22	147. Miller County	13.89	0.94	3
148. Brantley County	50.63	0.98	30	148. Gordon County	13.87	0.96	64
149. Walker County	50.62	1.00	53	149. Appling County	13.77	0.92	97
150. Candler County	50.00	0.95	129	150. Wheeler County	13.56	0.91	57
151. Meriwether County	48.73	0.94	121	151. Lamar County	13.04	1.00	144
152. Brooks County	48.72	0.93	166	152. Emanuel County	12.92	0.95	102
153. Twiggs County	48.00	0.94	164	153. Decatur County	12.43	0.88	71
154. Haralson County	46.54	1.00	52	154. Brantley County	12.03	1.00	30
155. Decatur County	46.45	0.89	71	155. Murray County	11.87	0.94	29
156. Wheeler County	45.76	0.90	57	156. Treutlen County	11.59	1.00	134
157. Treutlan County	44.93	1.00	134	157. Bleckley County	11.51	1.00	143
157. Putnam County	44.93	0.89	152	158. Pierce County	10.98	0.90	23
159. Tattnall County	44.71	0.90	160	159. Turner County	10.87	0.90	96
160. Charlton County	44.44	0.90	77	160. Towns County	10.76	1.00	94
161. Dade County	43.29	0.92	110	161. Bacon County	10.20	0.89	149
162. Chattooga County	42.65	0.91	126	162. Worth County	9.91	0.88	165
163. Stewart County	42.42	0.89	166	163. Wilcox County	9.84	0.99	9
164. Towns County	42.15	1.00	94	164. Coffee County	9.46	0.90	39
165. McIntosh County	40.00	1.00	56	165. Echols County	7.50	1.00	72
166. Greene County	35.53	0.85	136	166. Atkinson County	6.45	0.95	11

Notes: This table ranks the top 25 districts based only on the output measures and compares them to the efficiency scores produced by the DEA procedure and their HOPE eligibility ranking.

Table 1.8: District Rankings: SAT and Graduation Rates

SAT Rankings	SAT Composite	Score	Grad Rate Rankings	Graduation (%)	Score
1. Rome City	1101	1.00	1. Trion City	96.7	1.00
2. Fulton County	1087	1.00	2. Bremen City	93.3	1.00
3. Decatur City	1078	0.68	3. Fayette County	91.5	0.96
4. Oconee County	1077	0.62	4. Decatur City	89.3	0.94
5. Fayette County	1061	0.73	5. Buford City	89.2	1.00
6. Bleckley County	1060	1.00	6. Chickamauga City	88.1	1.00
7. Cherokee County	1054	0.67	7. Oconee County	87.5	0.92
7. Forsyth County	1054	0.73	8. Wilkes County	87.4	1.00
7. Jefferson City	1054	1.00	9. Social Circle City	87.2	1.00
10. Cobb County	1052	1.00	10. Union County	86.5	0.98
11. Gwinnett County	1049	0.78	10. Schley County	86.4	0.97
12. Marietta City	1043	0.99	10. Towns County	86.4	1.00
13. Floyd County	1042	0.73	13. Jefferson City	84.2	1.00
14. Columbia County	1040	0.76	14. Commerce City	83.9	0.94
15. Glascock County	1031	1.00	15. Wilkinson County	83.5	1.00
16. Whitfield County	1030	0.88	16. Forsyth County	83.4	0.95
17. Coweta County	1029	0.96	17. Lumpkin County	83.2	0.95
18. Buford City	1028	0.84	18. Calhoun City	82.5	0.99
19. Vidalia City	1027	1.00	19. Bryan County	81.8	1.00
20. Glynn County	1026	0.79	20. Carrollton City	81.5	0.97
20. Pickens County	1026	0.69	21. Columbia County	81.4	0.93
22. Bulloch County	1024	0.98	22. Cobb County	81.3	1.00
22. Trion City	1024	0.76	22. Lincoln County	81.3	0.97
24. Bryan County	1022	1.00	24. Hancock County	81.1	1.00
25. Catoosa County	1021	0.73	25. Harris County	81.0	0.92
25. Fannin County	1021	0.83			

Notes: This table ranks the top 25 districts based only on the output measures and compares them to the efficiency scores produced by the DEA procedure.

Table 1.9: Bottom 25 District Rankings: SAT and Graduation Rates

SAT Rankings	SAT Composite	Score	Grad Rate Rankings	Graduation (%)	Score
142. Long County	901	1.00	142. Elbert County	61.8	0.95
143. Jenkins County	900	0.71	143. Dougherty County	61.5	0.92
143. Turner County	900	0.77	144. McIntosh County	61.2	1.00
145. Emanuel County	896	0.81	145. Coffee County	60.4	0.92
145. Worth County	896	0.82	146. Sumter County	60.1	0.94
147. Bibb County	893	0.66	147. Dublin City	59.8	0.92
147. Lamar County	893	1.00	148. Jasper County	59.7	1.00
149. Peach County	886	0.49	149. Candler County	59.6	0.93
150. Jefferson County	884	0.92	149. Macon County	59.6	0.99
151. Sumter County	883	0.71	151. Rome City	59.4	0.87
152. Clayton County	881	1.00	152. Dooly County	59.0	0.90
153. McIntosh County	878	1.00	153. Franklin County	58.9	0.93
154. Seminole County	874	0.70	154. Bibb County	58.8	0.91
155. Brooks County	856	0.63	155. Worth County	58.5	0.93
156. Calhoun County	852	1.00	156. Clarke County	58.4	1.00
157. Meriwether County	844	0.55	157. Murray County	57.4	0.89
158. Randolph County	837	0.73	158. Valdosta City	57.3	0.93
159. Clinch County	827	0.40	159. Baldwin County	56.9	0.90
160. Dooly County	822	0.52	160. Brooks County	56.2	0.93
161. Macon County	797	0.64	161. Warren County	56.0	1.00
162. Warren County	787	1.00	162. Walker County	55.4	1.00
163. Greene County	778	0.26	163. Spalding County	55.0	0.88
164. Twiggs County	773	0.50	164. Mitchell County	53.3	1.00
165. Stewart County	772	0.56	165. Burke County	50.1	0.87
166. Hancock County	741	1.00	166. Stewart County	42.9	0.86

Notes: This table ranks the top 25 districts based only on the output measures and compares them to the efficiency scores produced by the DEA procedure.

Table 1.10: Bottom 25 Efficiency Score Districts for Models 1, 3 and 4

Postsecondary (%)	Score	SATC	Score	Graduation (%)	Score
142. VALDOSTA CITY	0.931	PUTNAM COUNTY	0.6679	CAMDEN COUNTY	0.916
143. STEPHENS COUNTY	0.9307	CHATTOOGA COUNTY	0.6642	RABUN COUNTY	0.9158
144. THOMAS COUNTY	0.9302	COFFEE COUNTY	0.6622	PEACH COUNTY	0.9155
145. BROOKS COUNTY	0.926	WARE COUNTY	0.6542	TAYLOR COUNTY	0.9149
146. WHITFIELD COUNTY	0.926	CHARLTON COUNTY	0.6477	DOUGHERTY COUNTY	0.9148
147. GILMER COUNTY	0.9233	SCHLEY COUNTY	0.6457	IRWIN COUNTY	0.9142
148. MORGAN COUNTY	0.9231	WHITE COUNTY	0.6457	RICHMOND COUNTY	0.9138
149. PICKENS COUNTY	0.9228	MACON COUNTY	0.6375	THOMASTON-UPSON COUNTY	0.9138
150. WALTON COUNTY	0.9219	BROOKS COUNTY	0.6265	WARE COUNTY	0.9137
151. DEKALB COUNTY	0.9205	OCONEE COUNTY	0.6214	BIBB COUNTY	0.9134
152. RICHMOND COUNTY	0.9198	COMMERCE CITY	0.6115	TIFT COUNTY	0.9125
153. DADE COUNTY	0.9194	DALTON CITY	0.6003	HABERSHAM COUNTY	0.9113
154. HALL COUNTY	0.9155	UNION COUNTY	0.5972	HART COUNTY	0.9101
155. BACON COUNTY	0.9154	HART COUNTY	0.5939	WHEELER COUNTY	0.906
156. CARROLL COUNTY	0.9153	MORGAN COUNTY	0.5765	HALL COUNTY	0.9013
157. CHATTOOGA COUNTY	0.9143	STEPHENS COUNTY	0.568	CHEROKEE COUNTY	0.899
158. MILLER COUNTY	0.9119	STEWART COUNTY	0.5572	BALDWIN COUNTY	0.8957
159. HART COUNTY	0.9043	MERIWETHER COUNTY	0.5506	DOOLY COUNTY	0.8953
160. TATTNALL COUNTY	0.904	HABERSHAM COUNTY	0.5363	MURRAY COUNTY	0.8946
161. WHEELER COUNTY	0.9002	RABUN COUNTY	0.5355	CATOOSA COUNTY	0.8932
162. CHARLTON COUNTY	0.8963	DOOLY COUNTY	0.5235	SPALDING COUNTY	0.8814
163. PUTNAM COUNTY	0.8941	TWIGGS COUNTY	0.5001	GLYNN COUNTY	0.8775
164. DECATUR COUNTY	0.8918	PEACH COUNTY	0.4882	BURKE COUNTY	0.8712
165. STEWART COUNTY	0.8856	CLINCH COUNTY	0.3982	ROME CITY	0.8652
166. GREENE COUNTY	0.8498	GREENE COUNTY	0.2588	STEWART COUNTY	0.858

Notes: Districts ranked by efficiency scores with district 166 being the lowest efficiency score for each output variable.

Chapter 2

The Effect of the Business Cycle on Freshman Major Choice

2.1 Introduction

Connections between higher education decisions and the business cycle have garnered the attention of researchers, policy makers, and university administrators for decades. Declining economic conditions induce university budget cuts, increase student enrollment rates, and encourage higher levels of student debt, stretching the resources of postsecondary institutions and their students (Clark, 2010; Weller, 2012). In the face of tighter budget constraints, college students may alter their postsecondary decisions in several ways. This paper focuses on college major choice, one particular decision channel that students may adjust during recessions, and one that few researches have explored. Identifying changes in student major decisions during economic downturns helps university administrators to anticipate demand for certain courses and reduces uncertainty about future labor market shortages and surpluses.

The “Great Recession” serves as a reminder of how economic downturns constrain higher education resources and alter student incentives. Despite the growing education debt, there

is a renewed effort to increase post-secondary enrollment and graduation rates. In President Obama’s 2011 Back-To-School Speech, he challenges high school students to continue their education after graduation: “...our country used to have the world’s highest proportion of young people with a college degree; we now rank 16th. I don’t like being 16th. I like being number one.” In addition, the President fostered opportunities for unemployed workers to return to school through programs that give special Federal Pell Grant consideration to those collecting unemployment insurance (Budd, 2009).

Private organizations – like the Lumina Foundation for Education and the Gates Foundation – also support increasing the number of college degree attaining citizens. The Lumina Big Goal 2025 seeks “to increase the percentage of Americans with high-quality degrees and credentials to 60 percent by the year 2025” (Lumina Foundation, 2012). In the summer of 2012, the Gates Foundation announced an additional 9 million dollars in grants supporting access to and completion of higher education degrees (Young, 2012). Initiatives such as these can modify student education decisions.

In the wake of the most recent recession, students’ major decisions are under the microscope, as many fear that mounting education debt and the inability of students to pay back college loans will be the next big economic bubble (Cronin and Horton, 2009; Bonner, 2012). Contributing to the increasing education loan default rate are the high U.S. unemployment and underemployment rates for young college graduates, which are now at all time highs of above 50 percent (Yen, 2012). In July 2012, the National College Finance Center launched the “Don’t Major in Debt” campaign that provides free loan counseling for students. Although not an explicit goal of the campaign, the name implies that students can choose certain college majors that have better long term benefits than others.

Carnevale et al. (2012) caution that unemployment risk depends highly on undergraduate major. Their study reports that after the most recent recession, the highest unemployment rates for college graduates are in the Architecture, Arts, and Humanities fields; meanwhile,

students majoring in fields like Health and Education, enjoy the lowest unemployment rates. Furthermore, Florida’s Governor Rick Scott has proposed charging different tuition rates based on a student’s major and his or her ability to contribute to Florida’s economy upon graduation. Alvarez (2012) says the message from Tallahassee is clear, “Give us engineers, scientists, health care specialists and technology experts. Do not worry so much about historians, philosophers, anthropologists and English majors.”

Due to data limitations, previous research is unable to provide definitive results on if, or how, matriculating freshmen make different choices about college majors during recessions. The data used for this study assuage those limitations and are obtained from the “Freshman Survey,” administered by the Cooperative Institutional Research Program (CIRP) and housed at the University of California Los Angeles’s (UCLA’s) Higher Education Research Institute (HERI). Only students’ major intentions are collected, because the survey is limited to college freshman. Intended majors map to student demand for certain classes and also set students on a major track. Once a major is selected, students will incur switching costs if they deviate from that initial track.

This paper tests the hypothesis that after downturns in the business cycle, *ceteris paribus*, students are more likely to choose majors with better relative income or employment opportunities after graduation. For example, after the most recent recession, majors in Health, Education, Business, and Technology were most likely to find jobs, while majors in the Social Sciences, Arts, and Humanities were least likely to be employed (Associated Press, 2012: Atlantic, 2012). These outcomes should result in an expected influx in the likelihood that freshmen will declare majors in the former categories.

Section 2.2 provides background information on the major choice literature and develops a theoretical framework for understanding how students should alter their major decisions after they observe economic downturns. Section 2.3 thoroughly describes the unique CIRP “Freshman Survey” data used to explore the relationship between freshman intended major

and recessions. This section also describes the one key way this study differs from previous work by including national business cycle indicators as freshman major predictors. This section also outlines industry level data from the Current Population Survey. Section 2.4 explains the multinomial logit empirical model used for the identification of a recession's impact on freshman major choice. Section 2.5 reports the results using the previously outlined data and empirical model. In general, students are more likely to choose majors with better relative wages and employment opportunities after a they observe a recession. This is the first paper that can unambiguously confirm that to be true. Section 2.5 also explores different subsamples of the population, discussing how the major switching effect differs for males vs. females and blacks vs. whites. Lastly, Section 2.6 concludes.

2.2 Background and Theoretical Framework

Because college major choice is pivotal for determining future career paths and earnings over a lifetime, a large literature focuses on understanding how students choose particular disciplines (Arcidiacono, 2004; Arcidiacono et al., 2010; Montmarquette, 2002; Beffy et al., 2010; Berger, 1988; Porter and Umbach, 2006; Dickson, 2010; Wisall and Zafar, 2012; Eide and Waehrer 1998). Despite the extensive body of research on college major choice, no one has unambiguously determined if and how the presence of a recession affects a student's major decision. Because the business cycle informs many higher education choices, isolating a pure major choice effect to attribute to business cycle fluctuations is complex.

Fortunately, focusing on freshmen intended majors instead of college graduate majors simplifies matters, making identification of major choice in the face of economic downturns analytically straightforward. There are only two potential business cycle effects that can alter the proportion of students observed across majors and that are present in a college freshman's decision set: enrollment effects and intended major choice effects.

2.2.1 Enrollment Effects

Enrollment effects are any changes to the likelihoods of students majoring in certain disciplines after changes in the business cycle and are a direct result of new and different types of students enrolling in college. Numerous papers scrutinize how changes in the business cycle affect postsecondary enrollment rates (Mattila, 1982; Goldin, 1999; Sakellaris and Spilimbergo, 2000), all finding that adverse business cycle conditions increase college enrollment rates. Students who are at the margin of enrolling in college and not enrolling in college are more likely to pursue postsecondary degrees if they observe the labor market declining.

Borrowing basic ideas from Manski and Wise (1983) and Lee (2010), the following model outlines a student's choice between either entering the labor force or enrolling in college: The net present value for student i entering the labor force (L) at time t is captured by

$$NPV_{Lt}^i = \sum_{t=0}^N w_t^i h_t^i$$

where w_t^i are the lifetime wages for each time period that student i can expect to earn in the labor market in the absence of a college degree, and h_t^i are the number of hours that student i can plan to work in each time period in the absence of a college degree.

$$w_t^i = w^i + \varepsilon_{wt}^i$$

$$h_t^i = h^i + \varepsilon_{ht}^i$$

where ε_{wt}^i and ε_{ht}^i represent stochastic shocks to expected wages and work experience for student i in the absence of a college degree.

Next, the net present value for student i student enrolling in college (C) at time t is

$$NPV_{Ct}^i = \alpha_t^i \nu_{0t}^i + (1 - \alpha_t^i) \nu_{1t}^i - T_t^i$$

where ν_{0t}^i is the expected consumption value of going to college for student i at time period t , ν_{1t}^i is the expected investment value of enrolling in college for student i at time period t ,¹ α_t^i is the weight student i places on consumption value versus investment value when choosing a major, and T_t^i is the tuition and other costs of college that student i would incur if she decides to enroll in school. These terms are characterized as follows:

$$\nu_{0t}^i = \nu_0^i + \varepsilon_{0t}^i$$

$$\nu_{1t}^i = \nu_1^i + \varepsilon_{1t}^i$$

$$\alpha^i = \alpha^i + \varepsilon_{\alpha t}$$

where ε_{0t}^i , ε_{1t}^i , and $\varepsilon_{\alpha t}$ represent stochastic shocks to expected consumption value, investment value, and the weight student i gives to consumption value when choosing a college major, respectively.

If $NPV_{Lt}^i > NPV_{Ct}^i$, a student will enter the labor force instead of enrolling in school, or vice versa. Several factors might cause a student to switch from working in the labor force to enrolling in school during a recession:

1. The opportunity cost of leaving the job market to go to school is lower when wages are declining. This would enter the model through a negative shock to ε_{wt}^i .
2. Before the economy declined she could find a job with just a high school degree, but now she cannot. This scenario would enter the model through a negative shock to ε_{ht}^i .
3. The relative return of a college degree versus a high school diploma is rising. This case would appear as a positive shock to ε_{1t}^i .

¹The investment value of enrolling in college is essentially just the transformation of expected wages and work experience, resulting from the human capital accumulation of a college degree.

4. After observing recessions, she cares more about their labor market opportunities because she has seen first-hand the competitive nature of the job market.² This last case would manifest as a negative shock to $\varepsilon_{\alpha t}$.

Characterizing the students at the margin of going to college and not, before and after a recession, is vital to identify the direction of any enrollment effects. Controlling for and signing these enrollment effects is a crucial component to any empirical strategy that hopes to capture major choice, the true focus of this paper.

2.2.2 Major Choice Effects

Similarly, one can frame student's major choice behavior using an analogous theoretical model. A student's net present value of a particular college major j is defined as

$$NPV_{jt}^i = \alpha_t^i \nu_{0jt}^i + (1 - \alpha_t^i) \nu_{1jt}^i$$

where, again, ν_{0jt}^i is the expected consumption value for student i for major j at time period t , ν_{1jt}^i is the expected investment value for student i for major j at time period t , and α_t^i is the weight student i places on consumption value versus investment value when choosing a major.³

$$\nu_{0jt}^i = \nu_{0j}^i + \varepsilon_{0jt}^i$$

$$\nu_{1jt}^i = \nu_{1j}^i + \varepsilon_{1jt}^i$$

$$\alpha^i = \alpha^i + \varepsilon_{\alpha t}$$

²It might also be that after a recession, students can no longer afford to go to college and drop out of school. I ignore this for the analysis because I assume that this effect would not impact some college majors more than others, as the majority of schools do not price differentiate based on undergraduate major. If, however, the likelihood of students dropping out of school varies by major, one would expect to see the highest attrition rates in the high-wage, high-employment opportunity majors based on the summary statistics of major by income in Table 2.5. Therefore, major choice effects would be lower bounds in this case.

³I ignore tuition and other costs because the assumption is that there is no price differentiation between majors.

where $\varepsilon_{0t}, \varepsilon_{1t}, \varepsilon_{\alpha t}$ are stochastic error terms representing shocks to expected consumption value, investment value, and weights students place on consumption value, respectively.

If $NPV_{jt}^i > NPV_{kt}^i$, student i will choose major j over major k in time period t . Studies report that students do indeed change their major decisions when given new information that alters their expectations about the investment values of majors (Arcidiacono et al., 2010; Wiswall and Zafar, 2011). Arcidiacono et al. (2010) examine how expected earnings influence students' major choices. They find that if expected earnings were the same across majors, more students would choose Humanities and Social Science majors than the highly technical Math and Science fields. In addition, they show that students' priors about the future wages earned in different majors are generally wrong; in the absence of forecast errors of expected future earnings, 7.5% of the Duke students they surveyed would have selected a different college major. These results suggest that some students will indeed modify their major decisions when expected investment values change.

Additionally, Wiswall and Zafar (2012) show that students' perceptions about potential earnings are ordinarily incorrect and when students receive more accurate information, they tend to change their major choices. These authors advocate for information campaigns that precisely reflect returns to schooling that have proven to work in developing countries (Jensen, 2010; Nguyen, 2010).

Clearly, students exploit job market signals when choosing a college major and update their decisions based on the information they receive. Presumably, freshmen could use a recession as an informational labor market signal. Business cycle shocks would enter a students major decision through ε_{1jt} , ε_{1kt} , or $\varepsilon_{\alpha t}$. Two scenarios would cause students to choose a different major in the presence of a recession than the otherwise would have:

1. The relative investment values between major j and k suddenly change in the presence of a recession. A student would switch from major j to major k if there were sufficiently large negative shocks to ε_{1jt}^i or positive shocks to ε_{1kt}^i .

2. Students care more about the investment values of majors after they observe recessions.

A student would switch from major j to major k if there were sufficiently large negative shocks to ε_{at} .

If students consider the quality of their first job and its salary when making their major choices, then changes in the business cycle should provide students with updated information about job and wage prospects in the approaching years (Lee, 2010). Students can observe how negative shocks in the short-run can effect certain industries more than others. However, even if students make decisions based purely on rational expectations (Berger, 1988), starting salary is still an important component in those expectations. When students graduate in a particularly unhealthy economic climate, it can affect the wages and employment opportunities they receive over their entire careers. Kahn (2010) and Oreopolous et al. (2012) provide evidence of this labor market “scarring.” Kahn (2010) reports that the effects of graduating in a poor economy are large, persistent, and negative. Therefore, rational students should consider economic climates when choosing their majors.

One can hypothesize the types of majors students are more likely to choose after recessions by examining the relative investment values of majors across time. While relative differences in investment values might be changing over time, the relative rankings of those values are not changing. Lee (2010) examines majors in the early 1980s and discovers that the relative investment values are highest for Engineering, Science, Business and lowest for Liberal Arts and Education majors. Rumberger and Thomas (1993) and Hamermesh and Donald (2008) show a similar investment value rankings ranking for the late 1980s and the 1990s through the early 2000s, respectively. They find that Engineering, Health, Science, Math, and Business majors rank highest followed by Social Science, Education and Humanities majors.

Furthermore, future employment stability differs between college majors. Job opportunities in the Government, Health Care, Public Safety, Education, Energy, Accounting, Technology, and Military sectors usually experience less of a decline during economic downturns than

do other types of jobs (Shatkin, 2008). A recent survey after the recession of 2009 found that unemployment rates for new college graduates were highest for Architecture, Humanities, Social Sciences, and Arts majors. Earnings were lowest for those majors (excluding Architecture) as well (Carnevale et al., 2012). If high-wage and high-employment-opportunity majors do not suffer as much relative to low-wage and low-employment-opportunity majors, then the former are the majors that students should be more likely to choose if there are shocks to investment values. Similarly, if students care more about investment value of majors after recessions, they should choose higher ranking employment and wage opportunity majors more often.

2.3 Data

Data constraints are the main barrier to answering whether students alter college major decisions after recessions. Few datasets collect information on student demographics and major choices over an extended time period, making it difficult to observe several recessions and major choice simultaneously. Three previous papers explore the relationship between the business cycle and college major choices use three different data sources: High School & Beyond, the Integrated Postsecondary Education System’s (IPED’s) “Completions Survey,” and the American Community Survey.

Lee (2010) analyzes how the business cycle influences college major decisions, using data from the High School & Beyond survey that provides student-level panel data from the 1980’s. He obtains his business cycle variables from the College Placement Council’s (CPC’s) salary survey and the U.S. and state unemployment rates from the Bureau of Labor Statistics (BLS). Lee exploits the period from 1982-84 as a time of severe recession and 1985-1988 as a time of economic recovery. He uses a mixed conditional logit model, employing individual student characteristics as well as major-specific characteristics to model major choice. Lee’s findings are ambiguous and statistically insignificant for the majority of the cases he studies. This outcome could result because Lee is not working with a balanced panel; 80 percent of

the students sampled made their major decisions in 1983 and are not observed after 1984, the threshold year.

The Integrated Postsecondary Education Data System (IPEDS) collects institutional-level data on the number of students graduating with degrees in different disciplines. These data are problematic because the intended majors of students beginning college are not observed, and it is hard to know whether changes in institutional proportions are a result of enrollment, major-switching, or a function of the time it takes students to graduate (Bradley, 2012).

Blom (2013) uses data on student major choice from the American Community Survey (ACS) from 1976-2006 and labor market information from the Current Population Survey (CPS). She attempts to map wages and unemployment from the CPS to majors in the ACS by assigning weights for each major category to occupations. The major choice in these data are observed after the student graduates, so the fluctuations in students across major might also result from different types of students are enrolling during recessions and students extending the time it takes them to graduate from college.

An alternate data source that collects student major information over an extended time period is the Cooperative Institutional Research Program's (CIRP's) "Freshman Survey" housed in the Higher Education Research Institute (HERI) at the University of California, Los Angeles (UCLA). These data have never before been used to investigate the relationship of student major and the business cycle. The HERI data have the advantage of observing freshman intended majors before they enroll in classes, so the identification of the major switching effect is not muddled by students' time-to-degree decisions (Bradley, 2012). In addition, the student-level nature of the data enables one to control for enrollment effects, addressing another identification problem of previous approaches (Bradley, 2012).

2.3.1 Higher Education Research Institute Data

Every year CIRP offers a survey of college freshmen that institutions can administer to their students. Schools who opt into the survey must pay HERI a fee for the survey materials and the data analysis provided after survey completion. HERI requires the survey to be administered to first-time, full-time freshmen before they begin fall semester classes. As recommended by HERI, the large majority of institutions conduct the survey during their freshman orientations in a proctored setting, ensuring the highest response rates and the most accurate information.⁴

Consequently, the majors observed in these data are intended majors of college freshmen and not the majors with which students graduate, as in other data sources. This characteristic has both favorable and unfavorable implications for the research question at hand. First, because only intended majors are observable, students' major preferences have not been altered by what they learn about the consumption values of majors in college. This type of information is irrelevant for this analysis, and if it can be eliminated, identification of major choice effect is more straightforward. However, because the majors with which students graduate is not observable, it is more difficult to make conclusions about how the business cycles affect the general composition of the labor market.

This study uses data from 191 institutions that participated in "The Freshman Survey" thirty out of the thirty eight years from 1971-2008,⁵ and where the state of the institution is observable. To protect the identity of the institutions, HERI requires that five or more institutions from the same state to be present in the sample before they reveal the state identity of the institution.⁶

⁴The "Freshman Survey" data obtained for research purposes are restricted access data and only granted to researchers after a thorough proposal process to ensure the identities of the institutions and the students are protected.

⁵Data outside this date range were unavailable.

⁶The states observed for the 191 institutions are CA, CT, GA, IL, IN, IA, MD, MA, MI, MN, MO, NY, NC, OH, PA, TX, VA, and WI.

HERI Institutions Compared to a National Sample

Table 2.1 reports the composition of schools in the HERI sample versus the national universe of four-year universities.⁷ Public institutions account for 17.4 percent of all of the institutions in the HERI sample versus about 24.4 percent of all national institutions. Because the cost of attending private universities is generally higher than the cost of attending public universities, the average student in the HERI sample might be more financially secure than the average college freshman. Strong evidence of this fact is reported in Table 2.2 when student level characteristics are compared to a nationally representative sample of college freshmen.

More importantly, the observed institutions in this study are more heavily weighted towards religious and liberal arts institutions than the nationally representative sample of institutions. The discrepancy in the proportion of liberal arts colleges has important implications for this analysis because of the different experience average students have at liberal arts institutions versus at other types of private and public institutions. The Annapolis Group, an alliance of the majority of liberal arts colleges in the country, commissioned a study that found its graduates reported extreme differences in their college experience and the value of their college degrees compared to students at other types of private and flagship public institutions. For example, 87 percent of students at liberal arts colleges graduated in four years versus 76 percent at other private institutions and 51 percent of students at national flagship public institutions. Because students at liberal arts institutions graduate faster, on average, than students at other types of universities, liberal arts students are more likely to complete their degrees. Also, the intended majors with which they start will more closely mirror the majors with which they will graduate because they have less time to absorb the switching costs of changing majors (Brunello and Winter-Ember, 2003; Messer and Wolter, 2007).

⁷Data for the national universe of schools come from IPEDS and the *Digest of Education Statistics* from the NCES.

Furthermore, 79 percent of students who attended the liberal arts colleges in the survey reported the quality and breadth of academic preparation equipped them well for being accepted to graduate school or finding their first job. Only 73 percent of students at other private universities and 64 percent of students at national flagship public schools reported the same level of preparation, respectively (Day, 2011).

Finally, the percentage of institutions classified as a Historically Black College or University (HBCU) in the HERI sample is comparable to the national average, with 3.7 percent in the HERI sample versus 3.9 percent, nationally. However, as reported in Table 2.2, there is a disparity in percentage of students in the sample identifying as black compared to the nationally representative proportion of black freshmen.

HERI Students Compared to a National Sample

One beneficial characteristic of the HERI data is the observable level of detail for student demographic characteristics. These characteristics are important major determinants, and when trying to identify the major choice effects they should be measured to control for any changes in enrollment. Montmarquette et al. (2002) find that women are less influenced than men by expected earnings when making their college major choice. This finding is reasonable given that men are traditionally the main breadwinners of a household, so they are more sensitive to future earnings possibilities than women (Hamermesh and Donald, 2008). Therefore, men are more likely than women to major in disciplines like Business, Engineering, and Technology. Wiswall and Zafar (2012) report strong taste parameter estimates for men in the Business and Economics disciplines and for women in the Arts and Humanities disciplines. Porter and Umbach (2006) cite several studies that confirm women are less likely to major in the Sciences and Engineering than men and are more likely to major in fields like Education, Nursing, and the Humanities. Gender-role reinforcement and minority status within a discipline might explain these observed gender differences (Lackland, 2001; Kanter, 1993).

The same theories apply to why racial differences might affect major choice. Minority students are less likely to choose a major where they are one of the few present in that major (Kanter, 1993). For this reason, there might be sorting on race by major as well. Dickson (2010),⁸ who specifically studies race and gender differences in college major choice, finds a 16 percentage point gap between white women compared to white men when examining the likelihoods of choosing Engineering and Technology majors. Additionally, white males are more likely to major in Business than white and Hispanic women and Asian and Hispanic males. Furthermore, Dickson (2010) finds that women are more likely to major in the Humanities than are men. Asians are less likely to major in the Humanities than whites and Hispanics (Dickson, 2010). She does not say anything about race and gender differences in the Social Sciences because she uses that major category as her reference major.

Income and age are also important determinants in the major choice literature (Porter and Umbach, 2006; Montmarquette et al. 2002; Berger, 1988). Students who have a higher relative family incomes may place less weight on the investment value of a major when choosing a major because they might have more family income to support them later in life. The opposite might be true for older more non-traditional students who may place more weight than the average student on the investment value of a major. Presumably, students who go back to school after taking time off might care less about the consumption value of a college degree and might be more concerned with how their degree will impact their labor market opportunities.

HERI provides a publicly available sample of students and sample weights that approximate national trends for college freshmen through the year 1999. To see if any strong student-level selection occurs in the data used for this paper, Table 2.2 compares the re-

⁸One difficulty in interpreting Dickson's results is that she does not report race and gender likelihood coefficients separately but instead the interaction terms of race and gender.

stricted access data provided by HERI for this study to the national trends for the years 1980-1999.⁹

In the freshmen survey data, income is reported as a categorical variable. Following the technique used in Hout (2004), income becomes a numeric variable by taking the midpoint of each category and converting it to 2008 dollars to adjust for inflation. Age is also a categorical variable, but each category maps to a one year change in age, so this is not converted to actual age. The age category “3” maps to reporting an age of 18. Therefore, the higher the age is above 3, the more non-traditional is the freshman sample.

After conducting a difference in means test for the observable demographic variables, the differences between the two samples are confirmed as statistically significant, although they are not large. One option to address this selection problem is to weight the data to more closely resemble the national trends. Unfortunately, all of the student and institutional-level variables required to apply the reported national norm weights cannot be observed. Therefore, I must recognize how these samples differ to generalize my results to the national context.

Papers like Wiswall and Zafar (2011) are also unable to weight their sample to more closely resemble the population. They address this problem by recognizing the differences in the two samples and discussing how those differences might affect the results when students are selecting a major. In the present context, because the sample has a greater percentage of private and liberal arts institutions, the students are richer, whiter, of more traditional age, and more likely female than a more nationally-representative sample of students. Although the students in this sample do differ slightly from the representative sample, the direction

⁹Although intended major and the other important demographic characteristics are observable for the years 1971-2008, I only use data for 1980-2008 in the final model. The identification strategy used in this paper is not feasible with long periods of economic turmoil and little recovery. As discussed in the next section, identification of the major choice effects relies on periods of negative economic shocks followed by observable periods of recovery, unlike the period of stagflation in the 1970s. Because the 1970s is viewed as a entire decade of economic turmoil, including these years in the model muddles the identification of major choice effects.

of the differences turns out to be quite fortunate. A more representative sample of students would be more likely to change their majors after recessions than students in this sample because, as outlined previously in this section, male, minority, poorer and older students care more about the investment value of a major than do their counterparts. Therefore, the effects in this study can be viewed as conservative estimates of major switching after recessions compared to a national sample of college students.

While the CIRP “Freshman Survey” data provide a broad range of student demographic information, one disadvantage is that response rates differ for all variables collected. Only variables for which there are high response rates over the entire sample period can be included in the model because of fears of sample selection based on survey nonresponse. Table 2.3 lists response rates for those in my model: gender, race, income, and age. All the variables listed have student response rates of over 89 percent of the sample. These response rates are comparable for the nationally representative sample provided by HERI. Therefore, there is no reason to believe that response rates for students in my sample would differ from the response rates from students in a national sample.

HERI Data and Major Heterogeneity

This analysis considers thirteen major categories. Table 2.4 details high-wage majors versus low-wage majors and high-employment-opportunity majors versus low-employment-opportunity majors, as outlined in Section 2.2.2 of the paper. Twelve of the thirteen majors are categorized the same for both employment and wages. This table hypothesizes the majors that students might be more likely to choose after recessions. The Education major is the lone exception because it is considered a low-wage major and a high-employment-opportunity major, so it is unclear how students will respond to this major when they observe business cycle shocks. If students are more likely to choose the Education major during recession years then this could indicate that they care more about job stability than wages during downturns or vice versa. Figure 2.1 displays the proportions of students intending to major

in each discipline averaged over all years in the sample. The largest percentage of freshmen intend to major in Business and the smallest percentage in Mathematics.

As mentioned earlier in this section, a student's demographic characteristics are critical for determining which major a student chooses. Table 2.5 summarizes important demographic characteristics by major; this table provides cursory evidence that students indeed sort into majors across income, age, gender and race. In general, richer students sort into majors with lower wages and lower job market opportunities like English, History, Humanities, and Social Sciences.¹⁰

The summary statistics by major for age, gender, and race also reveal expected trends. Older (more non-traditional) freshmen major in high-wage and high-employment-opportunity majors that are less likely to require graduate study such as Technology, Engineering, Business, and Education. Presumably, an older student is less likely to return to college to major in something that has a lower investment value after graduation. Furthermore, there is a larger share of male students majoring in Engineering, Technology, Physical Sciences, Business, Math, and History, respectively, than their share of the total freshmen population. This conforms to what Montmarquette et al. (2002) proposes: males care more about investment values of majors than do females.

Asian students constitute more than their representative share in the Biology, Health, Engineering, Technology, Physical Sciences, and Math majors. Black freshmen report intended majors at higher rates in Technology, Health, Social Sciences, Biology, and Business fields. Finally, white students represent more than their total share of the population in Education, English, Humanities, Mathematics, Physical Sciences, History, and Business.

Table 2.6, which ranks majors by average student high school GPA, summarizes how certain students sort into majors based on ability levels. This information conforms to what previous studies report about how a student's ability affects her major choice. HERI reports

¹⁰The Business major is the exception and the only high-family-income major in the top 5 that is not considered a low-wage, low-employment-opportunity major.

GPA on a 1-8 scale with 1 being a D, 8 being an A, and 5 being a B. The mean for all student is around a 6.1, or a B+ according to their scale. Those who perform better on average in high school choose more technical majors like Math, Physical Sciences, Biology, and Engineering. For example, Math majors have the highest high school GPA with an average of 6.83 and Education majors have the lowest with a 5.73 average. The variables Academic, Art, Math, Write, and Confidence are student self reported ability scores in these areas on a scale of 1-6. It is clear that students sort into majors for which they believe they have the highest abilities. Response rates are not high enough for many of these variables over a long enough time period for them to be included in the empirical model, but this table provides interesting information on which types of students choose certain majors.

2.3.2 Business Cycle Data

To correctly identify the effects of observed recessions on students' major decisions, the business cycle variables must capture the information shock of an economic downturn. The few previous papers that have explored similar topics as this paper use a variety of data to model the business cycles (Lee, 2010; Bradley, 2012, Blom, 2013). All business cycle data must signal both changes in expected future earnings and labor market opportunities. Lee (2010) uses the most comprehensive set of business cycle variables. He employs indicators for wages and unemployment at the national and state levels, and obtains ambiguous results. One of Lee's assumptions in his model specification is that student responses to certain economic indicators are symmetric. However, the ways students respond to a 3 percent increase in unemployment when unemployment is initially 4 percent might be different than how students change their major decisions when initial unemployment is 8 percent. Therefore, I use business cycle variables that allow for this asymmetry.

At the national level, the recession troughs reported by the National Bureau of Economic Research's (NBER's) Business Cycle Dating Committee are business cycle indicators that capture both changes to wages and unemployment and allow for student response asymmetry.

The recession troughs are the periods where national recessions are thought to bottom out before they begin periods of recovery. The NBER has no fixed definition of what determines trough dates and uses various measures of broad economic activity in its analysis: real GDP, economy-wide employment, and real income. The committee may also use sector specific information in its evaluation. The trough years observed for the sample period used in this model are 1980, 1982, 1991, and 2001.¹¹

Two variables capture the state level business cycle changes. The Bureau of Labor Statistics's (BLS) reports yearly unemployment rates by state. To allow for asymmetrical student decisions, I convert these data to an indicator which signals if the state unemployment rate is over 8 percent. The Regional Economic Information System at the Bureau of Economic Analysis (BEA) reports quarterly personal income per capita by state. These data are then adjusted for inflation and converted to growth rates by state from year to year. Negative per capita personal income growth rates signal declining economic conditions.

Figures 2-4 show how major proportions change over time with trough years indicated in the graph. After trough years, defined kinks appear in the reported major proportion lines, which simply provides suggestive evidence that students are in some way responding to this new information. Employing a full econometric model that controls for other factors that influence college major choice is the next step in determining how students respond to adverse business cycle information.

2.3.3 CPS Data

The change in relative employment and wage opportunities between majors is another source of information that could alter a student's major choice decision. There is no dataset that documents unemployment and earnings information by major throughout the time period

¹¹I used the national high unemployment and negative GDP growth rates, but the same story develops as using the trough years, although the coefficients are rarely statistically significant. GDP growth and unemployment rates are usually syncopated, so including both at the national level might not allow for separate identification. I include the trough years in models instead, because they capture both of these measures of national business cycle changes.

1980-2008. However, the “March Supplement” of the Current Population Survey collects information on earnings and unemployment by thirteen major industries during the period of interest in this paper. While the industry data does not perfectly map to college majors, it does represent the type of information students have access to when making major decisions. They might observe unemployment in the health care industry falling and decide to choose a major in the Health category. Conversely, they might observe declining relative wages in the health care industry compared to other industries and decide to major in Humanities instead.

To account for these sectoral changes over time I include the wages and unemployment rates by industry in the models. Table 2.7 displays the industry categories and their average unemployment and earnings levels in 2008 dollars for full-time, full-year workers. The Public Administration industry has the lowest unemployment rate over this time period at 3.2% followed by Health and Education at 3.4%. The highest average unemployment rates occur in the Construction and Entertainment sectors at 12.7% and 9.6%, respectively.

The highest average earnings¹² during this time period are in the Mining industry at \$61,235.09 followed by Finance and Business both around \$55,300. The Agricultural and the Services industries have the lowest average earnings with \$30,356.19 and \$32,421.05 respectively.

By observing both industry level data and aggregate business cycle data one can determine which is most important in student’s major decisions. If the industry wage and unemployment rates seem to drive student major decisions, then students are simply responding rationally to industrial changes over time. This is the way most current studies of student major choice are modeled (Berger, 1988; Lee, 2010; Rumberger and Thomas, 1993; Hammermesh and Donald, 2008). However, if the business cycle data proves to be more im-

¹²All earnings are inflation adjusted to 2008 dollars

portant, then students are responding to recessions by placing more weight on employment and wage opportunities during downturns.

2.4 Empirical Model

First, I will estimate the following logistic regression to determine whether freshmen are more likely to declare an intended major during downturns:

$$Pr(Y = 1|X) = \frac{e^{\beta_j'x_i}}{1 + e^{\beta_k'x_i}}$$

where $Y = 1$ if a student declares an intended major and $Y = 0$ otherwise. X is a vector of state and national business cycle variables, CPS industry data, student demographic characteristics, and institutional controls. The demographic variables include gender and race indicators, family income, and the student's age. The effects of these demographic characteristics are netted out to determine the true effect of business cycle changes on the probability that students declare majors. The results for this model will be reported as relative risk ratios (rrr's), or probability ratios of a student declaring a major versus not declaring a major. If $rrr > 1$, then the average student is more likely to declare an intended major during as that variable increases, and if the $rrr < 1$, then a student is less likely to choose a major with increases in the variable of interest.

Results for the contemporaneous trough indicator will be the focus in the models. The direction of the relative risk ratio for this variable most closely captures whether students are responding to national recessions. All of the contemporaneous business cycle variables are less likely to contain any enrollment effects. It is difficult for students to observe a recession and enroll in a four-year university in the same year. If enrollment effects exist they should materialize in the lags of trough and other state business cycle variables because it takes time to apply to and be accepted into a four-year university; Typically, students decide whether

they are going to college by the year prior to enrollment. Four lags of the trough variables are included in the model to also control for any enrollment effect.

After the logit model reveals whether students are more or less likely to declare intended majors during recessions, the analysis shifts to how the likelihoods of declaring particular majors changes with the business cycle. This study uses a multinomial logit technique similar to that used in Dickson (2010) and Porter and Umbach (2006), and is conditional on students declaring an intended major. Using the same vector of X variables from the logistic model I estimate the following empirical model for freshman intended major choice:

$$Pr(M_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=0}^K e^{\beta_k' x_i}}$$

for

$$j = 0, 1, 2, 3, 4, \dots, K$$

where K is the number of broad intended major categories in the data. M is the intended major choice of the student, which is a function of the demographic and time series variables included in vector X .¹³

By controlling for demographic characteristics, this empirical strategy compares similar students across time to assess whether the presence of a recession affects the majors students select. If different types of students are enrolling in college during recessions, controlling for observable demographic characteristics partially alleviates this issue. If, however, certain unobservable student characteristics are potentially correlated with major choice after reces-

¹³One important identifying assumption for the multinomial logit model is independence of irrelevant alternatives (IIA). This assumption claims that the odds of preferring one major over another do not depend on the presence or absence of other irrelevant majors. Previous papers that use multinomial or conditional logit to model major choice fail to test for this IIA assumption (Porter and Umbach, 2006; Dickson, 2010; and Lee, 2010). I test the validity of the IIA assumption using the Hausman-McFadden test. The test suggests that some of the majors fail to meet the IIA condition. I can collapse on more similar majors in future research using nested logit, which relaxes the IIA assumption. For now, the rrr's are reported using multinomial logit.

sions, then I must use techniques to hypothesize the direction of these effects to appropriately bound any major choice effects.

In addition, the school a student attends undoubtedly influences major choice. For example, a student attending the Georgia Institute of Technology is much more likely to choose an Engineering major than a student attending the University of Georgia. The large number of major categories and the computationally intensive multinomial logit routine does not make it analytically tractable to add 191 institutional indicator variables. Instead, I determine the average number of students over time at each institution majoring in the different major categories and include those control variables in the model. This is the best alternative that also captures any proclivity a student may have for a particular major given the institution he or she attends.

The results are reported as *rrr*'s between the remaining majors and the reference major, English. The English intended major possesses a steady share of the student totals over time. As shown in Figure 2.4, the share of English majors was 2.0 percent in 1980 and 2.7 percent in 2008. The proportion never deviates by more than 0.6 percentage points away from its mean of 2.6 and is not affected by the fluctuating choice pattern that characterizes other majors. Therefore, students are less likely to switch into or out of that major when business cycle fluctuations occur, making the English major a good reference point. Also, according to Table 2.5, English majors are the richest students compared to their peers in other majors; they might care less about the investment value of majors because they potentially have more financial support from their families. Additionally, because English is seen as a typically low-wage and low-employment opportunity major, theory suggests that this would not be a major the marginal student would want to choose after observing a recession.¹⁴

¹⁴However, *rrr*'s using each major as the reference major are reported for the contemporaneous trough term in Appendix Table B.1.

2.5 Results

Table 2.8 reports the results for the logit model estimation. The relative risk ratio for the contemporaneous trough term is 0.68. This reveals that freshmen are less likely to report an intended major in a trough year than in a non-trough year. The sign of the results are the same when observing the contemporaneous term for high state unemployment and negative personal income growth rates, although the magnitudes are not as intense. This suggests that freshman uncertainty about the correct major path increases when faced with unfavorable economic conditions.

Subsequently, I estimate the main empirical model conditional on declaring an intended major, using a sample of the freshmen whose relevant demographic information is observable from the years 1980-2008.¹⁵ The results conform to what theory and anecdotal evidence suggest: students alter their college major intentions when they observe shocks to the business cycle. Table 2.9 reports a summary of the relative risk ratios (*rrr*'s) for the contemporaneous trough variable for each of the twelve major categories compared to the reference major English. The *rrr*'s for the state level business cycle variables are rarely statistically different than 1.00. This may indicate that students care more about the national economy when making their major decisions than they care about state level economic conditions.¹⁶ Therefore, the focus remains on the contemporaneous business cycle term, which is least affected, theoretically, by enrollment effects. The full multinomial logit output is available in Appendix Tables B.2-B.3.

¹⁵I estimate the multinomial logit model with 20 percent sample of the observable students because of the model's analytical intensity. Five 20 percent samples were drawn without replacement were estimated to include every observable student. The results reported in the following tables are using the sample that has its relative risk ratios fall in the middle of the estimated ranges. The directions of each of the estimates are consistent for each of the samples, while the magnitudes differ. Fortunately, the relative magnitudes of the estimates within a sample are consistent across the five groups of students.

¹⁶A subsample of the population of freshman who live within 50 miles from home was used to see if the state level business cycle variables became more significant. No real difference was seen compared to the aggregate sample of students.

The first column in Table 2.9 lists the rank and magnitude of the relative risk ratios of the contemporaneous trough variable for the majors over an aggregate sample of freshmen. The second column lists the majors' rankings and magnitudes of the contemporaneous trough for females, the third column for males, and the fourth column for whites.¹⁷ Table 2.10 displays the tiers of majors whose magnitudes can not be statistically differentiated from one another.¹⁸ If majors are in the same tier, one cannot decipher which of the majors the students would prefer, on average, after a recession. However, if two majors are in different tiers, then, on average, students prefer a major in the higher of the two tiers after a recession.

In general, the rankings of the majors conform to theoretical priors. Majors that typically pay higher wages and have more employment opportunities have larger *rrr*'s relative to English majors, and majors for which wages and employment opportunities are not as substantial have smaller magnitudes relative to the reference major. A recession's effect on the likelihood that students will choose Technology is the strongest for the full sample of students, as well as for the male and white subgroups of students. Institutions should expect an increase in the demand for classes required for a Technology major after a recession. Interestingly, Technology classes are some of the most expensive classes to offer considering the resources they require. University administrators should not ignore this result given their strained budgets during economic downturns.

For the aggregate sample of students, Education and Biology fall into the second tier of majors, and remain in the top tiers for all of the subgroups of students. Both of these majors belong to the high employment opportunity category. Because Education is ranked so highly for each of the subgroups of students, it suggests that students place more weight on job security when choosing majors during recessions than they do on wages. The theory is reinforced by the fact that the Business major never rises above the penultimate tier for any

¹⁷Because so few blacks were present in the 20 percent sample of students the results were rarely statistically significant, but the rankings of the majors were similar to the rankings across the other groups.

¹⁸The majors in the same tiers for the same model have overlapping 95 percent confidence intervals.

of the subgroups. This might be surprising given the industry had one of the highest wage rankings according to the CPS data. But if students place more weight on being employed during downturns, the result is more believable.

While the major rankings are fairly consistent across columns in Table 2.9, one main difference between the subgroups is the ranking of the Physical Sciences and Social Sciences. They rank higher for the female subgroup compared to any other. The Humanities and Social Science majors are consistently ranked in the bottom tiers of majors. This is expected given that both are low-wage, low-employment opportunity majors.

The Fine Arts and Physical Science majors stand out as two exceptions to the hypothesis that high-wage, high-employment majors will be preferred after recessions. Psychological literature suggests that the result for Fine Arts majors is not as odd as it may seem. Csikszentmihalyi and Getzels (1973) report that Fine Arts majors compared to students who major in other disciplines have low levels of “superego strength,” which indicates that these students do not conform to cultural or social standards. They also describe artists as “resolute and accustomed to making their own decisions.” Shelton and Harris (1979) confirm that those who major in the Arts possess an “assertive boldness.” Students who major in Art already know they are making a risky financial decision and probably place a very low priority on the investment value of their college major. That weight is unlikely to change by enough after a recession to induce them to switch majors to another field. Therefore, any shocks to investment value, like a recession, would have no visible effect on their decision to be an Art major. It is probably the case that the exact same students who chose an Art major before a recession are going to choose an Art major after a recession. This suggests that if there are any changes at all in the number of students majoring in English after a recession, then the *rrr* for the Fine Arts major will be greater than 1.00.

The unexpected results for Physical Science majors are more difficult to explain. Combining evidence from Arcidiacono et al. (2010) and Stinebrickner and Stinebrickner (2011),

students would prefer to major in less challenging disciplines, *ceteris paribus*. When students receive updated information, many times they change out of the more technical majors like Math and Science to majors like Humanities and Social Sciences. Stinebrickner and Stinebrickner (2011) also show that students are not very likely to switch into a Physical Science major after receiving updated information but, most of the time, will switch out of the major.

There might be concern that some enrollment effects are present in the contemporaneous trough term. Each demographic variable can be regressed on the remaining variables in the model. By observing the magnitude and the significance level of the contemporaneous trough term and if there are priors about the direction of correlation between the observable demographic variables and any unobservable variables, then any remaining enrollment effects can be signed. Table 2.11 reports the results for the OLS regressions of the demographic variables on the other variables in the empirical model. The contemporaneous trough terms for males, whites, and family income are negative and significant. This implies that in trough years fewer males, whites enroll in college, and the students have lower family incomes. The contemporaneous trough variable is positive and significant for age indicating that older students are more likely to enroll in college during downturns. This may indicate that workers are leaving the labor force and enrolling in college instead. Even though there appear to be enrollment effects across these variables, these should not affect the estimated major-switching effects because these variables are controlled for in the multinomial logit model.

Table 2.12 reports OLS regression results for some of the variables not included in the multinomial logit model because of their low response rates in the HERI survey. Students have higher high school GPAs, but lower SAT Math scores and SAT Verbal scores in business cycle trough years. Therefore, no strong conclusions can be made about how or if average student ability is changing with recessions. Because these ability measures are not included in the model, if there are ability changes it might bias the results for the major choice effects.

If bias is a concern, then the relative risk ratios should be interpreted as the aggregate change in the enrollment and major choice effect during contemporaneous trough years.

2.6 Conclusion

This is one of the first papers to empirically show an unambiguous relationship between the business cycle and the majors that college students choose. First, this study finds that freshmen are more likely to have an undeclared intended major during a recession trough year. Those who do report an intended major during a recession are generally more likely to choose majors that pay higher wages and/or have more job security like Technology, Biology, Health, and Education majors.

The results of this paper should be interpreted as conservative estimates of student major choice responses after recessions, as this sample is more heavily weighted towards wealthy, white, female, and liberal arts students. A more nationally representative sample than the CIRP “Freshman Survey” might more closely capture an average student’s response to a recession.

This paper helps researchers to better understand how students make their major decisions. Because of data limitations, studies have been unable to identify whether students respond to business cycle signals when choosing college majors. The data used here improve upon the student-level college major data and introduce a new variable that characterizes the business cycle. While recession troughs may seem like obvious business cycle indicators, previous papers focus on levels of wages and unemployment within industries. Those variables appear to be less important to student’s decisions than national level business cycle indicators. Students may not initially have perfect information about wage and unemployment variables by major or industry to factor into their major decisions. However, students should have a basic understanding of how the economy is performing, and this is best captured by the recession trough data from the NBER. The information shock of a recession

trough induces students to switch their intended majors in the direction that theory and anecdotal evidence suggests.

Knowing the types of majors students are more likely to choose during recessions helps administrators plan for fluctuations across field of study. University administrators armed with the information of a recession's effect on student major choice can then allocate resources accordingly. Also, if economists and other researchers have a more complete understanding of how students choose majors during recession years, then the forecasting of labor market shortages and surpluses in certain fields will become more accurate.

2.7 Tables and Figures

Table 2.1: Institutional Characteristics

Sample of Institutions	Public (%)	Religious (%)	HBCU (%)	Liberal Arts (%)
HERI Sample	17.42	37.76	3.73	55.60
National Universe	24.41	33.33	3.90	15.00-25.00 [†]

Notes: [†] This percentage depends on the source reporting.

Table 2.2: HERI Trends Sample vs. My Sample: 1980-1999

Variables	Trends(weighted)	My Sample	Difference _{MySample-Trends}
Male	52.88%	48.04%	-4.84% ***
Black	10.72%	7.53%	-3.19%***
White	82.33%	84.33%	2.00% ***
Asian	3.74%	5.32%	1.58%***
Income	\$94,791.34	\$110,161.30	\$15,369.96***
Age	3.26	3.22	-0.04***

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

The “Trends” data are publically available through HERI and depict a nationally representative sample of the population. The “My Sample” data are the restricted access data obtained through HERI.

Table 2.3: Response Rates

Variables	My Sample	Trends
Major	94.23	N/A
Male	99.90	100.0
Race	98.20	98.47
Income	89.03	89.11
Age	99.27	99.37

Notes: The “Trends” data are publically available through HERI and depict a nationally representative sample of the population. The “My Sample” data are the restricted access data obtained through HERI.

Table 2.4: High-Wage vs. Low-Wage Majors/High-Employment-Opportunity versus Low-Employment-Opportunity Majors

High Wage	Low Wage	High Employment	Low Employment
Biology	Education	Biology	English
Business	English	Business	History
Engineering	History	Education	Humanities
Health	Humanities	Engineering	Fine Arts
Mathematics	Fine Arts	Health	Social Sciences
Physical Sciences	Social Sciences	Mathematics	
Technology		Physical Sciences	
		Technology	

Table 2.5: Demographic Summary Statistics by Major: Sorted by Family Income

Major	Income(\$)	Age	Male(%)	Asian(%)	Black(%)	White(%)
English	133,923.20	3.21	31.54	4.78	5.01	88.10
History	132,113.20	3.23	48.22	4.89	6.49	85.05
Business	122,722.60	3.27	55.20	4.97	8.07	83.88
Humanities	121,792.10	3.23	34.53	3.96	5.08	88.09
Social Sciences	119,204.80	3.23	28.95	5.88	9.09	80.98
Biology	117,183.40	3.20	40.33	11.66	8.25	76.20
Physical Sciences	112,968.90	3.22	61.03	7.23	5.32	85.26
Fine Arts	111,426.60	3.26	44.01	5.31	5.56	86.74
Math	107,124.70	3.17	50.26	6.38	4.91	86.77
Engineering	104,067.80	3.25	81.33	8.75	6.68	81.54
Health	102,743.80	3.22	29.50	8.77	10.45	76.97
Education	94,047.69	3.26	23.65	1.77	5.21	90.69
Technology	90,398.65	3.26	66.95	8.09	11.23	77.66
All Majors	113,452.80	3.24	46.64	6.34	7.68	82.78

Notes: “Income” represents family income in 2008 dollars. “Age” is a categorical variable with 3.0 equivalent to age 18.

Table 2.6: Ability Summary Statistics by Major: Sorted by HSGPA

Major	HSGPA	SATM	SATV	Academic	Art	Math	Write	Confidence
Math	6.83	679.93	587.62	4.36	2.66	4.58	3.30	3.88
Physical Sci	6.70	656.15	608.88	4.33	2.87	4.08	3.52	3.95
Biology	6.62	622.96	594.21	4.17	2.94	3.66	3.53	3.81
Engineering	6.47	653.93	576.77	4.23	2.87	4.20	3.34	3.90
English	6.45	604.07	643.95	4.19	3.27	2.99	4.36	3.87
Health	6.37	587.26	553.34	4.00	2.76	3.52	3.43	3.70
History	6.37	605.79	613.26	4.18	2.81	3.20	3.83	3.96
Humanities	6.20	598.41	612.72	4.04	3.40	3.08	3.81	3.81
Social Sci	6.03	590.25	582.30	3.92	2.85	3.16	3.61	3.66
Technology	5.95	616.48	562.47	3.97	2.83	3.77	3.32	3.74
Fine Arts	5.89	585.77	573.88	3.87	3.99	3.18	3.55	3.65
Business	5.77	582.96	538.65	3.86	2.62	3.51	3.35	3.70
Education	5.73	540.53	525.28	3.67	2.71	3.06	3.34	3.48
All Majors	6.13	602.35	575.46	4.00	2.89	3.47	3.52	3.76

Notes: HSGPA is on a 1.00 to 8.00 scale with 6.00 equivalent to a B+ average.

“Academic,” “Art,” “Math,” “Write,” and “Confidence” are all student self-rated ability scores on a 1-6 scale.

Table 2.7: Average Unemployment and Earnings by Industry: 1980-2008

Industry	Unemployment (%)	Earnings (\$)
Agriculture	8.98 (1.64)	30,356.19 (5203.14)
Mining	7.55 (3.84)	61,235.09 (3637.68)
Construction	12.74 (3.96)	45,647.33 (1633.01)
Manufacturing	7.00 (2.66)	49,515.22 (3501.03)
Wholesale and Retail Trade	7.59 (2.19)	40,406.79 (3683.62)
Transportation and Utilities	5.03 (1.51)	50,421.11 (1978.04)
Information and Communications	3.99 (1.37)	57,816.53 (5274.24)
Finance	3.76 (1.23)	55,321.81 (9644.84)
Business	6.44 (1.44)	55,346.63 (7694.86)
Health and Education	3.38 (1.59)	47,349.67 (4772.24)
Entertainment	9.58 (2.51)	39,284.06 (4282.72)
Services	6.58 (6.58)	32,421.05 (4009.66)
Public Administration	3.27 (3.27)	51,352.20 (3799.43)

Notes: Earnings are in 2008 dollars. Standard deviations in parentheses
Data come from CPS collected by the BLS and the U.S. Census Bureau.

Table 2.8: Logit Model of Declaring a Major

	Declared	Declared
Trough _t	0.68*** (0.07)	0.67*** (0.07)
Trough _{t-1}	0.97 (0.05)	1.01 (0.05)
Trough _{t-2}	1.39*** (0.08)	1.34*** (0.08)
Trough _{t-3}	0.80*** (0.07)	0.78*** (0.07)
Trough _{t-4}	0.72*** (0.05)	0.73*** (0.05)
High Unemp _t	0.94*** (0.01)	1.00 (0.01)
High Unemp _{t-1}	0.99*** (0.01)	1.02 (0.01)
High Unemp _{t-2}	0.94*** (0.01)	0.97** (0.01)
High Unemp _{t-3}	0.97*** (0.01)	0.99 (0.01)
High Unemp _{t-4}	0.95*** (0.01)	0.99 (0.01)
Neg. PI Growth _t	0.98*** (0.01)	0.99 (0.01)
Neg. PI Growth _{t-1}	1.01* (0.01)	1.01 (0.01)
Neg. PI Growth _{t-2}	1.01*** (0.01)	1.01 (0.01)
Neg. PI Growth _{t-3}	1.02*** (0.01)	1.01 (0.01)
Neg. PI Growth _{t-4}	1.05*** (0.01)	1.02** (0.01)
Demographic Controls	Yes	Yes
State Indicators	No	Yes
CPS Data	Yes	Yes
No. of Obs	2,293,526	2,293,526

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Relative risk ratios reported with standard errors in parentheses.

Table 2.9: Summary of Contemporaneous Trough Relative Risk Ratios

All	Female		Male		White	
Technology	7.53***	Biology	3.13**	Technology	18.85***	Technology
Education	2.90**	Education	2.70*	Math	3.89	Biology
Biology	2.74**	Health	1.51	Education	3.01	Education
Health	1.92	Engineering	1.38	Health	2.67	Health
Engineering	1.48	Fine Arts	1.37	Biology	2.32	Engineering
Fine Arts	1.31	Technology	1.34	History	2.17	Math
Math	1.17	Phys. Sci	1.06	Engineering	1.91	Fine Arts
History	0.97	Social Sciences	1.04	Humanities	1.51	Social Sciences
Social Sciences	0.93	Business	0.54	Fine Arts	1.26	History
Phys. Sci	0.83	History	0.48	Business	1.16	Phys. Sci
Business	0.78	Math	0.37	Phys. Sci	0.84	Business
Humanities	0.58	Humanities	0.33*	Social Sciences	0.53	Humanities
N=419,925	N=220,330		N=199,595		N=348,745	

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

The results are reported for a 20 percent sample of students. The relative risk ratios are ranked by magnitude for each separate demographic category. If a major's relative risk ratio (rrr) is greater than 1.00, then students are more likely to choose that major relative to English after a recession. If $rrr=1.00$ then a student is just as likely to choose that major relative to English after a recession. If $rrr < 1.00$ then a student is less likely to choose that major after a recession. For example, if for females the rrr for a Business major =2.28 then the average female is 2.28 times more likely to choose an English major during a recession trough year than in a non-recession trough year. The complete multinomial logit results for the complete 20 percent sample of students can be found the Appendix tables A2-A3.

Table 2.10: Contemporaneous Trough Relative Risk Ratio Tiers

Tiers	All	Female	Male	White
Tier 1	Technology	Biology, Education	Technology	Technology
Tier 2	Biology, Education	Engineering, Fine Arts Health, Technology	Education, Math	Biology, Education
Tier 3	Engineering, Health, Fine Arts, Math	Physical Sciences, Social Sciences	Biology, Health History	Engineering, Health Math
Tier 4	History, Physical Sciences Social Sciences	Business, History	Engineering, Humanities	Fine Arts, Social Sciences
Tier 5	Business, Humanities	Humanities, Math	Business, Fine Arts Physical Sciences	Business, History Humanities, Physical Sciences
Tier 6			Social Sciences	
	N=419,925	N=220,330	N=199,595	N=348,745

Notes: Tiers represent overlapping 95% confidence intervals of the contemporaneous trough relative risk ratios.

Table 2.11: Estimated OLS Enrollment Effects by Observable Demographic Characteristics

	Male	Age	Income	White
Trough _t	−0.013*** (0.005)	0.024*** (0.005)	−2361.15*** (846.54)	−0.019*** (0.004)
Trough _{t−1}	−0.040*** (0.007)	0.027*** (0.008)	−6090.09*** (1146.64)	−0.006 (0.004)
Trough _{t−2}	−0.023*** (0.004)	0.031*** (0.005)	−10498.16*** (758.70)	−0.012*** (0.004)
Trough _{t−3}	−0.012*** (0.004)	0.024*** (0.004)	1394.18** (686.41)	−0.013*** (0.003)
Trough _{t−4}	−0.012*** (0.003)	0.020*** (0.004)	−2423.28*** (550.56)	0.004 (0.002)
High Unemp _t	0.001 (0.002)	−0.002 (0.002)	461.13* (251.76)	−0.011*** (0.001)
High Unemp _{t−1}	0.003** (0.002)	−0.001 (0.002)	−288.52 (278.15)	−0.003*** (0.001)
High Unemp _{t−2}	0.000 (0.002)	0.002 (0.002)	−1645.32*** (280.38)	−0.009*** (0.001)
High Unemp _{t−3}	−0.007*** (0.002)	−0.002 (0.002)	−976.79*** (262.32)	−0.000 (0.001)
High Unemp _{t−4}	0.003** (0.001)	−0.005*** (0.001)	−853.58*** (222.11)	0.002* (0.001)
Neg. PI Growth _t	0.003*** (0.001)	−0.001*** (0.001)	−285.46 (197.59)	−0.000 (0.001)
Neg. PI Growth _{t−1}	0.005*** (0.001)	−0.005*** (0.001)	−929.26*** (201.68)	−0.005*** (0.001)
Neg. PI Growth _{t−2}	0.007*** (0.001)	−0.006*** (0.001)	−753.89*** (200.12)	0.000 (0.001)
Neg. PI Growth _{t−3}	0.005*** (0.001)	−0.004*** (0.001)	−945.58** (207.22)	0.004*** (0.001)
Neg. PI Growth _{t−4}	0.006*** (0.001)	−0.006*** (0.001)	−1623.42*** (219.41)	0.001 (0.001)
Demographic Controls	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes
CPS Data	Yes	Yes	Yes	Yes
No. of Obs	2,293,526	2,293,526	2,293,526	2,293,526

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Robust standard errors in parentheses.

Table 2.12: Estimated OLS Enrollment Effects by Student Ability Measures

	HSGPA	SATM	SATV
Trough _t	0.182*** (0.013)	-3.229 (1988.56)	-23.377*** (0.441)
Trough _{t-1}	0.007 (0.018)	-28.638 (97.912)	-77.447*** (2.240)
Trough _{t-2}	0.161*** (0.012)	-3.739 (5269.066)	-48.140*** (1.540)
Trough _{t-3}	0.061*** (0.011)	-9.592 (167.869)	-19.093*** (0.614)
Trough _{t-4}	0.058*** (0.009)	-5.475 (202.512)	-0.425*** (0.933)
High Unemp _t	-0.016*** (0.004)	-5.450*** (0.559)	-4.678*** (0.0552)
High Unemp _{t-1}	0.017*** (0.005)	-0.405 (0.581)	-1.566*** (0.561)
High Unemp _{t-2}	-0.008* (0.005)	-1.504*** (0.555)	-1.957*** (0.534)
High Unemp _{t-3}	0.017*** (0.004)	-2.891*** (0.469)	-2.110*** (0.460)
High Unemp _{t-4}	-0.004 (0.004)	-2.292*** (0.370)	-2.096*** (0.367)
Neg. PI Growth _t	-0.008*** (0.003)	.336 (.280)	0.530* (0.283)
Neg. PI Growth _{t-1}	-0.019*** (0.003)	0.874*** (0.291)	0.615** (0.296)
Neg. PI Growth _{t-2}	-0.012*** (0.003)	0.596** (0.288)	0.653** (0.292)
Neg. PI Growth _{t-3}	-0.005*** (0.003)	0.692*** (0.294)	0.436 (0.302)
Neg. PI Growth _{t-4}	-0.013*** (0.003)	0.093 (0.303)	-0.794*** (0.309)
Demographic Controls	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes
CPS Data	Yes	Yes	Yes
No. of Obs	2,280,220	1,143,683	1,140,642

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Robust standard errors in parentheses.

Figure 2.1: Proportion of Freshmen by Major

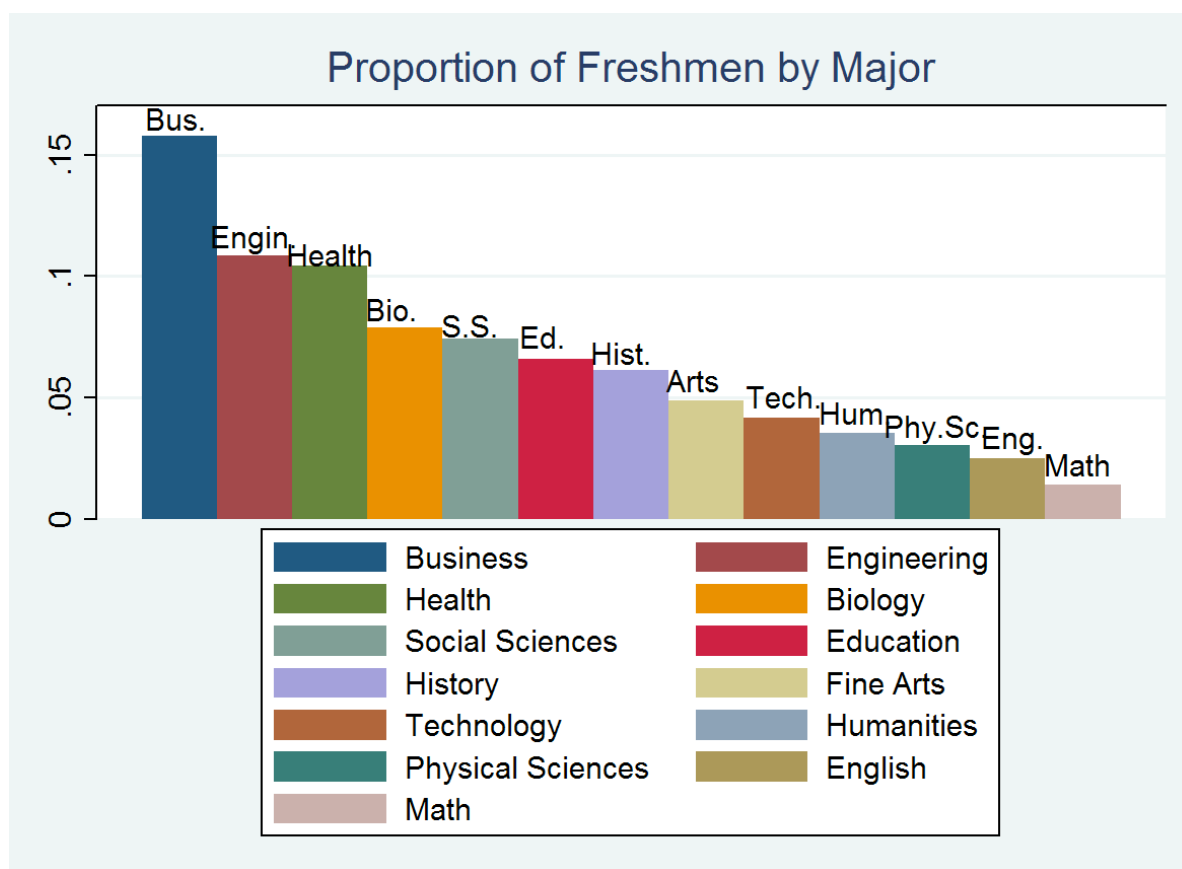


Figure 2.2: Major by Year 1

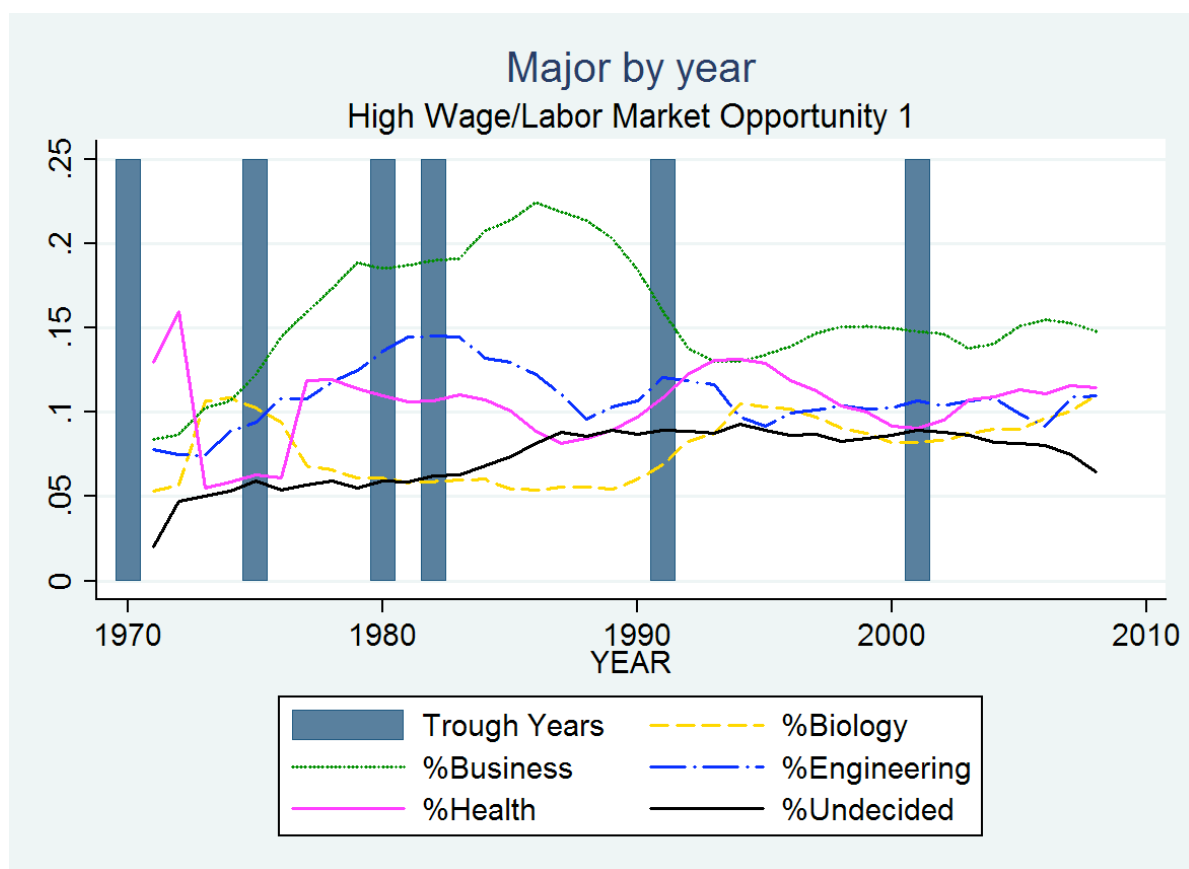


Figure 2.3: Major by Year 2

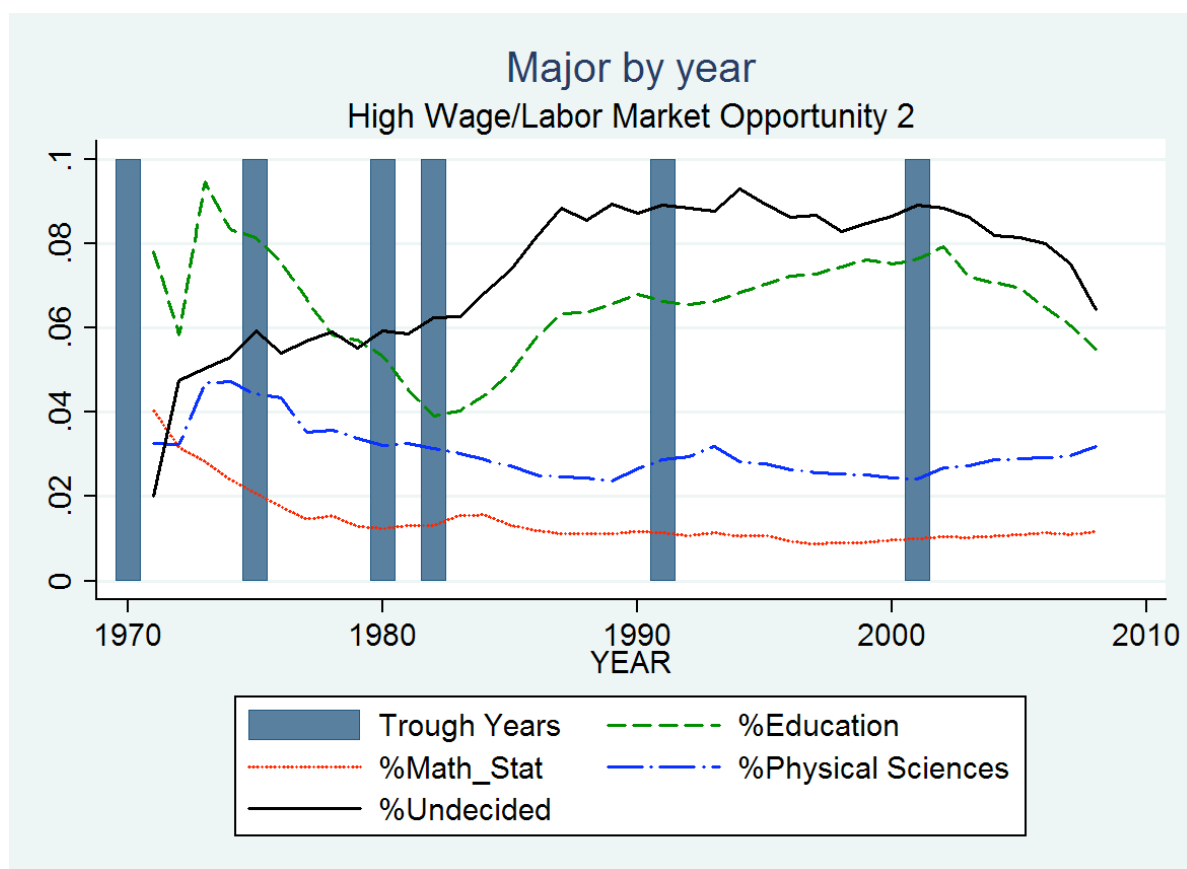
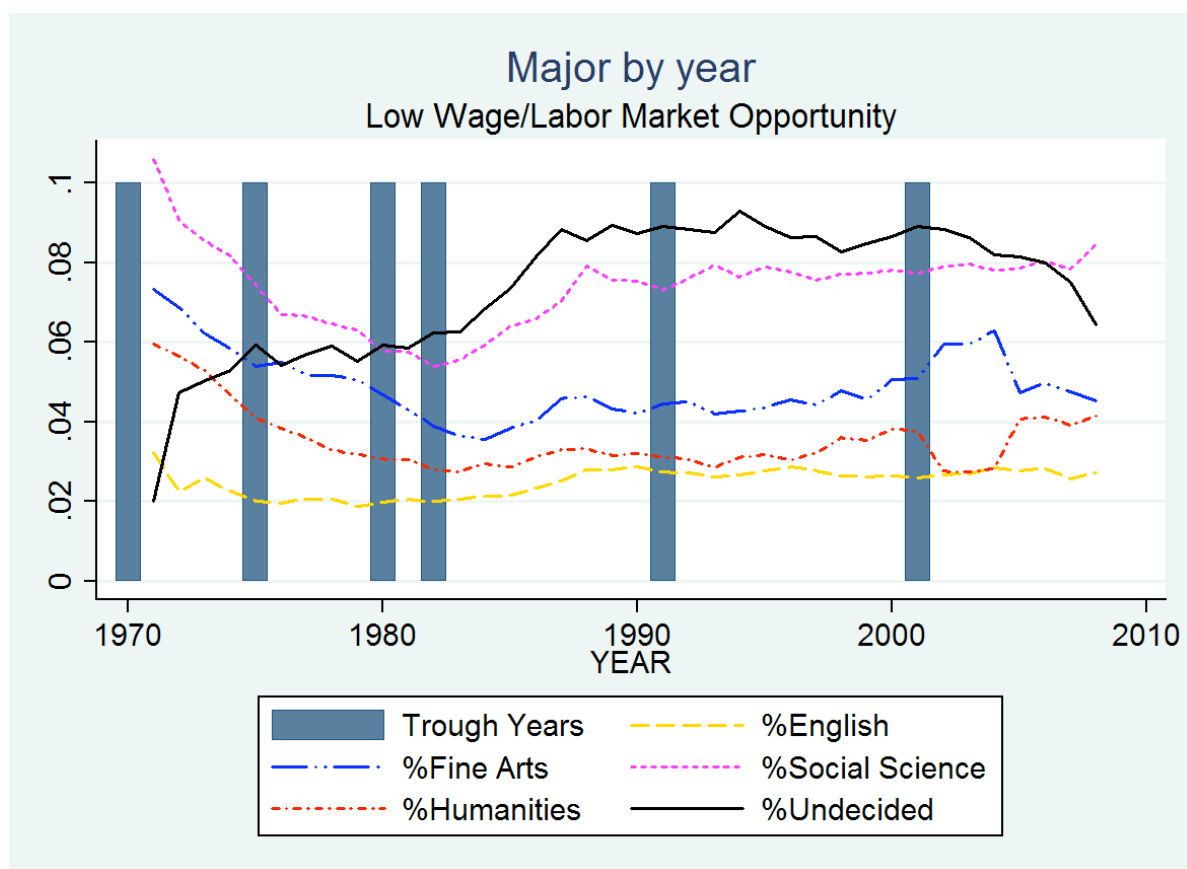


Figure 2.4: Major by Year 3



Chapter 3

The Business Cycle and Freshman Financial Aid

3.1 Introduction

In the wake of the most recent recession, student financial aid has garnered attention from the news media, policymakers, and university administrators. Declining economic conditions induce university budget cuts, increase student enrollment rates, and increase student loan application rates (Clark, 2010; Weller, 2012). Consequently, during downturns, there is more student demand for financial aid resources but less aid to allocate. By January 2009, the U.S. Department of Education had processed 10% more loan applications than it had in the previous year, while enrollment in universities across the country expanded dramatically (Erb, 2009).

Students can receive aid for higher education from several sources including the states, federal government, postsecondary institutions, private lenders, and their families. When this demand for resources increases, the proportions that these parties contribute to a student's aid package might shift. This is the first known paper to explore how contributions to a student's financial aid package change with business cycle fluctuations.

Understanding the ramifications of students borrowing money for higher education has been the focus of several public policy initiatives. The National College Finance Center recently launched the “Don’t Major in Debt Campaign,” to “educate students and families all across the country on how to evaluate their options for financing higher education.” If these options change during recessions, then programs like “Don’t Major in Debt” should be aware so they can provide better information to the beneficiaries of their services.

More extensive information about financial aid opportunities during downturns can also assist a struggling student to, “find dollars that they hadn’t connected with before,” says Tim Malette, the financial aid director at Michigan Technological University (Erb, 2009). Pleskac *et al.* (2011) show that on average low income students are more likely to drop out of college to avoid debt. It would be constructive for these students to know their options for aid during recessions before they drop out of school completely.

“Freshman Survey” data from the Higher Education Research Institute’s (HERI’s) Co-operative Institutional Research Project (CIRP) allows us to observe student demographic characteristics along with financial aid information from 1980-2000. Business cycle information comes from state level tax revenues, unemployment rates, and personal income growth rates per capita.

When tax revenues rise, we find that students are more likely to receive parental and state aid and less likely to receive all other forms of aid. On average, as tax revenues increase by one percentage point, parental aid increases by \$48.89, state aid increases by \$181.14, institutional aid falls by \$374.17, and Pell Grants fall by \$60.63. However, after unemployment rates increase students receive \$5.49 more in Pell Grants and \$10.22 Stafford loans, on average.

Section 3.2 outlines the background and intuitive framework for the paper. Section 3.3 describes the data used in the paper. Section 3.4 discusses the empirical models used for analysis. Section 3.5 reports the results from the estimation. Section 3.6 concludes.

3.2 Background and Intuitive Framework

The business cycle and student financial aid have been thoroughly researched individually, but little is known about the link of one topic to the other. This section provides an overview of the most important known aspects from the business cycle and financial aid literature that will assist in uncovering the relationship between the two topics.

3.2.1 Overview of the Business Cycle and its Effects on Student Decisions

Researchers have extensively investigated several links between the business cycle and students' higher education decisions. Most of these studies focus on the effects of economic fluctuations on student enrollment rates (Mattila, 1982; Goldin, 1999; Sakellaris and Spilimbergo, 2000), and time to degree during downturns (Messer and Wolter, 2007; Khan, 2010; Brunullo and Winter-Ebmer, 2003). These studies find that the aggregate college enrollment rate for students increases following downturns, and that students take longer to graduate during recessions.

These factors potentially influence student decisions about how much to spend on college and how they will finance their education. If different types of students enroll during recessions that were not going to college before the downturns, then these students might have different financial needs. The empirical methods described later control for this to some extent by including observable student level demographic characteristics. However, there might be unobservable student characteristics that influence a student's decision to enroll during recessions and their ability to pay for school. Therefore, the results in this paper should be interpreted with this in mind.

One benefit of only exploring freshman financial aid is that student's time-to-degree decisions in recessions should have very little impact on the aid they receive as a freshman.

Those financing decisions will be made at the margin that will occur a few years into their postsecondary studies.

Though several studies focus on a recession's impact on state funding and expenditure on higher education (Bhatt et al., 2011; O'Rear, 2010; Humphreys, 2000), few focus on how student specific funding and expenditure is affected. Long (2012) provides the most comprehensive examination of how "The Great Recession" affected students' financial decisions for higher education. She finds that for the 2009 recession college spending per student increased. This increase could be a result of tuition and fees rising during downturns.

While Long (2012) finds that students are spending more on college during recessions, she does not document the sources of the spending and the types of financial aid that students use. Therefore, this paper examines the breakdown in the shares of different types of financial aid, not just the raw totals of aid received.

3.2.2 Overview of Financial Aid and its Effects on Student Decisions

There are several studies on student financial aid and its effects on student decisions. The economics of education literature focuses mainly on how financial aid influences three key student behaviors: the decision to enroll in college (Ehrenberg and Sherman, 1984; Moore et al. (1991); and Cornwell *et al.*, 2006) the choice of which college to attend (Avery and Hoxby, 2004; Fuller *et al.*, 1982), and whether a student persists to graduation (Bitzan, 2009; Singell, 2004; Bettinger, 2004). These studies find that increases in financial aid increases the likelihood that students enroll in college, choose a college that provides more aid, and persist to graduation. This section provides an overview of the different broad categories of financial aid. Distinguishing between the types of aid and who bears the burden for each type will be crucial to forming testable hypotheses.

Loans vs. Scholarships and Grants

Two very broad categories to consider are aid that must be repaid versus aid that does not have to be repaid. Student loans fall into the category of aid that must be repaid. These loans can come from several sources (federal government, states, families) and usually have interest attached. Two types of aid that do not have to be repaid are scholarships and grants. Scholarships are typically given based on some form of merit criterion like academic ability, athletic prowess, or a unique ability like skill in dairy farming. Grants are usually given based on categorical qualification like income level or ethnicity. We will assume that students strictly prefer aid that does not have to be repaid (scholarships and grants) to aid that does (loans).

Subsidized vs. Unsubsidized Loans

The student loan aid category can be broken down further into subsidized loans and unsubsidized loans. Subsidized loans are those that do have to be repaid, but the loan issuer assumes some or all of the interest burden. An examples of a subsidized loan would be a Perkins loan from the federal government, where interest rate is lower than other types of federal loans and does not begin to accumulate until after the student graduates from college. We also assume that students would prefer subsidized loans to unsubsidized loans.

3.2.3 Hypotheses

Given what we know about business cycle fluctuations and the types of financial aid, several testable hypotheses develop that propose directions of the changes to the likelihoods that students will receive certain types of aid during recession. These hypotheses differ based on the category of aid.

We expect state aid to decrease during downturns. Most states are required to pass balanced budgets and are more credit constrained than the federal government. Because states cut back on general funding for higher education during downturns, we expect to see

decreases in state funding for student aid (O’Rear, 2010; Humphreys, 2000; Bhatt et al., 2011). We can exploit the degrees of fiscal health and rigidity between the states to see if this hypothesis truly holds. We expect to see state financial aid falling at faster rates in states where the debt holding rules are more stringent.¹

We expect parental aid to be procyclical as well. During downturns families are more likely to face high unemployment and loss of savings. Therefore, they will have less money to allocate to their children’s higher education costs. During more stable economic times families are more likely to have money in reserve or more disposable income that can be used to fund college.

A recession’s overall impact on student institutional aid is less intuitive. Some students could see an increase in institutional aid if they are attending a school with a large endowment that uses some of its funds to smooth student need during downturns. Other students may see less institutional aid during downturns because certain schools do not have large endowments and their alumni giving rates fall during recessions. Therefore, we are unsure about how institutional aid will change during business cycle fluctuations.

The relationship between downturns and federal financial aid is more clear. Because the federal government is less credit constrained than the states, we expect that they will be able to borrow money if needed to meet the student demand for financial aid. Also, because family income and wealth are considered in the FAFSA funding formula and those formulas do not change during downturns, we will see more students qualifying for different types of federal aid as the economy declines. We especially expect to see an increase in federal aid programs like the Pell Grants and subsidized Perkins loans because this is the aid that is awarded to students with the highest degrees of financial need. Consequently, the federal government will bear a bigger aid burden during downturns because the Pell Grants will not

¹We tried to distinguish between debt holding rules in the constitutions of states included in our sample. All of the states were required to balance their budgets, and although many restrict carrying over deficits from one year to the next, states rarely abide by these rules. We are seeking another measure to adequately distinguish between states who are more credit constrained than others.

be paid back and the interest rates on Perkins loans does not start to accumulate until nine months after students graduate from college. We also expect to see an increase in the dollar amount of Stafford loans that students receive during downturns, but we do not anticipate that the average effects will be as strong as they are for the Pell Grants and Perkins loans.

3.3 Data

Researchers have made little headway in answering whether students financial aid packages change during recessions because of data limitations. Few datasets collect information on student demographics and financial aid packages with geographic heterogeneity over an extended time period. This makes it difficult to observe several recessions and financial aid simultaneously.

We explored several data options for this analysis. The National Postsecondary Student Aid Study (NPSAS) has extensive information about the type and amount of financial aid. However, these data are collected every four years and thus do not allow us to identify how business cycle fluctuations affect financial aid allocation over a continuous time period.

The National Longitudinal Survey of Youth (NLSY) data are different because they observe students over many years. Unfortunately, they collect only information on educational costs and whether students are receiving “educational loans or financial aid.” These data do not report the categories with which the financial aid is associated.

An alternate data source is the Cooperative Institutional Research Program’s (CIRP’s) Freshman survey housed in the Higher Education Research Institute (HERI) at the University of California, Los Angeles (UCLA). These data address both of the shortcomings of the NPSAS and the NLSY data by collecting student financial aid information for an extended time period and for several different aid categories. These data have never been used to investigate the relationship of a student’s financial aid package and the business cycle.

3.3.1 Higher Education Research Institute Data

Every year CIRP offers a survey of college freshmen that institutions can administer to their students. Schools who opt into the survey must pay HERI a fee for the survey materials and the data analysis provided after survey completion. HERI requires the survey to be administered to first-time, full-time freshmen before they begin fall semester classes. Consequently, only freshman financial aid information is observed. As recommended by HERI, the large majority of institutions conduct the survey during their freshmen orientations in a proctored setting, ensuring the highest response rates and the most accurate information.²

This study uses data from 191 institutions that participated in the “Freshman Survey” from 1980-2000,³ and where the state of the institution is observable. To protect the identity of the institutions, HERI requires that five or more institutions from the same state to be present in the sample before they reveal the state identity of the institution.⁴

HERI Institutions Compared to a National Sample

Table 3.1 reports the composition of schools in the HERI sample versus the national universe of four-year universities.⁵ Public institutions account for 17.42 percent of all of the institutions in the HERI sample versus about 24.40 percent of all national institutions.

Likewise, the observed institutions in this study are more heavily weighted towards religious and liberal arts institutions than the nationally representative sample of institutions. The discrepancy in the proportion of liberal arts colleges has important implications for this analysis because liberal arts universities are on average much more expensive than the average four year school. According to the National Center for Education Statistics (NCES)

²The “Freshman Survey” data obtained for research purposes are restricted access data and only granted to researchers after a thorough proposal process to ensure the identities of the institutions and the students are protected.

³HERI did not collect financial aid data on the “Freshman Survey” after 2000.

⁴The states observed for the 191 institutions are CA, CT, GA, IL, IN, IA, MD, MA, MI, MN, MO, NY, NC, OH, PA, TX, VA, and WI.

⁵Data for the national universe of schools come from IPEDS and the *Digest of Education Statistics* from the NCES.

the average tuition for the top tier liberal arts institutions was \$26,496 in 2002 compared to the average for all four year institutions of \$13,639.

The Annapolis Group, an alliance of the majority of liberal arts colleges in the country, commissioned a study that found its graduates reported extreme differences in their college experience and the value of their college degrees compared to students at other types of private and flagship public institutions. For example, 87 percent of students at liberal arts colleges graduated in four years versus 76 percent at other private institutions and 51 percent of students at state flagship public institutions. Because students at liberal arts institutions graduate faster, on average, than students at other types of universities, liberal arts students are more likely to complete their degrees.

Furthermore, 79 percent of students who attended the liberal arts colleges in the survey reported the quality and breadth of academic preparation equipped them well for being accepted to graduate school or finding their first job. Only 73 percent of students at other private universities and 64 percent of students at state flagship public schools reported the same level of preparation, respectively (Day, 2011). These factors might change a student's willingness to take out student loans compared to a more nationally representative sample of students, because the risk of not graduating from school is lower and their perceived preparation for graduate school and their careers is higher.

Finally, the percentage of institutions classified as a Historically Black College or University (HBCU) in the HERI sample is comparable to the national average, with 3.73 percent in the HERI sample versus 3.90 percent, nationally. However, as reported in Table 3.2, the percentage of students in the sample identifying as black is 3.49% less than the nationally representative proportion of black freshmen.

HERI Students Compared to a National Sample

Table 3.2 compares the demographic conditions between the HERI and a nationally representative samples. Because the institutions included in the survey differ from a nationally

representative sample of institutions, the students in the HERI data will also differ slightly from the broader group of their college going peers. The HERI sample of students has 7.39% more females than a nationally representative sample of students. Females are more likely to receive financial aid than are male students. Table 3.2 also documents that the average student in the HERI sample is more financially secure than the average college freshman. The average family income for a student in the HERI sample is \$106,683.70 compared to \$94,791.34 nationally, a \$11,892.36 difference. Students in the HERI sample are also more likely to be white than are average college students. Both of these groups are less likely to receive aid. Finally, students in our sample are marginally younger than a more nationally representative sample of students. Younger freshman are more likely to receive parental, institutional, and Perkins loans, and less likely to receive state aid, Pell Grants and Stafford loans.

The sample is also selected because of response rates to the variables of interest in our model. Only 42.6 percent of students in the HERI data answer all of the questions in our model. Much of the attrition occurs because of the low response rates to the financial aid variables.

Unfortunately, we do not have access to the weights to more closely resemble a nationally representative sample of students. Papers like Wiswall and Zafar (2011) are also unable to weight their sample to match the population. They address this problem by recognizing the differences in the two samples and discussing how those differences affect the results when students select a major. In the present context, the students are richer, whiter, of more traditional age, and more likely female than a more nationally-representative sample of students. While we can control for these observable demographic characteristics that influence student aid packages, there might be unobservable factors correlated with these groups that may bias our results. Therefore, the effects in this study can be interpreted

with caution knowing that the results apply to this specific population of students and not necessarily to college students universally.

Table 3.3 details the breakdown of each aid category by gender and race characteristics. On average, females receive more aid than males in all of the aid categories. Hispanic students receive the most institutional and state aid along with federal Stafford and Perkins loans. White students receive more parental aid, while black students receive more Pell Grants than any other race category.

Figures 3.4-3.7 display how the aid categories change over the sample period. Figure 3.4 compares average state and institutional aid. During recessions we see both of these types of aid falling until the recession troughs after which state and institutional aid increase. Figure 3.5 compares federal Pell grants and state aid. From the raw data it is difficult to distinguish if Pell and state aid are moving in tandem or in opposite directions. Their relationship differs depending on the time period. Empirical methods are needed to test our hypotheses about these aid types. The same is true for Figure 3.6 which compares federal Stafford loans to parental aid. Across some portions of the graph these groups are moving in opposite directions, but sometimes they are trending in the same direction. More careful empirical analysis is also needed to make any conclusions about their relationships to the business cycle. In Figure 3.7 we see that the general shape of the trend line for each federal aid category is the same. Empirical analysis will distinguish the degree of change between each of the federal aid categories, helping to establish if there is a difference in changes of unsubsidized versus subsidized aid.

3.3.2 Business Cycle Data

To correctly identify the effects of economic fluctuations on freshman financial aid packages, the business cycle variables must capture the information shock of an economic downturn. This paper will take advantage of the geographic heterogeneity in the data and focus attention on state level business cycle indicators. The state is the most appropriate level of

observation because fluctuations in a states' economy are going to determine the states and families' abilities to provide college funding for students, not fluctuations in national level business cycle variables. Presumably, the tax revenues in California are not going to affect Georgia's ability to provide aid to students. However, an aid package to a California student might be highly dependent on California's revenues.

Bhatt et al. (2011) use fluctuations in tax revenues to capture business cycle fluctuations, which is appropriate in this context because we expect state aid to be highly sensitive to state tax revenues. Tax revenues simultaneously reflect changes in the state's economic activity and how much money the state can allocate to students as financial aid. Tax revenue data are from the U.S. Census Bureau's Quarterly Summary of State & Local Taxes and converted to real dollars.⁶ Figure 3.1 shows how the natural log of the average state tax revenues change over 1979-2000. These business cycle data allow us to observe the recessions of 1980, 1982, and 1991. We see that state tax revenues have been growing over time, but that upward trend is disrupted during recessions.

The rate of unemployment in a state reflects both the financial stability of the student's parents and the increase in demand for student aid. Unemployment also indirectly affects federal and state public finance because a decrease in labor market activity lowers the amount of tax revenue that the government can collect. The Bureau of Labor Statistic's (BLS) yearly unemployment rates by state from years 1979-2000 help capture the labor market opportunities of freshmen and their parents that potentially contribute to their need for outside aid. Figure 3.2 displays how average state unemployment rates change over the sample period. Unemployment rates are increasing until recession troughs and then they start to trend downward.

⁶Humphreys (2000) argues that state tax revenues might be a biased business cycle indicator because of fluctuations in tax rates. He uses personal income instead as his state level business cycle indicator. Even though state tax rates do not change very often over the period used in our analysis, we include both business cycle variables for robustness.

The Regional Economic Information System at the Bureau of Economic Analysis (BEA) reports quarterly personal income per capita by state. These data are then adjusted for inflation and converted to growth rates by state from year to year. As personal income growth increases, parents have more resources to give to their college bound children, and governments receive more money from tax revenues. Figure 3.3 shows how personal income growth rates are changing over the sample period. This graph is the opposite of the unemployment rate graph. Personal income growth rates trend downward until the recession trough when the economy starts to recover.

During a recession, increases in unemployment usually lag behind decreases in wages. Therefore, the lags of these variables will be introduced in the empirical model to allow past values of personal income growth and unemployment rates to affect the current shares and levels of student aid. The lags are not expected to be important for the tax revenue variable because the contemporaneous revenues determine the amount of aid that states can allocate to incoming freshman. In the results we will concentrate on the contemporaneous term models for the tax revenue variable, and the lagged terms for the unemployment and personal income growth rate variables.

3.3.3 Distribution of Financial Aid Variables

Table 3.4 displays the percentage of students receiving positive aid with corresponding standard deviations. The type of aid that students most commonly receive is from their parents. Parents contributed positive amounts of aid for nearly 89 percent of students. The next most common source of aid is institutional aid with more than 41 percent of students receiving aid. These statistics reflect the high concentration of private liberal arts colleges.

Government aid plays a significant but smaller role in our sample. Nearly 25 percent of students received a state-based grant, and around 25 percent a federal need-based Pell Grant. Regarding federally subsidized student loans, nearly 38 percent received Stafford loans and 15 percent received Perkins loans.

Figure 3.8 displays the distributions of the financial aid categories, conditional on receiving aid. Parental aid and institutional aid appear normally distributed. The distributions for the other aid categories are somewhat right skewed which could cause bias in some of the empirical models described in the following section. One of the methods, the hurdle model, will address this concern.

3.4 Empirical Models

Each empirical approach outlined here has a different goal. Incorporating a logit model into the estimation scheme addresses whether students are more likely to receive the different categories of aid during business cycle fluctuations. The OLS midpoint model is the first and most basic attempt to assign a dollar value to the amount student's aid packages may change during downturns. The interval regressions correct for the perceived biases introduced by the OLS midpoint model. Finally, the hurdle model conditions on students receiving aid to estimate the dollar amount changes in each aid category.

3.4.1 Logit Model Estimation

First, we investigate whether the likelihoods that students receive the different categories of aid change during downturns by estimating the following logit model:

$$Pr(Y = 1|X) = \frac{e^{\beta_j'x_i}}{1 + e^{\beta_k'x_i}}$$

where $Y = 1$ if a student receives the particular type of aid of interest and $Y = 0$ otherwise. X is a vector of business cycle variables, student demographic characteristics, and year, state, and institutional indicators. The demographic variables include gender and race indicators, family income, high school GPA, and the student's age, which influence the probability that students receive financial aid and must be accounted for to determine the true effect of business cycle changes. Each business cycle variable (tax revenues, unemployment rate, and personal income growth rate) is included in a separate model. Coefficient estimates for this

model can be interpreted as percentage point changes in the likelihood that students receive a particular type of aid given changes in the variable in X .

3.4.2 OLS Midpoint Model Estimation

The “Freshman Survey” is an excellent data set to study these effects because it surveys many college students in various states over a number of business cycles. One difficulty with the data is that income and the amount of financial aid are reported as categorical data. The categories are broken into ranges of \$500 each. The most common approach to convert categorical data into a continuous dependent variable, which we adopt first for baseline estimates, is to simply take the midpoint of each category and thus artificially create a continuous dependent variable.

After calculating the midpoint for each observation, we estimate the following baseline regressions for student i in state s and year t :

$$Aid_i = \gamma BC_{st} + X_i\beta + \theta_1 state + \theta_2 college + \theta_1 year + \epsilon_i, \quad (3.1)$$

$$Aid_i = \gamma BC_{st} + \gamma BC_{st-1} + X_i\beta + \theta_1 state + \theta_2 college + \theta_1 year + \epsilon_i, \quad (3.2)$$

where Aid is one of the following financial aid categories: parent, institutional, state, Pell Grants, Stafford Loans, and Perkins Loans. X is a matrix of controls including high school GPA, parent income, age, and whether the student is male, black, or Hispanic. Finally, we estimate equations 1 and 2 separately with three separate models for the different business cycle indicators: log of state revenues, the unemployment rate and average personal income growth rate for the state where the institution is located.

3.4.3 Interval Regression

While the “midpoint method” has been used by various researchers (Eide and Showalter, 1999; Layard *et al.*, 2008; Trostel *et al.*, 2002), there are some concerns that the technique

may bias results since construction of the continuous dependent variable may introduce measurement error since the true value is unobserved and censored by the categorical cutoffs (Bettin and Lucchetti, 2012; Stewart, 1983). Caudill (1992) shows that if the intervals are of equal length and exhaustive⁷, then the bias is very small. Unfortunately, our data do not meet these conditions. One common alternative that avoids using a biased OLS estimator is to use an interval maximum likelihood routine proposed by Stewart (1983) who assumes that the true value of the amount of financial aid (y^*) is unobserved, but the interval that contains y^* is observed:

$$A_{k-1} < y^* < A_k,$$

where A_k and A_{k-1} represent the higher and lower bounds for a given category k . Stewart estimates the following log-likelihood function to obtain the conditional probabilities $P(w = j|X)$:

$$l_i(\beta, \sigma) = 1[w_i = 0] \log \left\{ \Phi \left(\frac{A_1 - x_i\beta}{\sigma} \right) \right\} + 1[w_i = 1] \log \left\{ \Phi \left(\frac{A_2 - x_i\beta}{\sigma} \right) - \Phi \left(\frac{A_1 - x_i\beta}{\sigma} \right) \right\} \\ + \dots + 1[w_i = J] \log \left\{ 1 - \Phi \left(\frac{A_1 - x_i\beta}{\sigma} \right) \right\}, \quad (3.3)$$

assuming that ϕ is the standard normal distribution. The coefficients from this estimation routine can be interpreted similar to those estimated by ordinary least squares (Wooldridge, 2010, page 783); meaning that a one unit increase in a dependent variable corresponds to a change in the dependent variable of magnitude β .

⁷Meaning that there are no open ended categories.

3.4.4 Hurdle Models

Each of the previous empirical techniques only requires a one-step estimation procedure to estimate a student's financial aid package. However, in reality a student's financial aid package is built in two steps. The first step determines whether a student will receive a certain type of aid at all. Then the second step determines the amount of aid a student will receive conditional on receiving a nonzero amount. Given the large tail of zero aid in each category, the previous estimation techniques do not condition on students receiving aid and could be biased downward.

Hurdle models jointly estimate two step decision processes. In this context we can employ a type of hurdle model to fit the two stage process of financial aid package determination. The first step estimates whether students are receiving aid at all, and the second step estimates the amount of aid a student will receive conditional on receiving aid. We use the Cragg's tobit version of the hurdle model (Cragg, 1971), where the first step of the model is a standard probit estimation and the second step is a truncated normal estimation. This model can be characterized as follows:

$$f(w, y|x_1, x_2) = \{1 - \phi(x_1\gamma)\}^{1(w=0)}[\phi(x_1\gamma)(2\pi)^{-\frac{1}{2}}\sigma^{-1}\exp\{-(y - x_2\beta)^2/2\sigma^2/\phi(x_2\beta/\sigma)\}]^{1(w=1)} \quad (3.4)$$

where w is an indicator equal to 1 when y is positive. The model will return estimated coefficients for the first stage γ which are maximum likelihood estimates using the probit model, and β which are returned in the second step using Cragg's likelihood function. We are interested in the conditional and unconditional partial effects of the business cycle variables in β . We can compare these estimates to the OLS Midpoint and to see if there is strong bias present because of the tail of zeros in our financial aid distributions.⁸

⁸Using this version of the hurdle model we are unable to correct for any bias used from using the midpoint as the categorical mean. Therefore these estimates are not as comparable to the interval regression results.

3.5 Results

The coefficients for the business cycle variables are reported in Tables 3.5-3.6 for the Logit, Tables 3.7-3.8 for the OLS Midpoint, and Tables 3.9-3.10 for the Interval Regression models, respectively. The models in Tables 3.5, 3.7, and 3.9 are estimated with just the contemporaneous term of the business cycle variable, while the models in 3.6, 3.8, and 3.10 include the contemporaneous and the first lagged terms of the business cycle variables. As expected, the model with only the contemporaneous term produces the best and most consistent results for the tax revenue variable, while the models with the first lags produce the best and most theoretically sound results for the unemployment rate and the personal income growth rate variables. We also focus on the sign of the changes to the log likelihoods when reporting the logit model estimations. But when we report the OLS Midpoint and the Interval Regression results we center the discussion on the magnitudes of the coefficients, because they estimate the dollar amounts by which aid is changing during business cycle fluctuations.

3.5.1 Logit Model Results

Tables 3.5 and 3.6 report the results for the logit model estimation for the contemporaneous business cycle term model and the lagged business cycle variable model. For the tax revenue variable we will concentrate on the results from the contemporaneous term in Table 3.5. For the unemployment and personal income growth rate variables we will concentrate our analysis on the coefficients on the first lag of these terms in Table 3.6.

Table 3.5 shows that as the contemporaneous term for tax revenues increases the log odds that students receive state aid increases, while the log odds that students receive parental, institutional, and all forms of federal aid falls. This supports our hypothesis that as states have more money coming in, they make that money available as financial aid for college students. Symmetrically, as state revenues decrease other aid granting parties are more likely to give students aid.

Table 3.6 reports that as the first lag of unemployment increases the log odds of Federal Pell Grants and Stafford loans increase along with institutional aid, although not by much. Meanwhile, students are less likely to receive parental and state aid, along with federal Perkins loans. Therefore, as students' family resources and states are constrained, the institutions and federal government steps in and is more likely to provide students aid. The federal government is more likely to provide grants and subsidized aid after downturns and less likely to provide Perkins loans because more students qualify for free or subsidized aid when the unemployment rate increases.

Finally, as the first lag of the personal income growth rate per capita increases, students are more likely to receive state aid and rely less on federal Pell grants and Perkins loans. The results for the other aid categories are statistically insignificant. Again this supports the idea that as the economy is booming, states are better equipped to provide money for college students, and students do not rely as heavily on the federal government for help.

3.5.2 OLS Midpoint Results

Contemporaneous Lags-OLS

Table 3.7 displays results from the baseline OLS estimates using the business cycle indicator from the contemporaneous time period. The first row shows results using the log of the tax revenues from the state where the institution is located. The interpretation of the log is a one percent increase in state tax revenues changes the dollar amount of the type of financial aid. The estimates indicate that a one percent increase in state tax revenues increase state-based financial aid by \$558 and Stafford Loans by \$123.74, but decrease parent aid by \$621.16, institutional aid by \$317.90, Pell Grants by \$91.68, and Perkins Loans by \$82.94. As states distribute more aid to students, parents allocate family resources to other needs.

Also, Li (2010) finds a high correlation between tax receipts and GDP growth. This helps explain the results for the federal aid variables. Since tax revenues and income growth rates

are found to be positively related, as state tax revenues increase then presumably students' family incomes are increasing as well. Because of the federal student aid eligibility formula, the number of low-income students eligible for Pell Grants and Perkins loans decreases, while the number of students who are no longer eligible for Pell Grants and Perkins loans but are offered unsubsidized Stafford loan increases.

Contemporaneous lags are the most appropriate indicator of the flexibility of state and federal budgets since budgeting is an annual process and policy makers have already spent any previous year's tax revenues. These results show that during recessions, state governments become budget constrained and reduce the amount of aid they allocate to students. This reduction in aid places a higher burden on parents⁹ and the federal government who can easily borrow to fund the increased number of students applying for aid. The receding economy also causes more students to be eligible for need-based aid such as Pell Grants and Perkins Loans.

The state unemployment rate also has large implications for financial aid allocation. As unemployment increases, parents can no longer fund their children's education as previously planned. Also, as more workers become unemployed, governments receive less tax revenue. In addition, more displaced workers enroll in college to learn new skills to re-enter the labor market. Table 3.7 shows that as unemployment increases, parent, institutional, and state aid all decrease. This result is evidence that these groups have fewer resources to allocate generally and thus reduce their contribution to individual student's education. However as unemployment increases, more students are eligible for Pell Grants, and take out a higher balance of Stafford and Perkins loans. These results show that as parent and other forms of grant aid decline, more students rely on loans to pay for college.

The final business cycle indicator is the percentage change of personal income for the state in which the institution is located. While an increase in the personal income growth

⁹Like the state governments they are probably budget constrained.

rate boosts parent aid, state aid and Pell Grant aid declines. This result may be because as parents have more disposable income, students may no longer be eligible for state need-based aid and Pell Grants. However, the balance of Stafford and Perkins loans does not change with personal income growth.

One Period Lag-OLS

Table 3.8 displays the results for estimating the baseline OLS models with the business cycle indicator for both the contemporaneous and lagged time periods. As noted above, this model is not very useful for the log of tax revenues because what matters most to policy makers who are setting federal and state budgets is the current amount of tax revenue that can be allocated for the current fiscal year. Thus the results for the one period lag model with state tax revenues are either not statistically significant or have an unclear interpretation.

The lagged unemployment matches the story from the model with only the contemporaneous time period because the previous year's labor is taxed to fund public goods in the next fiscal year. Thus, as the previous year's unemployment increases, the amount of revenue available for state funded financial aid for the next year decreases. The states take some time to recover from the previous year's unemployment shock. Also if there is an increase in unemployment during the previous year, federally funded financial aid increases because there are more eligible students and the federal government can more easily raise money for deficit spending than a state or family. An increase in the lagged unemployment rate increases Pell Grants by \$6.80, Stafford Loans by \$44.50, and Perkins Loans by \$10.95. These magnitudes may be small because a significant portion of students did not receive these types of aid. A hurdle model framework may be beneficial to correct for the long tail of zeros in the financial aid distribution.

The rate of personal income growth for the previous year also has a logical effect on the financial aid given to a student for the current year. As the previous year's personal income increases, parents may have more in savings to devote to their children's college education,

while fewer students may be eligible for need-based programs such as Pell Grants and Perkins Loans. Also students who were on the margin between a Stafford loan and a Pell Grant will receive the loan.

3.5.3 Interval Regression

Contemporaneous Lags-Interval Regression

As outlined in the econometric section, the interval regression corrects for any biasedness caused by introducing measurement error by using the midpoint method. Table 3.9 displays the results from estimating the interval regression with only contemporaneous business cycle indicators. Most of the signs on the coefficients are the same between the interval regression and the baseline OLS estimates except state aid and Stafford loans. These results make more sense than the baseline estimates because state revenues also reflect the amount of labor market income earned in the state during the year.¹⁰ Thus as the economy expands, parent and state aid increases by \$48.89 and \$181.14, respectively, for every one percent increase in state tax revenues. The coefficient for log tax revenue in regards to Stafford Loans also changes from positive to negative with the interval regression. This result implies that as parent and state income increases, students do not need to use student loans to finance their educations, and thus the balance of Stafford and Perkins loans decreases.

In addition to the sign changes for parent aid and Stafford loans, almost all of the magnitudes of the coefficient are smaller with interval regression than the baseline OLS estimates. These results show that business cycle fluctuations may have a smaller effect on financial aid when one corrects for the possible bias from the midpoint method.

One Period Lag-Interval Regression

Table 3.10 displays the results from the interval regression with a one period lag. As noted earlier, the one period lag model is more helpful for the unemployment and rate of personal

¹⁰Assuming that state income taxes remain constant.

income growth indicators than tax revenue because financial aid is determined by the budget that is based on fiscal year estimates of the current year. Any state revenue that is collected during previous years should not affect future budgets.

As in the interval regression with contemporaneous business cycle indicators, the interval regression with one lag dampens the magnitude of the coefficients. However, the unemployment variable shows that as the previous year's unemployment rate increases, institutional and state aid decreases. However, similar to the interval regression with contemporaneous variables, the coefficient for the Stafford loan variable is positive; indicating that an increase in the unemployment rate increases the balance of the student's loans. The rate of personal income growth also influences the allocation of student aid, albeit at a smaller magnitude than tax revenues or the unemployment rate. As the previous year's rate of personal income growth increases, the amount of institutional aid increases while the balance of student loans and Pell Grants decrease.

3.5.4 Hurdle Model Results

To determine whether there is bias present from the tail of zeros, we estimate the contemporaneous models for the different types of aid using a 20 percent sample of institutions.¹¹ Results in Table 3.11 report the unconditional partial effects which are most comparable to the OLS Midpoint estimates in 3.7.¹² We then report the conditional partial effects for each category using the hurdle model in Table 3.12.

According to Table 3.11 we find that as tax revenues increase, freshmen receive more dollars of state aid and fewer dollars of all other forms of aid. This is the same result we find using the OLS midpoint method with the exception of the Stafford loan category, which has a very probable explanation. As tax revenues increase, fewer students are receiving

¹¹Estimates for Perkins loans were not available because the sample size became too small when using a 20 percent sample for this particular aid category.

¹²Using this version of the hurdle model we are unable to correct for any bias used from using the midpoint as the categorical mean. Therefore these estimates are not as comparable to the interval regression results in Table 3.9

Stafford aid, but those who are remaining and receiving aid are the lowest income students. Therefore, they will be receiving more aid on average. The OLS midpoint method does not take into account that fewer students on average are receiving Stafford loans, so that is why we observe the counterintuitive positive sign for this category. The hurdle model corrects for the bias and when we consider that fewer students are receiving Stafford loans, the group average falls by \$119.49. Table 3.12 helps confirm this hypothesis because we see that conditional on students receiving Stafford aid, students actually receive more aid.

The magnitudes for most of the remaining categories in Table 3.11 are tempered by using the hurdle model instead of the OLS midpoint version. We find that students receive \$286.11 fewer dollars of parental aid as tax revenues increase by one percentage point, compared to the \$621.16 fewer dollars they received using the OLS midpoint method. They receive \$260.64 fewer dollars of institutional aid compared to the \$317.90 fewer dollars they received according to OLS midpoint. They receive \$411.70 more dollars in state aid compared to the \$558.71 using OLS midpoint. The magnitude of the negative coefficient for Pell aid increases compared to the OLS midpoint method. According to the hurdle model students receive \$200.20 fewer dollars of Pell aid as tax revenues increase compared to \$91.68 fewer dollars of Pell aid when using the OLS midpoint method.

The results for the unemployment and personal income growth rate business cycle variables are not as interesting because we are using the contemporaneous version of the variables instead of their lags, which are the most important for these variables. However, note that for both of these business cycle variables the signs are the same and magnitudes are very similar for parental, institutional and state aid compared to the OLS midpoint estimates. For the Pell aid category the magnitudes differ more dramatically. Students receive \$24.60 more dollars of Pell aid as unemployment rates increase by one percent. We can compare this to a \$10.27 increase when using OLS midpoint. As personal income growth rate increases by one percent Pell aid increases by \$2.84 according to the hurdle model but decreases by \$2.64

when using the OLS midpoint model. Intuitively, we expect this sign of this coefficient to be negative. The coefficients for the Stafford loan category are statistically insignificant for these business cycle variables when using the hurdle model. By examining the lags of these business cycle variables in future research we will be able to better determine how well the hurdle model fits our theoretical priors for this set of business cycle variables.

3.5.5 Robustness Checks

The results in the paper conform to our hypotheses, however some may be concerned that different types of students may enroll during recessions. As reported in Chapter 2, students enrolling during recessions are more likely to be female, lower income, and older on average. While we control for those variables in the model, these variables may be correlated with some unobservable. We want to be sure that these unobservables are not driving our results.

The HERI data include many behavioral type questions in the Freshmen Survey. We do not include these types of variables in our model because of the low response rates to the questions and we do not want to lose any more observations. They ask students questions like the following: did you choose this college because of you were offered financial assistance?, did you choose this college because of the low tuition rate?, do you plan to work full time while attending college?, etc. If student answers to these types of questions are correlated with recessions then our results might be biased. However, we observe no association between the behavioral questions and business cycle fluctuations. There are clear trends over time in students answers but none that can be linked to recessions.

3.6 Conclusion

Since the recent recession of 2008, higher education has begun to rethink the way that it allocates financial aid to students. One concern is the countercyclical relationship of enrollment and the business cycle. As the economy slips into recession, more students enroll in college to retrain for the workforce and increase future labor market opportunities. Unfor-

tunately, at the same time that colleges see dramatic enrollment increases, there are fewer financial aid resources to allocate to these new students. In this study, we estimate the effects of business cycle fluctuations on the amount of financial aid that a given student receives, and the composition of a student's financial aid package.

These results from both the baseline OLS, interval regression, and hurdle models show a fairly consistent pattern of how different types of aid react differently to business cycle fluctuations. The results indicate that state, institutional, and parental aid moves in tandem with the business cycle. As the economy expands, parents have more resources to fund their children's education and states receive more tax revenue that can be allocated to students. During times of economic expansion, students are able to substitute loans for grants.

When the economy slips into recession, however, students are now more likely to be eligible for Pell Grants and since the federal government can more easily borrow money to offer more Pell Grants than institutions or state legislatures. Parents also have fewer resources so students must rely on student loans to meet tuition balances. Thus, Pell Grants and student loans are countercyclical, while parent, institution, and state aid seem to fluctuate with the business cycle.

The changing composition of financial aid packages are important because financial aid plays a key role in determining whether a student enrolls in college, the quality of institution that the student selects, and the probability that a student persists to graduation. Enacting policies that ensure that ample resources are available for students during recessions may ensure positive education outcomes during times of increasing budget constraints for governments, institutions, and families.

3.7 Tables and Figures

Table 3.1: Institutional Characteristics

Sample of Institutions	Public (%)	Religious (%)	HBCU (%)	Liberal Arts (%)
HERI Sample	17.42	37.76	3.73	55.60
National Universe	24.41	33.33	3.90	20.00

Table 3.2: Nationally Representative vs. HERI Sample: 1980-1999

Variables	National	HERI	Difference _{HERI-National}
Male	52.88%	45.49%	-7.39% ***
Asian	3.74%	4.97%	1.23% ***
Black	10.72%	7.23%	-3.49% ***
Hispanic	2.88%	2.56%	-0.32% ***
White	82.33%	86.06%	3.73% ***
Income	\$94,791.34	\$106,683.70	\$11,892.36 ***
Age	3.26	3.20	-0.06 ***

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Table 3.3: Demographic Summary Statistics by Aid Type

Aid Type	Male	Female	Asian	Black	Hispanic	White	All Students
Parental	3,065.10	3,145.79	3,125.72	2,170.73	2,456.05	3,201.06	3,108.89
Institutional	1,168.43	1,306.51	1,501.74	1,481.48	1,866.58	1,244.21	1,244.21
State	487.63	518.27	656.42	738.08	885.51	465.46	504.39
Federal:							
Pell	550.35	560.79	721.96	1,366.48	1,128.35	458.66	556.06
Stafford	1,099.11	1,134.82	1,058.63	1,147.22	1,338.50	1,114.61	1,118.63
Perkins	324.92	337.29	397.16	492.13	560.15	309.37	331.68

Table 3.4: Percentage of Students Receiving a Particular Type of Aid

Aid Type	Percentage	Standard Deviation
Parental	88.9	31.4
Institutional	41.2	49.2
State	24.3	42.9
Pell	25.4	43.6
Stafford	38.0	48.5
Perkins	15.3	36.0

Table 3.5: Logit Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	-0.305*** (0.040)	-0.247*** (0.031)	1.192*** (0.032)	-0.299*** (0.035)	-0.126*** (0.030)	-0.500*** (0.040)
Unemployment_t	-0.008*** (0.003)	-0.013*** (0.002)	-0.036*** (0.002)	0.020*** (0.003)	0.040*** (0.002)	-0.017*** (0.003)
PIgrowth_t	-0.001 (0.002)	-0.006*** (0.002)	0.002 (0.002)	0.005*** (0.002)	0.009*** (0.002)	0.009*** (0.002)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable. Demographic controls include high school GPA, male, race, family income, and age. Standard errors in parentheses.

Table 3.6: Logit Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	-0.812 (3.06)	0.638 (2.514)	-0.090*** (2.66)	1.99 (2.721)	-2.339 (2.355)	-1.027 (3.447)
$\ln \text{TaxRev}_{t-1}$	0.508 (3.06)	-0.885 (2.514)	1.282*** (2.658)	-2.293 (2.720)	2.214 (2.355)	0.527*** (3.447)
Unemployment_t	0.028*** (0.005)	-0.019*** (0.004)	-0.015*** (0.004)	-0.012*** (0.005)	-0.006 (0.004)	-0.008 (0.005)
$\text{Unemployment}_{t-1}$	-0.043*** (0.005)	0.007* (0.004)	-0.024*** (0.004)	0.037*** (0.005)	0.054*** (0.004)	-0.011** (0.006)
PIgrowth_t	-0.001 (0.002)	-0.006*** (0.002)	0.001 (0.002)	0.007*** (0.002)	0.009*** (0.002)	0.009*** (0.002)
PIgrowth_{t-1}	-0.002 (0.002)	0.001 (0.002)	0.007*** (0.002)	-0.009*** (0.002)	0.000 (0.002)	-0.004*** (0.002)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Standard errors in parentheses.

Table 3.7: OLS Midpoint Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	-621.16*** (19.72)	-317.90*** (17.14)	558.71*** (12.07)	-91.68*** (12.58)	123.74*** (18.26)	-82.94*** (10.14)
Unemployment_t	-7.45*** (1.43)	-7.86*** (1.24)	-5.39*** (0.87)	10.27*** (0.91)	15.69*** (1.32)	3.01*** (0.73)
PIgrowth_t	5.257*** (1.12)	3.71 (2.95)	-9.58*** (0.68)	-2.64*** (0.71)	-1.02 (0.97)	0.66 (0.57)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Robust standard errors in parentheses.

Table 3.8: OLS Midpoint Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	-216.99 (1,003.02)	-663.79*** (1,385.07)	-92.98 (464.99)	285.53 (464.00)	-972.71 (724.71)	42.24 (819.57)
$\ln \text{TaxRev}_{t-1}$	265.90 (1,002.99)	345.87 (1,385.03)	274.16 (464.98)	-346.18 (463.98)	872.44 (724.69)	-125.20 (819.55)
Unemployment_t	-4.01*** (1.21)	-13.32*** (2.31)	4.65*** (0.77)	-0.25 (0.78)	-22.18*** (2.46)	-6.25*** (1.37)
$\text{Unemployment}_{t-1}$	13.06*** (1.20)	6.42*** (2.29)	-8.38*** (0.77)	6.80*** (0.77)	44.50*** (2.44)	10.95*** (1.36)
PIgrowth_t	5.06*** (0.51)	-0.67 (0.98)	-9.83*** (0.69)	-0.16 (0.33)	7.41*** (1.05)	1.25** (0.59)
PIgrowth_{t-1}	1.47*** (0.52)	-2.14** (0.99)	-3.35*** (0.33)	-1.67*** (0.33)	0.74 (1.05)	-3.67*** (0.59)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Robust standard errors in parentheses.

Table 3.9: Interval Regression Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	48.89*** (12.53)	-374.17*** (11.04)	181.14*** (5.74)	-60.63*** (5.76)	-100.36*** (9.02)	-47.97*** (4.59)
Unemployment_t	9.10*** (0.89)	-7.35*** (0.80)	-2.48*** (0.42)	5.54*** (0.42)	7.09*** (0.65)	0.33 (0.33)
PIgrowth_t	-0.84 (0.70)	6.19*** (0.62)	-3.32*** (0.32)	-0.43 (0.33)	5.30*** (0.51)	1.03*** (0.26)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Standard errors in parentheses.

Table 3.10: Interval Regression Results

BC Variable	Parental	Institutional	State	Pell	Stafford	Perkins
$\ln \text{TaxRev}_t$	42.11 (61.57)	-828.58 (886.51)	98.042*** (33.86)	-142.44*** (34.59)	-179.59*** (54.12)	-122.02 (369.76)
$\ln \text{TaxRev}_{t-1}$	-37.76 (53.22)	454.45 (886.48)	42.36 (29.26)	49.39* (29.87)	60.54 (46.72)	74.05 (369.75)
Unemployment_t	-0.39 (4.15)	-4.41*** (1.48)	5.56*** (2.29)	1.83 (2.34)	-1.72 (3.65)	-1.00 (0.62)
$\text{Unemployment}_{t-1}$	-1.33 (4.13)	-3.46** (1.47)	-6.96*** (2.28)	5.49*** (2.33)	10.22*** (3.64)	1.56 (0.612)
PIgrowth_t	0.69 (1.77)	5.93*** (0.63)	-2.67*** (0.97)	1.79* (1.00)	3.42** (1.56)	1.21*** (0.26)
PIgrowth_{t-1}	0.09 (1.77)	1.60** (0.63)	-0.36 (0.98)	-2.32** (1.00)	2.03 (1.56)	-1.09*** (0.26)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes	Yes
N	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666	1,343,666

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Standard errors in parentheses.

Table 3.11: Hurdle Model Results: Unconditional Partial Effects

BC Variable	Parental	Institutional	State	Pell	Stafford
$\ln \text{TaxRev}_t$	-286.11*** (60.24)	-260.64*** (55.45)	411.70*** (33.09)	-200.20*** (21.76)	-119.49*** (48.51)
Unemployment_t	-7.61* (4.26)	-14.23*** (4.02)	-4.17* (2.24)	24.60*** (4.11)	-3.84 (5.41)
PIgrowth_t	1.71 (3.37)	0.91*** (3.16)	-5.00** (1.71)	2.84* (1.29)	4.82 (3.33)
Demographics	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes
N	146,870	146,870	146,870	146,870	146,870

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Standard errors in parentheses.

Table 3.12: Hurdle Model Results: Conditional Partial Effects

BC Variable	Parental	Institutional	State	Pell	Stafford
$\ln \text{TaxRev}_t$	-248.68*** (53.71)	-541.64*** (75.80)	435.03*** (89.09)	-256.96*** (82.55)	81.23 (74.88)
Unemployment_t	-2.03 (3.87)	-29.96*** (5.73)	-1.38 (6.48)	9.36*** (6.54)	-3.84 (5.41)
PIgrowth_t	1.26 (3.03)	5.28 (4.29)	-34.18*** (5.20)	-1.57 (4.75)	7.36* (4.13)
Demographics	Yes	Yes	Yes	Yes	Yes
Year Indicators	Yes	Yes	Yes	Yes	Yes
State Indicators	Yes	Yes	Yes	Yes	Yes
Institutional Indicators	Yes	Yes	Yes	Yes	Yes
N	146,870	146,870	146,870	146,870	146,870

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Each column is a unique dependent variable, and each row is a unique independent business cycle variable, where we estimate the models for each business cycle variable separately. Demographic controls include high school GPA, male, race, family income, and age.

Standard errors in parentheses.

Figure 3.1: Tax Revenues and Recession Troughs

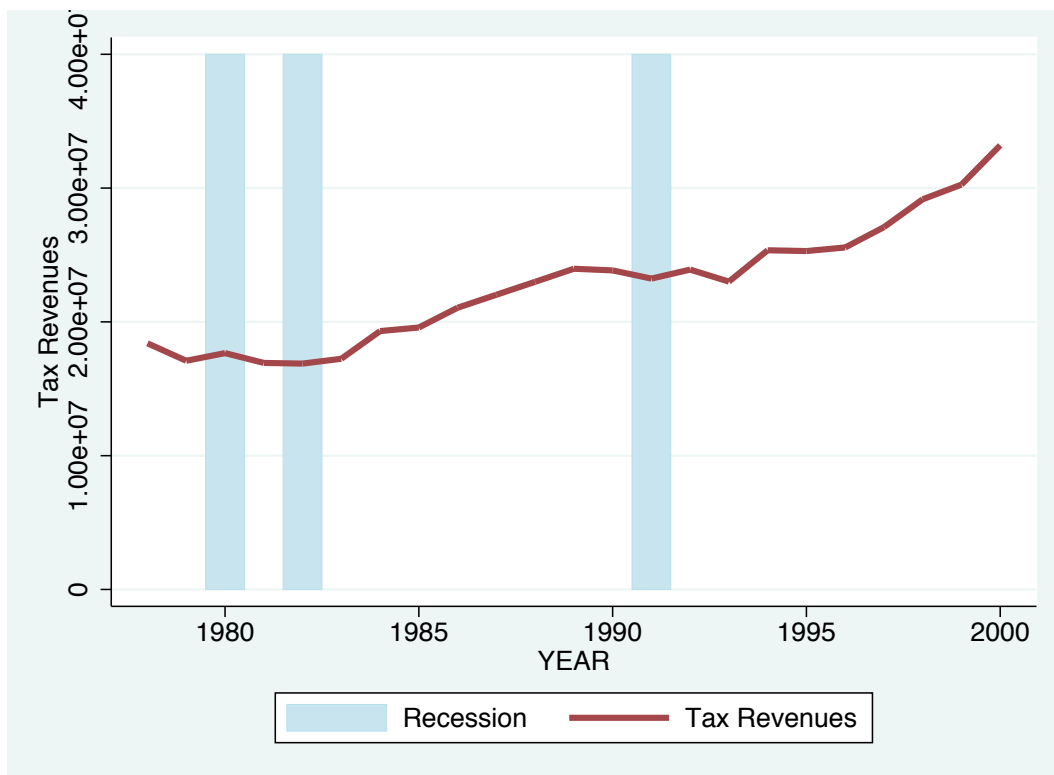


Figure 3.2: Unemployment Rate and Recession Troughs



Figure 3.3: Personal Income Growth and Recession Troughs



Figure 3.4: State vs. Institutional Aid: 1980-2000

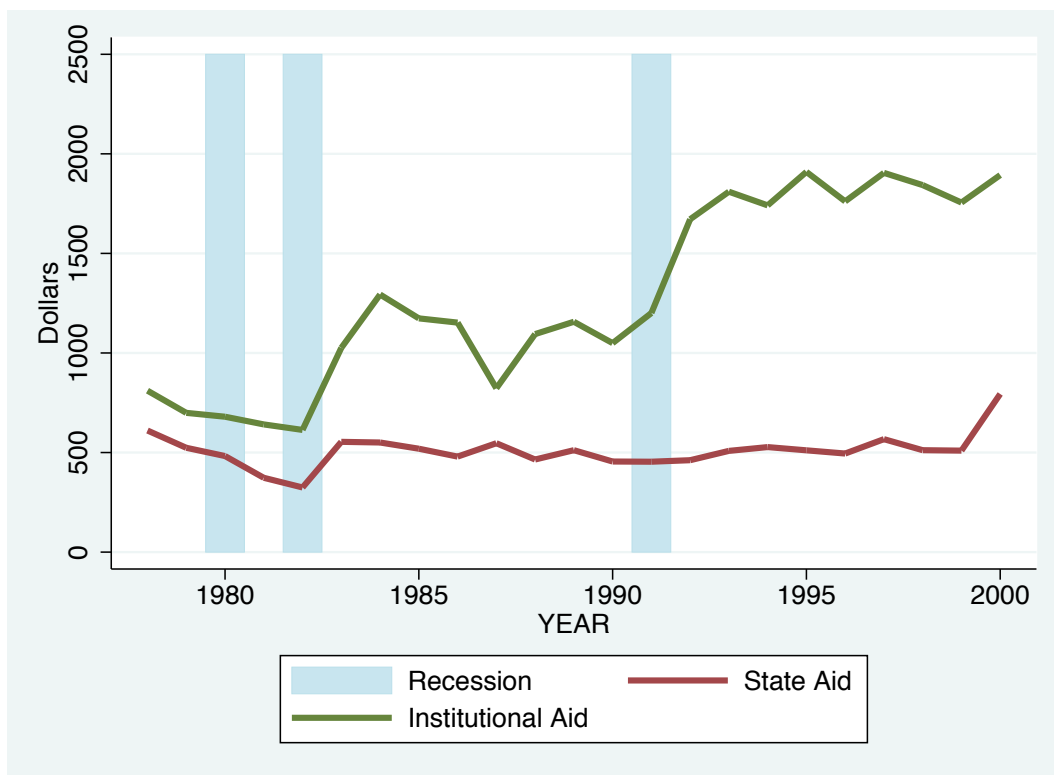


Figure 3.5: State vs. Pell Aid: 1980-2000

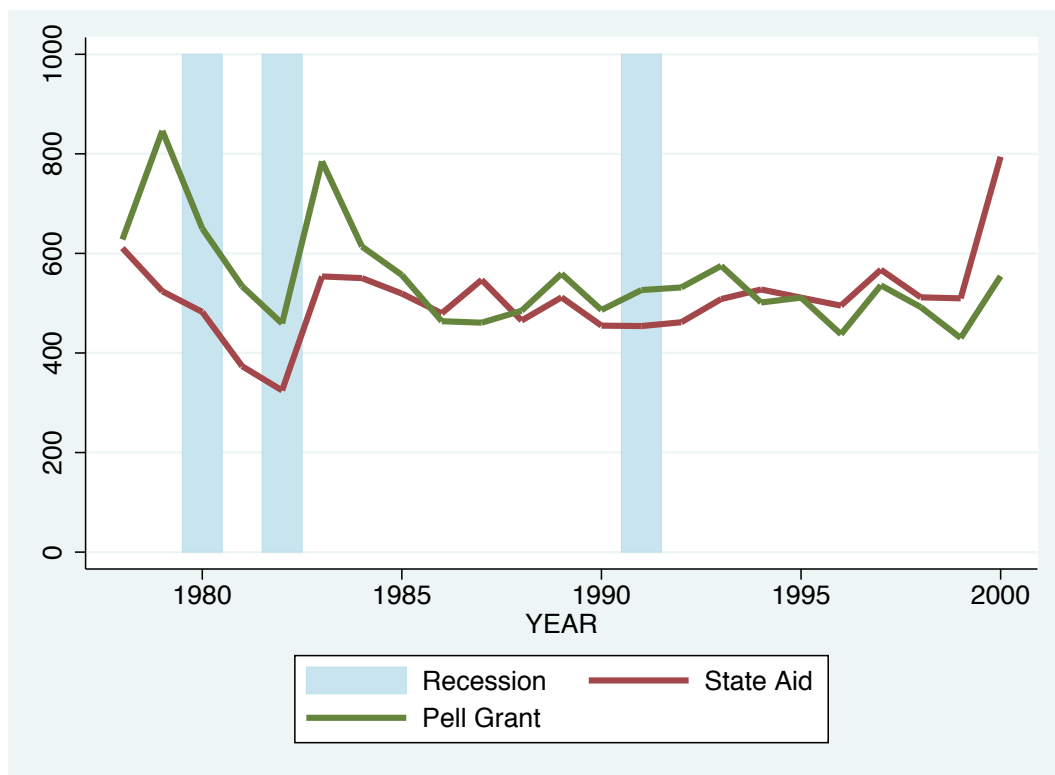


Figure 3.6: Parental Aid vs. Federal Aid: 1980-2000

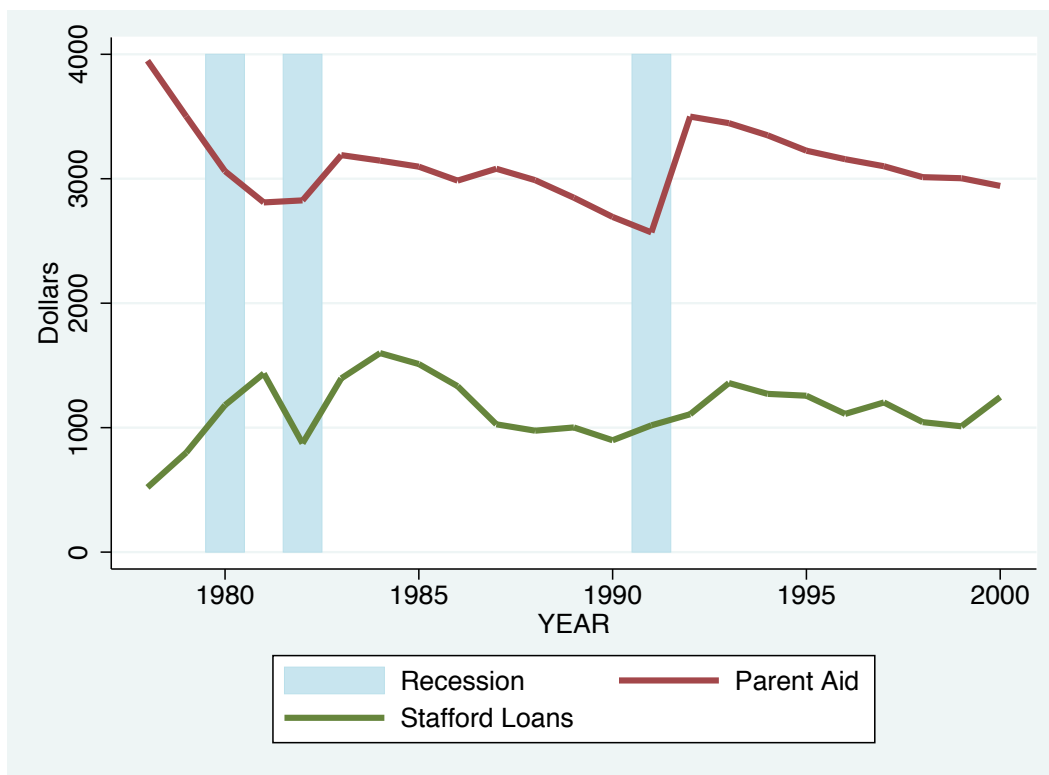


Figure 3.7: Federal Aid by Type: 1980-2000

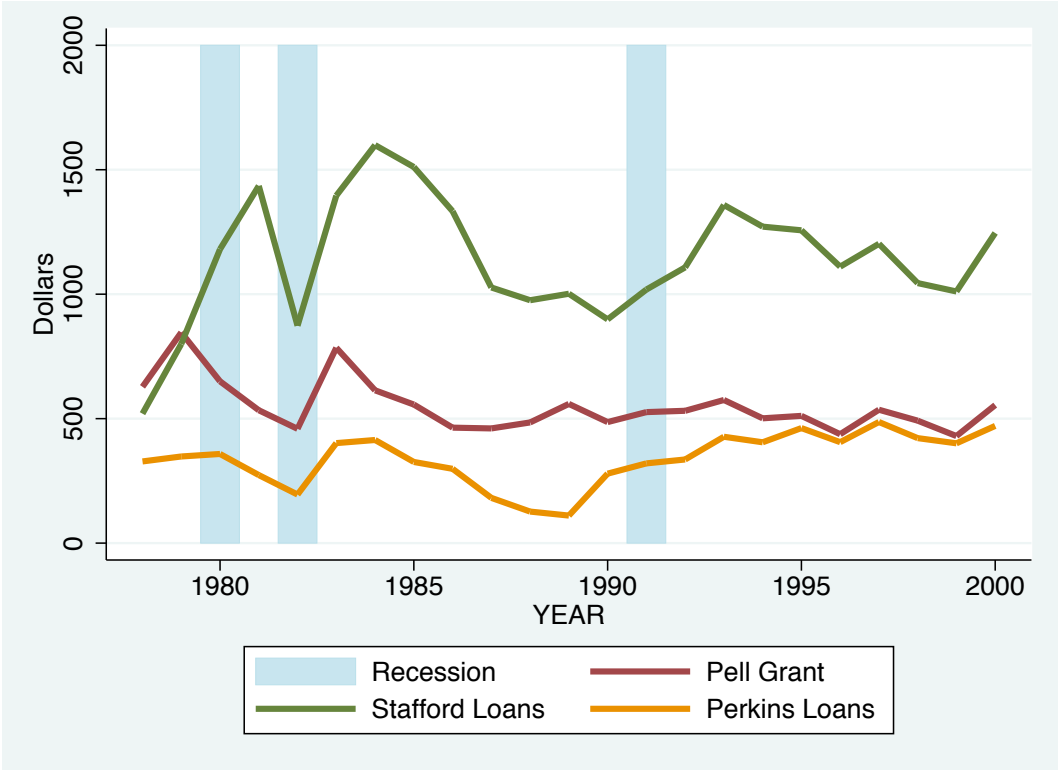
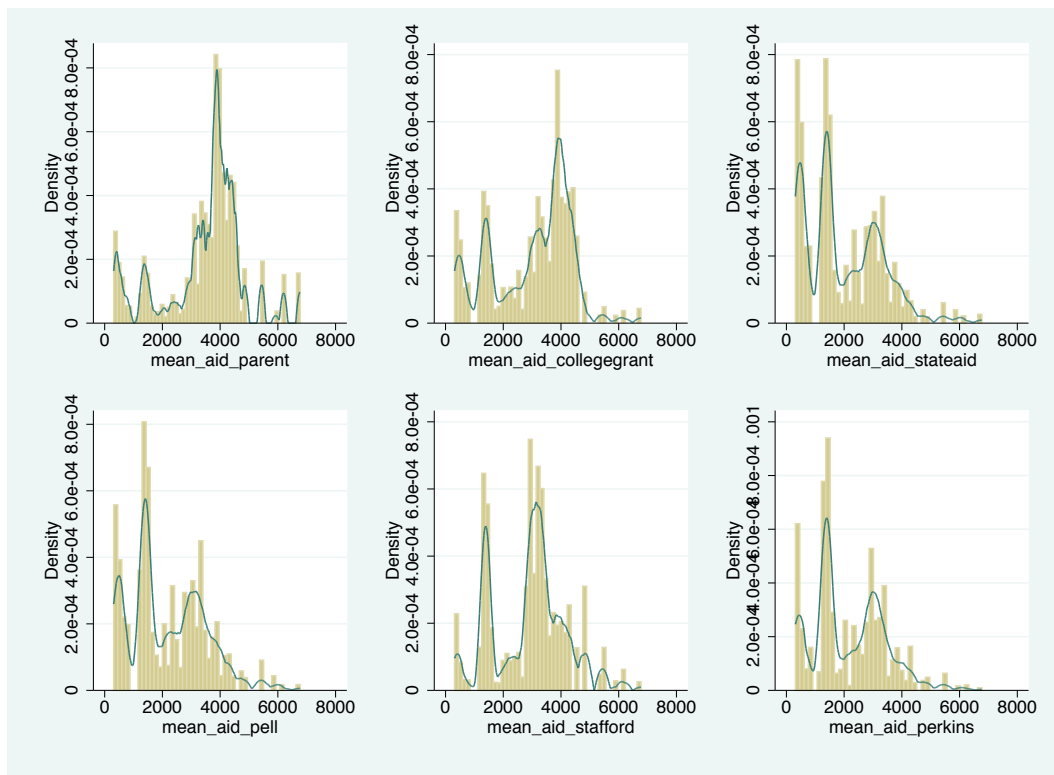


Figure 3.8: Distribution of Financial Aid by Aid Type



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Table A.1: Model 1 Efficiency Scores (Postsecondary Enrollment Rate)

District	Score	District	Score	District	Score	District	Score
APPLING COUNTY	0.9365	CRISP COUNTY	0.9785	JEFF DAVIS COUNTY	0.9491	RICHMOND	0.9198
ATKINSON COUNTY	0.9706	DADE COUNTY	0.9194	JEFFERSON CITY	0.976	ROCKDALE COUNTY	0.9642
BACON COUNTY	0.9154	DALTON CITY	0.9564	JEFFERSON COUNTY	0.9517	ROME CITY	0.9771
BALDWIN COUNTY	0.9492	DAWSON COUNTY	1	JENKINS COUNTY	0.9827	SCHLEY COUNTY	0.9907
BARROW COUNTY	1	DECATUR CITY	0.9411	JOHNSON COUNTY	1	SCREVEN COUNTY	0.9786
BARTOW COUNTY	0.9571	DECATUR COUNTY	0.8918	JONES COUNTY	0.9616	SEMINOLE COUNTY	0.9656
BEN HILL COUNTY	0.9975	DEKALB COUNTY	0.9205	LAMAR COUNTY	1	SOCIAL CIRCLE CITY	0.9868
BERRIEN COUNTY	1	DODGE COUNTY	0.9967	LANIER COUNTY	1	SPALDING COUNTY	0.9329
BIBB COUNTY	0.9673	DOOLY COUNTY	0.9688	LAURENS COUNTY	0.9675	STEPHENS COUNTY	0.9307
BLECKLEY COUNTY	1	DOUGHERTY COUNTY	0.9777	LEE COUNTY	1	STEWART COUNTY	0.8856
BRANTLEY COUNTY	0.9777	DOUGLAS COUNTY	1	LIBERTY COUNTY	0.9674	SUMTER COUNTY	0.9705
BREMEN CITY	0.9571	DUBLIN CITY	0.9797	LINCOLN COUNTY	0.9396	TATTNALL COUNTY	0.904
BROOKS COUNTY	0.926	EARLY COUNTY	0.9876	LONG COUNTY	1	TAYLOR COUNTY	0.9417
BRYAN COUNTY	1	ECHOLS COUNTY	1	LOWNDES COUNTY	0.9728	TELFAIR COUNTY	0.9546
BUFORD CITY	0.9599	EFFINGHAM COUNTY	1	LUMPKIN COUNTY	0.9418	THOMAS COUNTY	0.9302
BULLOCH COUNTY	0.9859	ELBERT COUNTY	0.9386	MACON COUNTY	1	THOMASTON-UPSON COUNTY	0.9406
BURKE COUNTY	0.9567	EMANUEL COUNTY	1	MADISON COUNTY	0.9421	THOMASVILLE CITY	0.9366
BUTTS COUNTY	1	EVANS COUNTY	1	MARIETTA CITY	0.9471	TIFT COUNTY	0.987
CALHOUN CITY	0.9633	FANNIN COUNTY	0.9507	MARION COUNTY	1	TOOMBS COUNTY	0.9695
CALHOUN COUNTY	1	FAYETTE COUNTY	0.9773	MCDUFFIE COUNTY	0.9673	TOWNS COUNTY	1
CAMDEN COUNTY	0.9376	FLOYD COUNTY	0.9685	MCINTOSH COUNTY	1	TREUTLEN COUNTY	1
CANDLER COUNTY	0.9506	FORSYTH COUNTY	0.9713	MERIWETHER COUNTY	0.9408	TRION CITY	0.9725
CARROLL COUNTY	0.9153	FRANKLIN COUNTY	0.9684	MILLER COUNTY	0.9119	TROUP COUNTY	0.9575
CARROLLTON CITY	1	FULTON COUNTY	1	MITCHELL COUNTY	1	TURNER COUNTY	0.9895
CARTERSVILLE CITY	0.9509	GAINESVILLE CITY	0.9416	MONROE COUNTY	0.9593	TWIGGS COUNTY	0.9376
CATOOSA COUNTY	0.9523	GILMER COUNTY	0.9233	MONTGOMERY COUNTY	0.9874	UNION COUNTY	0.9689
CHARLTON COUNTY	0.8963	GLASCOCK COUNTY	1	MORGAN COUNTY	0.9231	VALDOSTA CITY	0.931
CHATHAM COUNTY	0.9325	GLYNN COUNTY	0.9428	MURRAY COUNTY	0.96	VIDALIA CITY	1
CHATTOOGA COUNTY	0.9143	GORDON COUNTY	0.9751	MUSCOGEE COUNTY	0.9467	WALKER COUNTY	1
CHEROKEE COUNTY	0.9391	GRADY COUNTY	0.9893	NEWTON COUNTY	0.9619	WALTON COUNTY	0.9219
CHICKAMAUGA CITY	1	GREENE COUNTY	0.8498	OCONEE COUNTY	0.9752	WARE COUNTY	0.9432
CLARKE COUNTY	1	GWINNETT COUNTY	0.9409	OGLETHORPE COUNTY	0.9873	WARREN COUNTY	1
CLAYTON COUNTY	1	HABERSHAM COUNTY	0.9847	PAULDING COUNTY	1	WASHINGTON COUNTY	0.9507
CLINCH COUNTY	0.985	HALL COUNTY	0.9155	PEACH COUNTY	0.9631	WAYNE COUNTY	1
COBB COUNTY	1	HANCOCK COUNTY	1	PICKENS COUNTY	0.9228	WHEELER COUNTY	0.9002
COFFEE COUNTY	0.9368	HARALSON COUNTY	1	PIERCE COUNTY	0.9686	WHITE COUNTY	0.9459
COLUMBIA COUNTY	0.9985	HARRIS COUNTY	0.9445	PIKE COUNTY	1	WHITFIELD COUNTY	0.926
COMMERCE CITY	0.957	HART COUNTY	0.9043	POLK COUNTY	0.9889	WILCOX COUNTY	1
COOK COUNTY	0.9824	HOUSTON COUNTY	0.9888	PULASKI COUNTY	0.9667	WILKES COUNTY	0.9909
COWETA COUNTY	0.9649	IRWIN COUNTY	0.9682	PUTNAM COUNTY	0.8941	WILKINSON COUNTY	0.9634
CRAWFORD COUNTY	1	JACKSON COUNTY	0.9418	RABUN COUNTY	0.9611	WORTH COUNTY	0.953
		JASPER COUNTY	1	RANDOLPH COUNTY	0.9366		

Table A.2: Model 2 Efficiency Scores (Four-Year Enrollment Rates)

District	Score	District	Score	District	Score	District	Score
APPLING COUNTY	0.9232	CRISP COUNTY	0.8852	JEFF DAVIS COUNTY	0.9218	RICHMOND COUNTY	0.9469
ATKINSON COUNTY	0.9546	DADE COUNTY	0.9646	JEFFERSON CITY	0.9412	ROCKDALE COUNTY	0.9436
BACON COUNTY	0.8923	DALTON CITY	0.9458	JEFFERSON COUNTY	0.9428	ROME CITY	0.9845
BALDWIN COUNTY	0.8864	DAWSON COUNTY	1	JENKINS COUNTY	0.924	SCHELEY COUNTY	0.9798
BARROW COUNTY	1	DECATUR CITY	0.8901	JOHNSON COUNTY	1	SCREVEN COUNTY	0.9863
BARTOW COUNTY	0.9544	DECATUR COUNTY	0.8798	JONES COUNTY	0.9672	SEMINOLE COUNTY	0.9327
BEN HILL COUNTY	0.9203	DEKALB COUNTY	0.9158	LAMAR COUNTY	1	SOCIAL CIRCLE CITY	0.9546
BERRIEN COUNTY	1	DODGE COUNTY	0.9288	LANIER COUNTY	1	SPALDING COUNTY	0.9346
BIBB COUNTY	0.9965	DOOLY COUNTY	0.9258	LAURENS COUNTY	0.9123	STEPHENS COUNTY	0.8992
BLECKLEY COUNTY	1	DOUGHERTY COUNTY	0.9014	LEE COUNTY	0.9411	STEWART COUNTY	0.9106
BRANTLEY COUNTY	1	DOUGLAS COUNTY	1	LIBERTY COUNTY	0.9265	SUMTER COUNTY	0.9634
BREMEN CITY	0.9991	DUBLIN CITY	0.9268	LINCOLN COUNTY	1	TATTNALL COUNTY	0.9558
BROOKS COUNTY	0.9179	EARLY COUNTY	0.9627	LONG COUNTY	1	TAYLOR COUNTY	0.9229
BRYAN COUNTY	1	ECHOLS COUNTY	1	LOWNDES COUNTY	0.9409	TELFAIR COUNTY	0.9182
BUFORD CITY	0.9565	EFFINGHAM COUNTY	1	LUMPKIN COUNTY	0.967	THOMAS COUNTY	0.9248
BULLOCH COUNTY	0.9822	ELBERT COUNTY	0.9564	MACON COUNTY	1	THOMAS-STON-UPSON COUNTY	0.9233
BURKE COUNTY	0.959	EMANUEL COUNTY	0.9528	MADISON COUNTY	0.9263	THOMASVILLE CITY	0.9396
BUTTS COUNTY	1	EVANS COUNTY	1	MARIETTA CITY	0.9458	TIFT COUNTY	0.8936
CALHOUN CITY	0.9394	FANNIN COUNTY	1	MARION COUNTY	1	TOOMBS COUNTY	0.9685
CALHOUN COUNTY	1	FAYETTE COUNTY	0.9676	MCDUFFIE COUNTY	0.9562	TOWNS COUNTY	1
CAMDEN COUNTY	0.8917	FLOYD COUNTY	0.9083	MCINTOSH COUNTY	1	TREUTLEN COUNTY	1
CANDLER COUNTY	1	FORSYTH COUNTY	0.9866	MERIWETHER COUNTY	0.9462	TRION CITY	0.9814
CARROLL COUNTY	0.9484	FRANKLIN COUNTY	1	MILLER COUNTY	0.9399	TROUP COUNTY	0.9437
CARROLLTON CITY	1	FULTON COUNTY	1	MITCHELL COUNTY	1	TURNER COUNTY	0.9016
CARTERSVILLE CITY	0.93	GAINESVILLE CITY	0.9771	MONROE COUNTY	0.9674	TWIGGS COUNTY	0.9799
CATOOSA COUNTY	0.9008	GILMER COUNTY	0.9513	MONTGOMERY COUNTY	0.9289	UNION COUNTY	0.911
CHARLTON COUNTY	0.9168	GLASCOCK COUNTY	1	MORGAN COUNTY	0.9275	VALDOSTA CITY	0.912
CHATHAM COUNTY	0.9868	GLYNN COUNTY	0.918	MURRAY COUNTY	0.9365	VIDALIA CITY	1
CHATTOOGA COUNTY	0.9471	GORDON COUNTY	0.9595	MUSCOGEE COUNTY	0.9552	WALKER COUNTY	1
CHEROKEE COUNTY	0.9259	GRADY COUNTY	0.8912	NEWTON COUNTY	0.9497	WALTON COUNTY	0.9303
CHICKAMAUGA CITY	1	GREENE COUNTY	0.8819	OCONEE COUNTY	0.9115	WARE COUNTY	0.9215
CLARKE COUNTY	1	GWINNETT COUNTY	0.9358	OGLETHORPE COUNTY	0.9195	WARREN COUNTY	1
CLAYTON COUNTY	1	HABERSHAM COUNTY	0.9464	PAULDING COUNTY	1	WASHINGTON COUNTY	0.9379
CLINCH COUNTY	0.9354	HALL COUNTY	0.916	PEACH COUNTY	1	WAYNE COUNTY	0.9727
COBB COUNTY	1	HANCOCK COUNTY	1	PICKENS COUNTY	0.9189	WHEELER COUNTY	0.9059
COFFEE COUNTY	0.8996	HARALSON COUNTY	1	PIERCE COUNTY	0.9042	WHITE COUNTY	0.9538
COLUMBIA COUNTY	0.996	HARRIS COUNTY	0.9441	PIKE COUNTY	1	WHITFIELD COUNTY	0.9036
COMMERCE CITY	0.9135	HART COUNTY	0.929	POLK COUNTY	0.9481	WILCOX COUNTY	0.986
COOK COUNTY	0.9708	HOUSTON COUNTY	0.9722	PULASKI COUNTY	0.931	WILKES COUNTY	0.9819
COWETA COUNTY	0.9818	IRWIN COUNTY	0.8992	PUTNAM COUNTY	0.9274	WILKINSON COUNTY	0.9439
CRAWFORD COUNTY	1	JACKSON COUNTY	0.9287	RABUN COUNTY	0.9065	WORTH COUNTY	0.8838
		JASPER COUNTY	1	RANDOLPH COUNTY	0.9462		

Table A.3: Model 3 Efficiency Scores (SAT Composite)

District	Score	District	Score	District	Score	District	Score
APPLING COUNTY	0.7047	CRISP COUNTY	0.7075	JEFF DAVIS COUNTY	0.8329	RICHMOND COUNTY	0.8257
ATKINSON COUNTY	0.6697	DADE COUNTY	0.9321	JEFFERSON CITY	1	ROCKDALE COUNTY	0.9218
BACON COUNTY	0.7935	DALTON CITY	0.6003	JEFFERSON COUNTY	0.9233	ROME CITY	1
BALDWIN COUNTY	0.7224	DAWSON COUNTY	1	JENKINS COUNTY	0.7095	SCHLEY COUNTY	0.6457
BARROW COUNTY	1	DECATUR CITY	0.6801	JOHNSON COUNTY	1	SCREVEN COUNTY	0.9389
BARTOW COUNTY	0.9258	DECATUR COUNTY	0.7889	JONES COUNTY	0.7904	SEMINOLE COUNTY	0.7043
BEN HILL COUNTY	0.7295	DEKALB COUNTY	0.6866	LAMAR COUNTY	1	SOCIAL CIRCLE CITY	0.9271
BERRIEN COUNTY	1	DODGE COUNTY	0.851	LANIER COUNTY	1	SPALDING COUNTY	0.7276
BIBB COUNTY	0.66	DOOLY COUNTY	0.5235	LAURENS COUNTY	0.7896	STEPHENS COUNTY	0.568
BLECKLEY COUNTY	1	DOUGHERTY COUNTY	0.8149	LEE COUNTY	1	STEWART COUNTY	0.5572
BRANTLEY COUNTY	0.6739	DOUGLAS COUNTY	1	LIBERTY COUNTY	0.989	SUMTER COUNTY	0.717
BREMEN CITY	0.7475	DUBLIN CITY	1	LINCOLN COUNTY	0.7517	TATTNALL COUNTY	0.6794
BROOKS COUNTY	0.6265	EARLY COUNTY	1	LONG COUNTY	1	TAYLOR COUNTY	0.7064
BRYAN COUNTY	1	ECHOLS COUNTY	1	LOWNDES COUNTY	0.7746	TELFAIR COUNTY	0.8139
BUFORD CITY	0.8391	EFFINGHAM COUNTY	1	LUMPKIN COUNTY	0.819	THOMAS COUNTY	0.7886
BULLOCH COUNTY	0.9832	ELBERT COUNTY	0.9815	MACON COUNTY	0.6375	THOMASTON-UPSON COUNTY	0.7882
BURKE COUNTY	0.8947	EMANUEL COUNTY	0.805	MADISON COUNTY	0.8281	THOMASVILLE CITY	0.9512
BUTTS COUNTY	1	EVANS COUNTY	1	MARIETTA CITY	0.9929	TIFT COUNTY	0.8528
CALHOUN CITY	0.7461	FANNIN COUNTY	0.8339	MARION COUNTY	0.9544	TOOMBS COUNTY	0.9234
CALHOUN COUNTY	1	FAYETTE COUNTY	0.7345	MCDUFFIE COUNTY	0.7802	TOWNS COUNTY	1
CAMDEN COUNTY	0.7135	FLOYD COUNTY	0.7274	MCINTOSH COUNTY	1	TREUTLEN COUNTY	1
CANDLER COUNTY	0.7939	FORSYTH COUNTY	0.7333	MERIWETHER COUNTY	0.5506	TRION CITY	0.761
CARROLL COUNTY	0.7547	FRANKLIN COUNTY	0.7993	MILLER COUNTY	0.6981	TROUP COUNTY	0.7227
CARROLLTON CITY	0.7832	FULTON COUNTY	1	MITCHELL COUNTY	1	TURNER COUNTY	0.7692
CARTERSVILLE CITY	0.7809	GAINESVILLE CITY	0.7688	MONROE COUNTY	0.907	TWIGGS COUNTY	0.5001
CATOOSA COUNTY	0.7304	GILMER COUNTY	0.7471	MONTGOMERY COUNTY	0.7013	UNION COUNTY	0.5972
CHARLTON COUNTY	0.6477	GLASCOCK COUNTY	1	MORGAN COUNTY	0.5765	VALDOSTA CITY	1
CHATHAM COUNTY	0.68	GLYNN COUNTY	0.7864	MURRAY COUNTY	0.9095	VIDALIA CITY	1
CHATTOOGA COUNTY	0.6642	GORDON COUNTY	0.8219	MUSCOGEE COUNTY	0.6976	WALKER COUNTY	1
CHEROKEE COUNTY	0.6797	GRADY COUNTY	0.7519	NEWTON COUNTY	1	WALTON COUNTY	0.7105
CHICKAMAUGA CITY	1	GREENE COUNTY	0.2588	OCONEE COUNTY	0.6214	WARE COUNTY	0.6542
CLARKE COUNTY	1	GWINNETT COUNTY	0.7827	OGLETHORPE COUNTY	0.8008	WARREN COUNTY	1
CLAYTON COUNTY	1	HABERSHAM COUNTY	0.5363	PAULDING COUNTY	1	WASHINGTON COUNTY	0.9411
CLINCH COUNTY	0.3982	HALL COUNTY	0.7541	PEACH COUNTY	0.4882	WAYNE COUNTY	0.861
COBB COUNTY	1	HANCOCK COUNTY	1	PICKENS COUNTY	0.686	WHEELER COUNTY	0.7946
COFFEE COUNTY	0.6622	HARALSON COUNTY	1	PIERCE COUNTY	0.8231	WHITE COUNTY	0.6457
COLUMBIA COUNTY	0.7614	HARRIS COUNTY	0.7408	PIKE COUNTY	1	WHITFIELD COUNTY	0.8804
COMMERCE CITY	0.6115	HART COUNTY	0.5939	POLK COUNTY	0.742	WILCOX COUNTY	1
COOK COUNTY	0.8756	HOUSTON COUNTY	0.9592	PULASKI COUNTY	0.7116	WILKES COUNTY	0.9103
COWETA COUNTY	0.9555	IRWIN COUNTY	0.6687	PUTNAM COUNTY	0.6679	WILKINSON COUNTY	0.8195
CRAWFORD COUNTY	1	JACKSON COUNTY	0.9446	RABUN COUNTY	0.5355	WORTH COUNTY	0.8213
		JASPER COUNTY	1	RANDOLPH COUNTY	0.7284		

Table A.4: Model 4 Efficiency Scores (Graduation Rates)

District	Score	District	Score	District	Score	District	Score
APPLING COUNTY	0.9348	CRISP COUNTY	0.9214	JEFF DAVIS COUNTY	0.9451	RICHMOND COUNTY	0.9138
ATKINSON COUNTY	0.9937	DADE COUNTY	1	JEFFERSON CITY	0.9966	ROCKDALE COUNTY	0.9444
BACON COUNTY	0.9043	DALTON CITY	0.9249	JEFFERSON COUNTY	1	ROME CITY	0.8652
BALDWIN COUNTY	0.8957	DAWSON COUNTY	1	JENKINS COUNTY	0.9418	SCHLEY COUNTY	0.9668
BARROW COUNTY	1	DECATUR CITY	0.9442	JOHNSON COUNTY	0.9942	SCREVEN COUNTY	1
BARTOW COUNTY	0.9211	DECATUR COUNTY	0.9359	JONES COUNTY	0.9261	SEMINOLE COUNTY	1
BEN HILL COUNTY	0.956	DEKALB COUNTY	0.9541	LAMAR COUNTY	1	SOCIAL CIRCLE CITY	1
BERRIEN COUNTY	1	DODGE COUNTY	1	LANIER COUNTY	1	SPALDING COUNTY	0.8814
BIBB COUNTY	0.9134	DOOLY COUNTY	0.8953	LAURENS COUNTY	0.9619	STEPHENS COUNTY	0.9184
BLECKLEY COUNTY	1	DOUGHERTY COUNTY	0.9148	LEE COUNTY	0.993	STEWART COUNTY	0.858
BRANTLEY COUNTY	0.9777	DOUGLAS COUNTY	1	LIBERTY COUNTY	0.9533	SUMTER COUNTY	0.9444
BREMEN CITY	1	DUBLIN CITY	0.9205	LINCOLN COUNTY	0.9725	TATTNALL COUNTY	0.949
BROOKS COUNTY	0.9306	EARLY COUNTY	1	LONG COUNTY	1	TAYLOR COUNTY	0.9149
BRYAN COUNTY	1	ECHOLS COUNTY	1	LOWNDES COUNTY	0.9446	TELFAIR COUNTY	0.9534
BUFORD CITY	1	EFFINGHAM COUNTY	1	LUMPKIN COUNTY	0.9454	THOMAS COUNTY	0.9677
BULLOCH COUNTY	0.984	ELBERT COUNTY	0.9501	MACON COUNTY	0.9878	THOMASTON-UPSON COUNTY	0.9138
BURKE COUNTY	0.8712	EMANUEL COUNTY	1	MADISON COUNTY	0.9463	THOMASVILLE CITY	0.9664
BUTTS COUNTY	1	EVANS COUNTY	1	MARIETTA CITY	0.9734	TIFT COUNTY	0.9125
CALHOUN CITY	0.9948	FANNIN COUNTY	1	MARION COUNTY	0.9652	TOOMBS COUNTY	0.9835
CALHOUN COUNTY	1	FAYETTE COUNTY	0.9554	MCDUFFIE COUNTY	0.9516	TOWNS COUNTY	1
CAMDEN COUNTY	0.916	FLOYD COUNTY	0.9208	MCINTOSH COUNTY	1	TREUTLEN COUNTY	1
CANDLER COUNTY	0.9297	FORSYTH COUNTY	0.945	MERIWETHER COUNTY	0.9334	TRION CITY	1
CARROLL COUNTY	0.9317	FRANKLIN COUNTY	0.9279	MILLER COUNTY	1	TROUP COUNTY	0.9389
CARROLLTON CITY	0.9718	FULTON COUNTY	1	MITCHELL COUNTY	1	TURNER COUNTY	0.9402
CARTERSVILLE CITY	0.9398	GAINESVILLE CITY	0.9846	MONROE COUNTY	0.942	TWIGGS COUNTY	1
CATOOSA COUNTY	0.8932	GILMER COUNTY	0.9311	MONTGOMERY COUNTY	0.9743	UNION COUNTY	0.9763
CHARLTON COUNTY	0.9249	GLASCOCK COUNTY	1	MORGAN COUNTY	0.9283	VALDOSTA CITY	0.9284
CHATHAM COUNTY	0.9448	GLYNN COUNTY	0.8775	MURRAY COUNTY	0.8946	VIDALIA CITY	1
CHATTOOGA COUNTY	0.938	GORDON COUNTY	0.9651	MUSCOGEE COUNTY	0.9203	WALKER COUNTY	1
CHEROKEE COUNTY	0.899	GRADY COUNTY	0.9483	NEWTON COUNTY	1	WALTON COUNTY	0.9431
CHICKAMAUGA CITY	1	GREENE COUNTY	0.9319	OCONEE COUNTY	0.9218	WARE COUNTY	0.9137
CLARKE COUNTY	1	GWINNETT COUNTY	0.9692	OGLETHORPE COUNTY	0.9338	WARREN COUNTY	1
CLAYTON COUNTY	1	HABERSHAM COUNTY	0.9113	PAULDING COUNTY	1	WASHINGTON COUNTY	0.9258
CLINCH COUNTY	0.9754	HALL COUNTY	0.9013	PEACH COUNTY	0.9155	WAYNE COUNTY	0.9819
COBB COUNTY	1	HANCOCK COUNTY	1	PICKENS COUNTY	0.9245	WHEELER COUNTY	0.906
COFFEE COUNTY	0.9205	HARALSON COUNTY	1	PIERCE COUNTY	0.9368	WHITE COUNTY	0.9622
COLUMBIA COUNTY	0.9298	HARRIS COUNTY	0.9217	PIKE COUNTY	1	WHITFIELD COUNTY	0.941
COMMERCE CITY	0.9405	HART COUNTY	0.9101	POLK COUNTY	0.9191	WILCOX COUNTY	0.977
COOK COUNTY	0.9553	HOUSTON COUNTY	0.9878	PULASKI COUNTY	0.9478	WILKES COUNTY	1
COWETA COUNTY	0.9512	IRWIN COUNTY	0.9142	PUTNAM COUNTY	0.922	WILKINSON COUNTY	1
CRAWFORD COUNTY	0.974	JACKSON COUNTY	0.9316	RABUN COUNTY	0.9158	WORTH COUNTY	0.9347
		JASPER COUNTY	1	RANDOLPH COUNTY	0.9737		

Table A.5: Model 5 Efficiency Scores (All Output Measures)

District	Score	District	Score	District	Score	District	Score
APPLING COUNTY	0.9485	CRISP COUNTY	0.9819	JEFF DAVIS COUNTY	0.9862	RICHMOND COUNTY	0.9542
ATKINSON COUNTY	1	DADE COUNTY	1	JEFFERSON CITY	1	ROCKDALE COUNTY	0.9913
BACON COUNTY	0.9345	DALTON CITY	0.9642	JEFFERSON COUNTY	1	ROME CITY	1
BALDWIN COUNTY	0.9596	DAWSON COUNTY	1	JENKINS COUNTY	0.9869	SCHLEY COUNTY	0.9995
BARROW COUNTY	1	DECATUR CITY	0.9672	JOHNSON COUNTY	1	SCREVEN COUNTY	1
BARTOW COUNTY	0.9718	DECATUR COUNTY	0.9569	JONES COUNTY	0.9616	SEMINOLE COUNTY	1
BEN HILL COUNTY	1	DEKALB COUNTY	0.9637	LAMAR COUNTY	1	SOCIAL CIRCLE CITY	1
BERRIEN COUNTY	1	DODGE COUNTY	1	LANIER COUNTY	1	SPALDING COUNTY	0.945
BIBB COUNTY	0.9677	DOOLY COUNTY	0.9712	LAURENS COUNTY	0.984	STEWART COUNTY	0.9442
BLECKLEY COUNTY	1	DOUGHERTY COUNTY	0.9935	LEE COUNTY	1	STEWART COUNTY	0.8891
BRANTLEY COUNTY	0.9809	DOUGLAS COUNTY	1	LIBERTY COUNTY	1	SUMTER COUNTY	0.9786
BREMEN CITY	1	DUBLIN CITY	1	LINCOLN COUNTY	0.9865	TATTNALL COUNTY	0.9614
BROOKS COUNTY	0.9365	EARLY COUNTY	1	LONG COUNTY	1	TAYLOR COUNTY	0.9559
BRYAN COUNTY	1	ECHOLS COUNTY	1	LOWNDES COUNTY	0.9845	TELFAIR COUNTY	0.9776
BUFORD CITY	1	EFFINGHAM COUNTY	1	LUMPKIN COUNTY	0.972	THOMAS COUNTY	0.9918
BULLOCH COUNTY	1	ELBERT COUNTY	0.9815	MACON COUNTY	1	THOMASTON-UPSON COUNTY	0.9661
BURKE COUNTY	0.9723	EMANUEL COUNTY	1	MADISON COUNTY	0.962	THOMASVILLE CITY	0.9925
BUTTS COUNTY	1	EVANS COUNTY	1	MARIETTA CITY	1	TIFT COUNTY	0.9929
CALHOUN CITY	0.995	FANNIN COUNTY	1	MARION COUNTY	1	TOOMBS COUNTY	1
CALHOUN COUNTY	1	FAYETTE COUNTY	0.9909	MCDUFFIE COUNTY	0.9818	TOWNS COUNTY	1
CAMDEN COUNTY	0.9511	FLOYD COUNTY	0.9754	MCINTOSH COUNTY	1	TREUTLEN COUNTY	1
CANDLER COUNTY	0.9506	FORSYTH COUNTY	0.9782	MERIWETHER COUNTY	0.9566	TRION CITY	1
CARROLL COUNTY	0.9517	FRANKLIN COUNTY	0.9684	MILLER COUNTY	1	TROUP COUNTY	0.9769
CARROLLTON CITY	1	FULTON COUNTY	1	MITCHELL COUNTY	1	TURNER COUNTY	0.99
CARTERSVILLE CITY	0.9705	GAINESVILLE CITY	0.9909	MONROE COUNTY	0.9801	TWIGGS COUNTY	1
CATOOSA COUNTY	0.9627	GILMER COUNTY	0.9558	MONTGOMERY COUNTY	1	UNION COUNTY	0.9927
CHARLTON COUNTY	0.9358	GLASCOCK COUNTY	1	MORGAN COUNTY	0.9434	VALDOSTA CITY	1
CHATHAM COUNTY	0.9514	GLYNN COUNTY	0.9564	MURRAY COUNTY	0.9751	VIDALIA CITY	1
CHATTOOGA COUNTY	0.9483	GORDON COUNTY	0.9779	MUSCOGEE COUNTY	0.9574	WALKER COUNTY	1
CHEROKEE COUNTY	0.9482	GRADY COUNTY	0.999	NEWTON COUNTY	1	WALTON COUNTY	0.9556
CHICKAMAUGA CITY	1	GREENE COUNTY	0.9319	OCONEE COUNTY	0.9797	WARE COUNTY	0.9506
CLARKE COUNTY	1	GWINNETT COUNTY	0.9693	OGLETHORPE COUNTY	0.9897	WARREN COUNTY	1
CLAYTON COUNTY	1	HABERSHAM COUNTY	0.9869	PAULDING COUNTY	1	WASHINGTON COUNTY	1
CLINCH COUNTY	0.9971	HALL COUNTY	0.9331	PEACH COUNTY	0.9706	WAYNE COUNTY	1
COBB COUNTY	1	HANCOCK COUNTY	1	PICKENS COUNTY	0.9557	WHEELER COUNTY	0.9329
COFFEE COUNTY	0.9496	HARALSON COUNTY	1	PIERCE COUNTY	0.9752	WHITE COUNTY	0.9753
COLUMBIA COUNTY	0.9985	HARRIS COUNTY	0.9666	PIKE COUNTY	1	WHITFIELD COUNTY	0.9674
COMMERCE CITY	0.9744	HART COUNTY	0.9226	POLK COUNTY	0.9898	WILCOX COUNTY	1
COOK COUNTY	0.9824	HOUSTON COUNTY	1	PULASKI COUNTY	0.9793	WILKES COUNTY	1
COWETA COUNTY	0.9903	IRWIN COUNTY	0.9735	PUTNAM COUNTY	0.9285	WILKINSON COUNTY	1
CRAWFORD COUNTY	1	JACKSON COUNTY	0.9696	RABUN COUNTY	0.9682	WORTH COUNTY	0.9723
		JASPER COUNTY	1	RANDOLPH COUNTY	0.9787		

Table A.6: Model 1 Bootstrap (Postsecondary Enrollment)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
APPLING COUNTY	0.9365	0.9260	0.0105	0.0001	0.9179	0.9357
ATKINSON COUNTY	0.9706	0.9530	0.0176	0.0001	0.9311	0.9696
BACON COUNTY	0.9154	0.9071	0.0083	0.0000	0.9001	0.9145
BALDWIN COUNTY	0.9492	0.9344	0.0148	0.0000	0.9169	0.9481
BARROW COUNTY	1.0000	0.9609	0.0391	0.0010	0.9077	0.9990
BARTOW COUNTY	0.9571	0.9405	0.0166	0.0000	0.9225	0.9562
BEN HILL COUNTY	0.9975	0.9839	0.0136	0.0001	0.9720	0.9964
BERRIEN COUNTY	1.0000	0.9594	0.0406	0.0011	0.9068	0.9989
BIBB COUNTY	0.9673	0.9544	0.0129	0.0000	0.9428	0.9664
BLECKLEY COUNTY	1.0000	0.9613	0.0387	0.0010	0.9088	0.9989
BRANTLEY COUNTY	0.9777	0.9542	0.0235	0.0002	0.9282	0.9765
BREMEN CITY	0.9571	0.9365	0.0206	0.0001	0.9102	0.9559
BROOKS COUNTY	0.9260	0.9124	0.0136	0.0000	0.8959	0.9252
BRYAN COUNTY	1.0000	0.9607	0.0393	0.0010	0.9081	0.9990
BUFORD CITY	0.9599	0.9454	0.0145	0.0001	0.9295	0.9590
BULLOCH COUNTY	0.9859	0.9704	0.0155	0.0001	0.9569	0.9847
BURKE COUNTY	0.9567	0.9472	0.0095	0.0000	0.9385	0.9558
BUTTS COUNTY	1.0000	0.9603	0.0397	0.0010	0.9033	0.9988
CALHOUN CITY	0.9633	0.9473	0.0160	0.0001	0.9272	0.9622
CALHOUN COUNTY	1.0000	0.9607	0.0393	0.0010	0.9055	0.9989
CAMDEN COUNTY	0.9376	0.9323	0.0053	0.0000	0.9289	0.9368
CANDLER COUNTY	0.9506	0.9303	0.0203	0.0003	0.8933	0.9496
CARROLL COUNTY	0.9153	0.9012	0.0141	0.0001	0.8901	0.9143
CARROLLTON CITY	1.0000	0.9794	0.0206	0.0002	0.9561	0.9987
CARTERSVILLE CITY	0.9509	0.9392	0.0117	0.0000	0.9286	0.9498
CATOOSA COUNTY	0.9523	0.9437	0.0086	0.0000	0.9375	0.9514
CHARLTON COUNTY	0.8963	0.8883	0.0080	0.0000	0.8827	0.8955
CHATHAM COUNTY	0.9325	0.9141	0.0184	0.0001	0.8966	0.9316
CHATTOOGA COUNTY	0.9143	0.9034	0.0109	0.0000	0.8954	0.9133
CHEROKEE COUNTY	0.9391	0.9331	0.0060	0.0000	0.9283	0.9380
CHICKAMAUGA CITY	1.0000	0.9613	0.0387	0.0010	0.9086	0.9985

Table A.6: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
CLARKE COUNTY	1.0000	0.9612	0.0388	0.0010	0.9063	0.9991
CLAYTON COUNTY	1.0000	0.9609	0.0391	0.0011	0.9043	0.9990
CLINCH COUNTY	0.9850	0.9713	0.0137	0.0000	0.9575	0.9839
COBB COUNTY	1.0000	0.9606	0.0393	0.0011	0.9072	0.9991
COFFEE COUNTY	0.9368	0.9247	0.0121	0.0000	0.9140	0.9358
COLUMBIA COUNTY	0.9985	0.9848	0.0137	0.0000	0.9727	0.9975
COMMERCE CITY	0.9570	0.9501	0.0069	0.0000	0.9450	0.9559
COOK COUNTY	0.9824	0.9617	0.0207	0.0002	0.9363	0.9814
COWETA COUNTY	0.9649	0.9497	0.0152	0.0001	0.9328	0.9639
CRAWFORD COUNTY	1.0000	0.9738	0.0262	0.0003	0.9458	0.9989
CRISP COUNTY	0.9785	0.9695	0.0090	0.0000	0.9621	0.9776
DADE COUNTY	0.9194	0.9013	0.0181	0.0001	0.8809	0.9186
DALTON CITY	0.9564	0.9493	0.0071	0.0000	0.9413	0.9556
DAWSON COUNTY	1.0000	0.9596	0.0404	0.0012	0.9044	0.9989
DECATUR CITY	0.9411	0.9305	0.0106	0.0000	0.9200	0.9401
DECATUR COUNTY	0.8918	0.8793	0.0125	0.0000	0.8702	0.8910
DEKALB COUNTY	0.9205	0.9102	0.0103	0.0000	0.8976	0.9197
DODGE COUNTY	0.9967	0.9780	0.0187	0.0002	0.9564	0.9958
DOOLY COUNTY	0.9688	0.9623	0.0065	0.0000	0.9579	0.9678
DOUGHERTY COUNTY	0.9777	0.9677	0.0100	0.0000	0.9593	0.9764
DOUGLAS COUNTY	1.0000	0.9608	0.0392	0.0012	0.9080	0.9991
DUBLIN CITY	0.9797	0.9625	0.0172	0.0001	0.9428	0.9787
EARLY COUNTY	0.9876	0.9659	0.0217	0.0002	0.9385	0.9863
ECHOLS COUNTY	1.0000	0.9602	0.0398	0.0011	0.9059	0.9989
EFFINGHAM COUNTY	1.0000	0.9613	0.0387	0.0010	0.9086	0.9990
ELBERT COUNTY	0.9386	0.9210	0.0176	0.0001	0.89733	0.9376
EMANUEL COUNTY	1.0000	0.9794	0.0206	0.0002	0.9554	0.9988
EVANS COUNTY	1.0000	0.9600	0.0401	0.0011	0.9067	0.9989
FANNIN COUNTY	0.9507	0.9336	0.0171	0.0001	0.9123	0.9498
FAYETTE COUNTY	0.9773	0.9634	0.0139	0.0000	0.9527	0.9762
FLOYD COUNTY	0.9685	0.9631	0.0054	0.0000	0.9591	0.9678

Table A.6: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
FORSYTH COUNTY	0.9713	0.9570	0.0143	0.0000	0.9425	0.9702
FRANKLIN COUNTY	0.9684	0.9479	0.0205	0.0002	0.9251	0.9673
FULTON COUNTY	1.0000	0.9608	0.0393	0.0012	0.9063	0.9989
GAINESVILLE CITY	0.9416	0.9297	0.0119	0.0000	0.9162	0.9409
GILMER COUNTY	0.9233	0.9182	0.0051	0.0000	0.9140	0.9225
GLASCOCK COUNTY	1.0000	0.9605	0.0395	0.0011	0.9072	0.9990
GLYNN COUNTY	0.9428	0.9361	0.0067	0.0000	0.9317	0.9418
GORDON COUNTY	0.9751	0.9568	0.0183	0.0001	0.9374	0.9740
GRADY COUNTY	0.9893	0.9802	0.0091	0.0000	0.9742	0.9883
GREENE COUNTY	0.8498	0.8416	0.0082	0.0000	0.8362	0.8487
GWINNETT COUNTY	0.9409	0.9249	0.0160	0.0001	0.9034	0.9399
HABERSHAM COUNTY	0.9847	0.9750	0.0097	0.0000	0.9682	0.9836
HALL COUNTY	0.9155	0.9056	0.0099	0.0000	0.8977	0.9145
HANCOCK COUNTY	1.0000	0.9613	0.0387	0.0012	0.9076	0.9989
HARALSON COUNTY	1.0000	0.9613	0.0387	0.0011	0.9065	0.9990
HARRIS COUNTY	0.9445	0.9363	0.0082	0.0000	0.9302	0.9436
HART COUNTY	0.9043	0.8907	0.0136	0.0001	0.8774	0.9033
HOUSTON COUNTY	0.9888	0.9743	0.0145	0.0001	0.9609	0.9800
IRWIN COUNTY	0.9682	0.9600	0.0082	0.0000	0.9528	0.9673
JACKSON COUNTY	0.9418	0.9288	0.0130	0.0000	0.9169	0.9406
JASPER COUNTY	1.0000	0.9598	0.0402	0.0011	0.9063	0.9991
JEFF DAVIS COUNTY	0.9491	0.9406	0.0085	0.0000	0.9342	0.9480
JEFFERSON CITY	0.9760	0.9533	0.0227	0.0002	0.9242	0.9748
JEFFERSON COUNTY	0.9517	0.9371	0.0146	0.0001	0.9164	0.9509
JENKINS COUNTY	0.9827	0.9690	0.0137	0.0000	0.9573	0.9819
JOHNSON COUNTY	1.0000	0.9618	0.0382	0.0009	0.9152	0.9989
JONES COUNTY	0.9616	0.9432	0.0184	0.0001	0.9259	0.9608
LAMAR COUNTY	1.0000	0.9605	0.0393	0.0012	0.9055	0.9990
LANIER COUNTY	1.0000	0.9608	0.0392	0.0010	0.9056	0.9990
LAURENS COUNTY	0.9675	0.9505	0.0170	0.0001	0.9355	0.9666
LEE COUNTY	1.0000	0.9609	0.0391	0.0008	0.9201	0.9990

Table A.6: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
LIBERTY COUNTY	0.9674	0.9544	0.0130	0.0001	0.9407	0.9665
LINCOLN COUNTY	0.9396	0.9291	0.0105	0.0001	0.9200	0.9386
LONG COUNTY	1.0000	0.9604	0.0396	0.0011	0.9074	0.9989
LOWNDES COUNTY	0.9728	0.9627	0.0101	0.0000	0.9554	0.9717
LUMPKIN COUNTY	0.9418	0.9294	0.0124	0.0000	0.9181	0.9409
MACON COUNTY	1.0000	0.9616	0.0384	0.0009	0.9186	0.9991
MADISON COUNTY	0.9421	0.9237	0.0184	0.0001	0.9044	0.9411
MARIETTA CITY	0.9471	0.9364	0.0107	0.0000	0.9234	0.9463
MARION COUNTY	1.0000	0.9762	0.0238	0.0002	0.9570	0.9992
MCDUFFIE COUNTY	0.9673	0.9576	0.0097	0.0000	0.9501	0.9663
MCINTOSH COUNTY	1.0000	0.9604	0.0394	0.0012	0.9074	0.9990
MERIWETHER COUNTY	0.9408	0.9324	0.0084	0.0000	0.9232	0.9398
MILLER COUNTY	0.9119	0.8916	0.0203	0.0002	0.8664	0.9109
MITCHELL COUNTY	1.0000	0.9602	0.0398	0.0011	0.9045	0.9987
MONROE COUNTY	0.9593	0.9406	0.0187	0.0001	0.9201	0.9585
MONTGOMERY COUNTY	0.9874	0.9713	0.0161	0.0001	0.9513	0.9865
MORGAN COUNTY	0.9231	0.9197	0.0034	0.0000	0.9160	0.9224
MURRAY COUNTY	0.9600	0.9468	0.0132	0.0001	0.9326	0.9592
MUSCOGEE COUNTY	0.9467	0.9410	0.0057	0.0001	0.9374	0.9457
NEWTON COUNTY	0.9619	0.9401	0.0218	0.0002	0.9136	0.9609
OCONEE COUNTY	0.9752	0.9679	0.0073	0.0000	0.9615	0.9741
OGLETHORPE COUNTY	0.9873	0.9717	0.0156	0.0001	0.9551	0.9865
PAULDING COUNTY	1.0000	0.9604	0.0396	0.0011	0.9056	0.9991
PEACH COUNTY	0.9631	0.9553	0.0078	0.0000	0.9498	0.9620
PICKENS COUNTY	0.9228	0.9151	0.0077	0.0000	0.9099	0.9218
PIERCE COUNTY	0.9686	0.9556	0.01300	0.0000	0.9432	0.9676
PIKE COUNTY	1.0000	0.9600	0.0400	0.0012	0.9042	0.9990
POLK COUNTY	0.9889	0.9770	0.0120	0.0000	0.9680	0.9879
PULASKI COUNTY	0.9667	0.9506	0.0161	0.0001	0.9351	0.9658
PUTNAM COUNTY	0.8941	0.8853	0.0088	0.0001	0.8785	0.8932
RABUN COUNTY	0.9611	0.9557	0.0054	0.0000	0.9518	0.9603

Table A.6: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
RANDOLPH COUNTY	0.9366	0.9218	0.0148	0.0001	0.9075	0.9356
RICHMOND COUNTY	0.9198	0.9133	0.0065	0.0000	0.9081	0.9189
ROCKDALE COUNTY	0.9642	0.9493	0.0149	0.0001	0.9339	0.9633
ROME CITY	0.9771	0.9674	0.0097	0.0000	0.9606	0.9761
SCHLEY COUNTY	0.9907	0.9773	0.0134	0.0001	0.9634	0.9898
SCREVEN COUNTY	0.9786	0.9631	0.0155	0.0001	0.9495	0.9774
SEMINOLE COUNTY	0.9656	0.9514	0.0142	0.0001	0.9316	0.9646
SOCIAL CIRCLE CITY	0.9868	0.9673	0.0195	0.0002	0.9446	0.9857
SPALDING COUNTY	0.9329	0.9197	0.0132	0.0000	0.9081	0.9320
STEPHENS COUNTY	0.9307	0.9185	0.0122	0.0001	0.9058	0.9299
STEWART COUNTY	0.8856	0.8696	0.0160	0.0001	0.8539	0.8848
SUMTER COUNTY	0.9705	0.9564	0.0141	0.0001	0.9425	0.9694
TATTNALL COUNTY	0.9040	0.8929	0.0111	0.0000	0.8826	0.9032
TAYLOR COUNTY	0.9417	0.9322	0.0095	0.0000	0.9248	0.9405
TELFAIR COUNTY	0.9546	0.9420	0.0126	0.0000	0.9306	0.9534
THOMAS COUNTY	0.9302	0.9184	0.0118	0.0000	0.9074	0.9294
THOMASTON-UPSON	0.9406	0.9283	0.0123	0.0000	0.9192	0.9397
THOMASVILLE CITY	0.9366	0.9174	0.0192	0.0001	0.8959	0.9357
TIFT COUNTY	0.9870	0.9705	0.0165	0.0001	0.9568	0.9858
TOOMBS COUNTY	0.9695	0.9575	0.0120	0.0000	0.9480	0.9685
TOWNS COUNTY	1.0000	0.9602	0.0398	0.0011	0.9050	0.9991
TRUETLEN COUNTY	1.0000	0.9620	0.0380	0.0010	0.9109	0.9990
TRION CITY	0.9725	0.9543	0.0182	0.0001	0.9370	0.9715
TROUP COUNTY	0.9575	0.9475	0.0100	0.0000	0.9382	0.9567
TURNER COUNTY	0.9895	0.9728	0.0167	0.0001	0.9563	0.9887
TWIGGS COUNTY	0.9376	0.9170	0.0206	0.0002	0.8914	0.9367
UNION COUNTY	0.9689	0.9636	0.0053	0.0000	0.9593	0.9680
VALDOSTA CITY	0.9310	0.9124	0.0186	0.0002	0.8893	0.9300
VIDALIA CITY	1.0000	0.9603	0.0397	0.0011	0.9074	0.9992
WALKER COUNTY	1.0000	0.9597	0.0403	0.0010	0.9086	0.9989
WALTON COUNTY	0.9219	0.9106	0.0113	0.0000	0.8994	0.9210

Table A.6: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
WARE COUNTY	0.9432	0.9350	0.0082	0.0000	0.9290	0.9424
WARREN COUNTY	1.0000	0.9605	0.0395	0.0011	0.9061	0.9992
WASHINGTON COUNTY	0.9507	0.9419	0.0088	0.0001	0.9338	0.9497
WAYNE COUNTY	1.0000	0.9668	0.0332	0.0005	0.9346	0.9992
WHEELER COUNTY	0.9002	0.8917	0.0085	0.0000	0.8805	0.8994
WHITE COUNTY	0.9459	0.9380	0.0079	0.0000	0.9316	0.9448
WHITFIELD COUNTY	0.9260	0.9109	0.0151	0.0000	0.8988	0.9249
WILCOX COUNTY	1.0000	0.9652	0.0348	0.0007	0.9241	0.9991
WILKES COUNTY	0.9909	0.9806	0.0103	0.0000	0.9704	0.9900
WILKINSON COUNTY	0.9634	0.9578	0.0056	0.0000	0.9508	0.9626
WORTH COUNTY	0.9530	0.9340	0.0190	0.0002	0.9122	0.9521

Table A.7: Model 2 Bootstrap (4-year Enrollment)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
APPLING COUNTY	0.9232	0.9072	0.0160	0.0001	0.8940	0.9223
ATKINSON COUNTY	0.9546	0.9346	0.0200	0.0001	0.9116	0.9536
BACON COUNTY	0.8923	0.8829	0.0094	0.0000	0.8726	0.8914
BALDWIN COUNTY	0.8864	0.8727	0.0137	0.0001	0.8556	0.8855
BARROW COUNTY	1.0000	0.9475	0.0525	0.0014	0.8991	0.9988
BARTOW COUNTY	0.9544	0.9341	0.0203	0.0001	0.9137	0.9534
BEN HILL COUNTY	0.9203	0.9055	0.0148	0.0001	0.8919	0.9193
BERRIEN COUNTY	1.0000	0.9484	0.0516	0.0015	0.8978	0.9990
BIBB COUNTY	0.9965	0.9787	0.0178	0.0001	0.9618	0.9954
BLECKLEY COUNTY	1.0000	0.9476	0.0524	0.0014	0.8988	0.9989
BRANTLEY COUNTY	1.0000	0.9641	0.0359	0.0005	0.9324	0.9988
BREMEN CITY	0.9991	0.9710	0.0281	0.0003	0.9405	0.9979
BROOKS COUNTY	0.9179	0.8990	0.0189	0.0001	0.8769	0.9167
BRYAN COUNTY	1.0000	0.9483	0.0517	0.0015	0.8966	0.9987
BUFORD CITY	0.9565	0.9371	0.0194	0.0001	0.9161	0.9554
BULLOCH COUNTY	0.9822	0.9628	0.0194	0.0001	0.9445	0.9813
BURKE COUNTY	0.9590	0.9481	0.0109	0.0000	0.9379	0.9579
BUTTS COUNTY	1.0000	0.9494	0.0506	0.0014	0.8974	0.9989
CALHOUN CITY	0.9394	0.9143	0.0251	0.0003	0.8828	0.9386
CALHOUN COUNTY	1.0000	0.9476	0.0524	0.0015	0.8971	0.9988
CAMDEN COUNTY	0.8917	0.8846	0.0071	0.0001	0.8800	0.8909
CANDLER COUNTY	1.0000	0.9659	0.0341	0.0008	0.9182	0.9990
CARROLL COUNTY	0.9484	0.9343	0.0141	0.0001	0.9190	0.9473
CARROLLTON CITY	1.0000	0.9643	0.0357	0.0004	0.9361	0.9989
CATERSVILLE CITY	0.9300	0.9163	0.0137	0.0001	0.9034	0.9292
CATOOSA COUNTY	0.9008	0.8927	0.0081	0.0000	0.8863	0.8998
CHARLTON COUNTY	0.9168	0.9078	0.0090	0.0000	0.8998	0.9159
CHATAM COUNTY	0.9868	0.9678	0.0190	0.0001	0.9462	0.9860
CHATTOOGA COUNTY	0.9471	0.9333	0.0137	0.0000	0.9227	0.9461
CHEROKEE COUNTY	0.9259	0.9174	0.0085	0.0000	0.9109	0.9248
CHICKAMAUGA CITY	1.0000	0.9474	0.0526	0.0014	0.8980	0.9988

Table A.7: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
CLARKE COUNTY	1.0000	0.9474	0.0526	0.0015	0.8977	0.9987
CLAYTON COUNTY	1.0000	0.9476	0.0524	0.0014	0.8990	0.9988
CLINCH COUNTY	0.9354	0.9192	0.0162	0.0001	0.9037	0.9345
COBB COUNTY	1.0000	0.9474	0.0526	0.0014	0.8989	0.9990
COFFEE COUNTY	0.8996	0.8876	0.0120	0.0000	0.8762	0.8986
COLUMBIA COUNTY	0.9960	0.9797	0.0163	0.0001	0.9644	0.9950
COMMERCE CITY	0.9135	0.9035	0.0100	0.0000	0.8947	0.9125
COOK COUNTY	0.9708	0.9413	0.0295	0.0004	0.9073	0.9697
COWETA COUNTY	0.9818	0.9623	0.0195	0.0001	0.9405	0.9805
CRAWFORD COUNTY	1.0000	0.9515	0.0485	0.0010	0.9162	0.9986
CRISP COUNTY	0.8852	0.8716	0.0136	0.0001	0.8605	0.8842
DADE COUNTY	0.9646	0.9407	0.0239	0.0002	0.9154	0.9633
DALTON COUNTY	0.9458	0.9387	0.0072	0.0000	0.9321	0.9447
DAWSON COUNTY	1.0000	0.9482	0.0518	0.0015	0.8967	0.9991
DECATUR CITY	0.8901	0.8808	0.0093	0.0000	0.8692	0.8893
DECATUR COUNTY	0.8798	0.8643	0.0155	0.0001	0.8524	0.8789
CEKALB COUNTY ⁴⁸	0.9158	0.9002	0.0156	0.0001	0.8823	0.9147
DODGE COUNTY	0.9288	0.9109	0.0179	0.0001	0.8934	0.9278
DOOLY COUNTY	0.9258	0.9146	0.0112	0.0000	0.9069	0.9249
DOUGHERTY COUNTY	0.9014	0.8927	0.0087	0.0000	0.8841	0.9005
DOUGLAS COUNTY	1.0000	0.9484	0.0516	0.0014	0.8973	0.9989
DUBLIN CITY	0.9268	0.9053	0.0215	0.0002	0.8793	0.9255
EARLY COUNTY	0.9627	0.9338	0.0289	0.0003	0.9032	0.9614
ECHOLS COUNTY	1.0000	0.9493	0.0507	0.0014	0.8989	0.9989
EFFINGHAM COUNTY	1.0000	0.9482	0.0518	0.0015	0.8974	0.9989
ELBERT COUNTY	0.9564	0.9342	0.0222	0.0002	0.9076	0.9554
EMANUEL COUNTY	0.9528	0.9276	0.0252	0.0002	0.9015	0.9521
EVANS COUNTY	1.0000	0.9494	0.0506	0.0014	0.8994	0.9991
FANNIN COUNTY	1.0000	0.9676	0.0324	0.0004	0.9394	0.9990
FAYETTE COUNTY	0.9676	0.9519	0.0157	0.0001	0.9380	0.9666
FLOYD COUNTY	0.9083	0.9007	0.0076	0.0001	0.8954	0.9073

Table A.7: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
FORSYTH COUNTY	0.9866	0.9730	0.0135	0.0001	0.9590	0.9855
FRANKLIN COUNTY	1.0000	0.9699	0.0301	0.0004	0.9385	0.9989
FULTON COUNTY	1.0000	0.9462	0.0538	0.0014	0.8975	0.9989
GAINESVILLE CITY	0.9771	0.9654	0.0117	0.0000	0.9553	0.9759
GILMER COUNTY	0.9513	0.9432	0.0081	0.0000	0.9371	0.9501
GLASCOCK COUNTY	1.0000	0.9474	0.0526	0.0015	0.8968	0.9990
GLYNN COUNTY	0.9180	0.9097	0.0083	0.0000	0.9038	0.9169
GORDON COUNTY	0.9595	0.9359	0.0236	0.0002	0.9115	0.9587
GRADY COUNTY	0.8912	0.8778	0.0134	0.0000	0.8671	0.8901
GREENE COUNTY	0.8819	0.8728	0.0091	0.0000	0.8658	0.8810
GWINNETT COUNTY	0.9358	0.9163	0.0195	0.0001	0.8942	0.9348
HABERSHAM COUNTY	0.9464	0.9380	0.0084	0.0000	0.9304	0.9455
HALL COUNTY	0.9160	0.9041	0.0119	0.0000	0.8925	0.9150
HANCOCK COUNTY	1.0000	0.9497	0.0503	0.0015	0.8961	0.9989
HARALSON COUNTY	1.0000	0.9484	0.0516	0.0014	0.8979	0.9990
HARRIS COUNTY	0.9441	0.9332	0.0109	0.0000	0.9251	0.9432
HART COUNTY	0.9290	0.9136	0.0154	0.0001	0.8975	0.9281
HOUSTON COUNTY	0.9722	0.9560	0.0162	0.0001	0.9410	0.9711
IRWIN COUNTY	0.8992	0.8873	0.0119	0.0000	0.8747	0.8983
JACKSON COUNTY	0.9287	0.9127	0.0160	0.0001	0.8938	0.9277
JASPER COUNTY	1.0000	0.9473	0.0527	0.0015	0.8983	0.9986
JEFF DAVIS COUNTY	0.9218	0.9108	0.0110	0.0000	0.9023	0.9210
JEFFERSON CITY	0.9412	0.9107	0.0305	0.0004	0.8768	0.9400
JEFFERSON COUNTY	0.9428	0.9218	0.0210	0.0001	0.8996	0.9418
JENKINS COUNTY	0.924	0.90917	0.0148	0.0001	0.8951	0.9228
JOHNSON COUNTY	1.0000	0.9690	0.0311	0.0003	0.9393	0.9988
JONES COUNTY	0.9672	0.9457	0.0215	0.0001	0.9225	0.9663
LAMAR COUNTY	1.0000	0.9482	0.0518	0.0015	0.8981	0.9991
LANIER COUNTY	1.0000	0.9478	0.0522	0.0014	0.8986	0.9988
LAURENS COUNTY	0.9123	0.8945	0.0178	0.0001	0.8766	0.9114
LEE COUNTY	0.9411	0.9132	0.0279	0.0003	0.8823	0.9402

Table A.7: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
LIBERTY COUNTY	0.9265	0.9125	0.0140	0.0001	0.8987	0.9257
LINCOLN COUNTY	1.0000	0.9652	0.0348	0.0004	0.9457	0.9988
LONG COUNTY	1.0000	0.9487	0.0513	0.0014	0.8987	0.9989
LOWNDES COUNTY	0.9409	0.9281	0.0128	0.0000	0.9169	0.9397
LUMPKIN COUNTY	0.9670	0.9516	0.0154	0.0001	0.9360	0.9662
MACON COUNTY	1.0000	0.9546	0.0454	0.0009	0.9193	0.9990
MADISON COUNTY	0.9263	0.9067	0.0196	0.0001	0.8845	0.9255
MARIETTA CITY1	0.9458	0.9334	0.0124	0.0001	0.9174	0.9448
MARION COUNTY	1.0000	0.9803	0.0197	0.0001	0.9613	0.9988
MCDUFFIE COUNTY	0.9562	0.9434	0.0128	0.0000	0.9315	0.9550
MCINTOSH COUNTY	1.0000	0.9476	0.0524	0.0014	0.8986	0.9989
MERIWETHER COUNTY	0.9462	0.9321	0.0141	0.0001	0.9177	0.9450
MILLER COUNTY	0.9399	0.9142	0.0257	0.0003	0.8846	0.9391
MITCHELL COUNTY	1.0000	0.9469	0.0531	0.0015	0.8967	0.9990
MONROE COUNTY	0.9674	0.9491	0.0183	0.0001	0.9264	0.9666
MONTGOMERY COUNTY	0.9289	0.9104	0.0185	0.0001	0.8885	0.9277
MORGAN COUNTY	0.9275	0.9175	0.0100	0.0000	0.9099	0.9267
MURRAY COUNTY	0.9365	0.9183	0.0182	0.0001	0.9012	0.9356
MUSCOGEE COUNTY	0.9552	0.9463	0.0089	0.0000	0.9408	0.9542
NEWTON COUNTY	0.9497	0.9258	0.0239	0.0002	0.8992	0.9489
OCONEE COUNTY	0.9115	0.8997	0.0118	0.0000	0.8884	0.9102
OGLETHORPE COUNTY	0.9195	0.8997	0.0198	0.0001	0.8821	0.9184
PAULDING COUNTY	1.0000	0.9491	0.0509	0.0015	0.8980	0.9992
PEACH COUNTY	1.0000	0.9835	0.0165	0.0001	0.9746	0.9988
PICKENS COUNTY	0.9189	0.9098	0.0091	0.0000	0.9022	0.9181
PIERCE COUNTY	0.9042	0.8869	0.0173	0.0001	0.8702	0.9033
PIKE COUNTY	1.0000	0.9479	0.0521	0.0015	0.8972	0.9989
POLK COUNTY	0.9481	0.9350	0.0131	0.0000	0.9235	0.9469
PULASKI COUNTY	0.9310	0.9163	0.0147	0.0001	0.9000	0.9299
PUTNAM COUNTY	0.9274	0.9174	0.0010	0.0000	0.9102	0.9265
RABUN COUNTY	0.9065	0.8974	0.0091	0.0000	0.8918	0.9055

Table A.7: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
RANDOLPH COUNTY	0.9462	0.9270	0.0192	0.0001	0.9087	0.9453
RICHMOND COUNTY	0.9469	0.9366	0.0103	0.0000	0.9280	0.9460
ROCKDALE COUNTY	0.9436	0.9278	0.0158	0.0001	0.9090	0.9426
ROME CITY	0.9845	0.9726	0.0119	0.0000	0.9637	0.9833
SCHLEY COUNTY	0.9798	0.9628	0.0170	0.0001	0.9422	0.9787
SCREVEN COUNTY	0.9863	0.9666	0.0197	0.0001	0.9490	0.9854
SEMINOLE COUNTY	0.9327	0.9154	0.0173	0.0001	0.8922	0.9315
SOCIAL CIRCLE CITY	0.9546	0.9362	0.0184	0.0001	0.9083	0.9536
SPALDING COUNTY	0.9346	0.9185	0.0161	0.0001	0.9039	0.9338
STEPHENS COUNTY	0.8992	0.8818	0.0174	0.0001	0.8653	0.8980
STEWART COUNTY	0.9106	0.8931	0.0175	0.0001	0.8715	0.9097
SUMTER COUNTY	0.9634	0.9456	0.0178	0.0001	0.9280	0.9624
TATTNALL COUNTY	0.9558	0.9415	0.0143	0.0001	0.9256	0.9549
TAYLOR COUNTY	0.9229	0.9127	0.0102	0.0000	0.9039	0.9221
TELFAIR COUNTY	0.9182	0.9017	0.0165	0.0001	0.8870	0.9173
THOMAS COUNTY	0.9248	0.9106	0.0142	0.0000	0.8986	0.9238
THOMASTON-UPSON	0.9233	0.9084	0.0149	0.0001	0.8962	0.9223
THOMASVILLE CITY	0.9396	0.9138	0.0258	0.0002	0.8864	0.9384
TIFT COUNTY	0.8936	0.8780	0.0156	0.0001	0.8628	0.8926
TOOMBS COUNTY	0.9685	0.9522	0.0163	0.0001	0.9374	0.9675
TOWNS COUNTY	1.0000	0.9476	0.0524	0.0015	0.8961	0.9991
TREUTLEN COUNTY	1.0000	0.9499	0.0501	0.0015	0.8988	0.9990
TRION CITY	0.9814	0.9633	0.0181	0.0001	0.9460	0.9804
TROUP COUNTY	0.9437	0.9316	0.0121	0.0000	0.9206	0.9428
TURNER COUNTY	0.9016	0.8810	0.0206	0.0001	0.8623	0.9006
TWIGGS COUNTY	0.9799	0.9533	0.0266	0.0003	0.9214	0.9789
UNION COUNTY	0.9110	0.9025	0.0085	0.0000	0.8973	0.9100
VALDOSTA CITY	0.9120	0.8925	0.0195	0.0001	0.8736	0.9112
VIDALIA CITY	1.0000	0.9483	0.0517	0.0014	0.8988	0.9988
WALKER COUNTY	1.0000	0.9476	0.0524	0.0014	0.8988	0.9989
WALTON COUNTY	0.9303	0.9206	0.0097	0.0000	0.9108	0.9293

Table A.7: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
WARE COUNTY	0.9215	0.9086	0.0129	0.0000	0.8958	0.9205
WARREN COUNTY	1.0000	0.9478	0.0522	0.0015	0.8983	0.9989
WASHINGTON COUNTY	0.9379	0.9278	0.0101	0.0000	0.9182	0.9368
WAYNE COUNTY	0.9727	0.9452	0.0275	0.0004	0.9103	0.9720
WHEELER COUNTY	0.9059	0.8900	0.0159	0.0001	0.8721	0.9047
WHITE COUNTY	0.9538	0.9448	0.0090	0.0000	0.9380	0.9528
WHITFIELD COUNTY	0.9036	0.8927	0.0109	0.0000	0.8829	0.9024
WILCOX COUNTY	0.986	0.95876	0.0272	0.0005	0.9182	0.9849
WILKES COUNTY	0.9819	0.9659	0.0160	0.0001	0.9493	0.9809
WILKINSON COUNTY	0.9439	0.9322	0.0117	0.0000	0.9194	0.9430
WORTH COUNTY	0.8838	0.8618	0.0220	0.0002	0.8368	0.8827

Table A.8: Model 3 Bootstrap (SAT Composite)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
APPLING COUNTY	0.7047	0.6434	0.0613	0.0009	0.6147	0.7009
ATKINSON COUNTY	0.6697	0.5974	0.0723	0.0021	0.5533	0.6657
BACON COUNTY	0.7935	0.7392	0.0543	0.0006	0.7106	0.7885
BALDWIN COUNTY	0.7224	0.6485	0.0739	0.0016	0.6122	0.7178
BARROW COUNTY	1.0000	0.7158	0.2842	0.0923	0.6796	0.9936
BARTOW COUNTY	0.9258	0.8523	0.0735	0.0015	0.8061	0.9189
BEN HILL COUNTY	0.7295	0.6622	0.0673	0.0010	0.6350	0.7243
BERRIEN COUNTY	1.0000	0.6959	0.3041	0.1045	0.6708	0.9938
BIBB COUNTY	0.6600	0.5893	0.0707	0.0011	0.5648	0.6553
BLECKLEY COUNTY	1.0000	0.7121	0.2879	0.0869	0.6731	0.9940
BRANTLEY COUNTY	0.6739	0.5712	0.1027	0.0047	0.5289	0.6692
BREMEN CITY	0.7475	0.6423	0.1052	0.0048	0.5944	0.7418
BROOKS COUNTY	0.6265	0.5517	0.0748	0.0021	0.5158	0.6223
BRYAN COUNTY	1.0000	0.7091	0.2909	0.0957	0.6748	0.9948
BUFORD CITY	0.8391	0.7591	0.0800	0.0016	0.7224	0.8335
BULLOCH COUNTY	0.9832	0.8761	0.1071	0.0035	0.8267	0.9770
BURKE COUNTY	0.8947	0.8205	0.0742	0.0010	0.7925	0.8875
BUTTS COUNTY	1.0000	0.7025	0.2975	0.0999	0.6782	0.9936
CALHOUN CITY	0.7461	0.6742	0.0719	0.0018	0.6294	0.7412
CALHOUN COUNTY	1.0000	0.7138	0.2862	0.0800	0.6798	0.9934
CAMDEN COUNTY	0.7135	0.6683	0.0452	0.0004	0.6454	0.7094
CANDLER COUNTY	0.7939	0.6744	0.1195	0.0127	0.6003	0.7897
CARROLL COUNTY	0.7547	0.6897	0.0650	0.0009	0.6651	0.7488
CARROLLTON CITY	0.7832	0.6863	0.0969	0.0038	0.6397	0.7770
CARTERSVILLE CITY	0.7809	0.7039	0.0770	0.0023	0.6634	0.7758
CATOOSA COUNTY	0.7304	0.6736	0.0568	0.0006	0.6520	0.7255
CHARLTON COUNTY	0.6477	0.6053	0.0424	0.0003	0.5858	0.6433
CHATAM COUNTY	0.6800	0.6058	0.0742	0.0021	0.5628	0.6750
CHATTOOGA COUNTY	0.6642	0.6023	0.0619	0.0012	0.5739	0.6594
CHEROKEE COUNTY	0.6797	0.6342	0.0455	0.0003	0.6166	0.6738
CHICKAMAUGA CITY	1.0000	0.6924	0.3076	0.1209	0.6681	0.9933

Table A.8: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
CLARKE COUNTY	1.0000	0.7080	0.2920	0.0887	0.6808	0.9930
CLAYTON COUNTY	1.0000	0.7107	0.2893	0.0820	0.6765	0.9939
CLINCH COUNTY	0.3982	0.3681	0.0301	0.0002	0.3532	0.3956
COBB COUNTY	1.0000	0.7056	0.2944	0.0878	0.6772	0.9926
COFFEE COUNTY	0.6622	0.6096	0.0526	0.0005	0.5877	0.6575
COLUMBIA COUNTY	0.7614	0.6952	0.0662	0.0013	0.6604	0.7559
COMMERCE CITY	0.6115	0.5662	0.0453	0.0004	0.5492	0.6072
COOK COUNTY	0.8756	0.7649	0.1107	0.0056	0.7008	0.8703
COWETA COUNTY	0.9555	0.8599	0.0956	0.0028	0.8132	0.9503
CRAWFORD COUNTY	1.0000	0.8530	0.1470	0.0076	0.8026	0.9937
CRISP COUNTY	0.7075	0.6673	0.0402	0.0002	0.6492	0.7022
DADE COUNTY	0.9321	0.8299	0.1022	0.0036	0.7772	0.9264
DALTON CITY	0.6003	0.5660	0.0343	0.0001	0.5488	0.5946
DAWSON COUNTY	1.0000	0.7079	0.2921	0.0904	0.6757	0.9930
DECATUR CITY	0.6801	0.6308	0.0493	0.0005	0.6058	0.6755
DECATUR COUNTY	0.7889	0.7251	0.0638	0.0007	0.7001	0.7839
DEKALB COUNTY	0.6866	0.6318	0.0548	0.0008	0.6008	0.6814
DODGE COUNTY	0.8510	0.7531	0.0979	0.0045	0.6968	0.8454
DOOLY COUNTY	0.5235	0.4836	0.0399	0.0004	0.4640	0.5200
DOUGHERTY COUNTY	0.8149	0.7358	0.0791	0.0017	0.7008	0.8100
DOUGLAS COUNTY	1.0000	0.7077	0.2923	0.0987	0.6777	0.9927
DUBLIN CITY	1.0000	0.8563	0.1437	0.0073	0.8042	0.9925
EARLY COUNTY	1.0000	0.7964	0.2036	0.0175	0.7610	0.9923
ECHOLS COUNTY	1.0000	0.7088	0.2912	0.0928	0.6748	0.9940
EFFINGHAM COUNTY	1.0000	0.7037	0.2963	0.0914	0.6723	0.9931
ELBERT COUNTY	0.9815	0.8590	0.1225	0.0058	0.8028	0.9750
EMANUEL COUNTY	0.8050	0.7081	0.0969	0.0040	0.6562	0.8009
EVANS COUNTY	1.0000	0.7140	0.2860	0.0827	0.6780	0.9944
FANNIN COUNTY	0.8339	0.7152	0.1187	0.0070	0.6550	0.8277
FAYETTE COUNTY	0.7345	0.6759	0.0586	0.0008	0.6449	0.7281
FLOYD COUNTY	0.7274	0.6801	0.0473	0.0005	0.6557	0.7232

Table A.8: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
FORSYTH COUNTY	0.7333	0.6795	0.0538	0.0007	0.6495	0.7262
FRANKLIN COUNTY	0.7993	0.7017	0.0976	0.0037	0.6536	0.7939
FULTON COUNTY	1.0000	0.7159	0.2848	0.0844	0.6757	0.9936
GAINESVILLE CITY	0.7688	0.7169	0.0519	0.0005	0.6908	0.7627
GILMER COUNTY	0.7471	0.6875	0.0596	0.0009	0.6601	0.7422
GLASCOCK COUNTY	1.0000	0.7049	0.2951	0.1020	0.6696	0.9931
GLYNN COUNTY	0.7864	0.7311	0.0553	0.0006	0.7088	0.7814
GORDON COUNTY	0.8219	0.7195	0.1024	0.0037	0.6750	0.8165
GRADY COUNTY	0.7519	0.6931	0.0588	0.0006	0.6707	0.7469
GREENE COUNTY	0.2588	0.2365	0.0223	0.0001	0.2268	0.2570
GWINNETT COUNTY	0.7827	0.7132	0.0695	0.0018	0.6678	0.7781
HABERSHAM COUNTY	0.5363	0.4871	0.0492	0.0006	0.4669	0.5322
HALL COUNTY	0.7541	0.7093	0.0448	0.0003	0.6879	0.7481
HANCOCK COUNTY	1.0000	0.6996	0.3004	0.1063	0.6749	0.9939
HARALSON COUNTY	1.0000	0.7000	0.2999	0.1042	0.6768	0.9929
HARRIS COUNTY	0.7408	0.6900	0.0508	0.0004	0.6700	0.7356
HART COUNTY	0.5939	0.5365	0.0574	0.0014	0.5037	0.5908
HOUSTON COUNTY	0.9592	0.8835	0.0757	0.0013	0.8446	0.9535
IRWIN COUNTY	0.6687	0.6271	0.0416	0.0003	0.6009	0.6640
JACKSON COUNTY	0.9446	0.8638	0.0808	0.0017	0.8215	0.9373
JASPER COUNTY	1.0000	0.7129	0.2871	0.0851	0.6740	0.9929
JEFF DAVIS COUNTY	0.8329	0.7750	0.0579	0.0006	0.7507	0.8267
JEFFERSON CITY	1.0000	0.7433	0.2567	0.0351	0.7190	0.9931
JEFFERSON COUNTY	0.9233	0.8379	0.0854	0.0018	0.8002	0.9179
JENKINS COUNTY	0.7095	0.6485	0.0610	0.0008	0.6215	0.7041
JOHNSON COUNTY	1.0000	0.7330	0.2669	0.0434	0.7059	0.9940
JONES COUNTY	0.7904	0.7100	0.0804	0.0017	0.6742	0.7843
LAMAR COUNTY	1.0000	0.7049	0.2951	0.0957	0.6750	0.9931
LANIER COUNTY	1.0000	0.7090	0.2910	0.0947	0.6734	0.9926
LAURENS COUNTY	0.7896	0.7051	0.0845	0.0020	0.6690	0.7855
LEE COUNTY	1.0000	0.8151	0.1849	0.0145	0.7664	0.9929

Table A.8: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
LIBERTY COUNTY	0.9890	0.9074	0.0816	0.0015	0.8676	0.9822
LINCOLN COUNTY	0.7517	0.7028	0.0489	0.0005	0.6768	0.7472
LONG COUNTY	1.0000	0.6906	0.3094	0.1216	0.6695	0.9929
LOWNDES COUNTY	0.7746	0.7236	0.0510	0.0004	0.7010	0.7695
LUMPKIN COUNTY	0.8190	0.7643	0.0547	0.0004	0.7407	0.8136
MACON COUNTY	0.6375	0.5510	0.0865	0.0027	0.5150	0.6330
MADISON COUNTY	0.8281	0.7467	0.0814	0.0019	0.7046	0.8229
MARIETTA CITY	0.9929	0.9264	0.0665	0.0014	0.8754	0.9870
MARION COUNTY	0.9544	0.8473	0.1071	0.0039	0.7983	0.9466
MCDUFFIE COUNTY	0.7802	0.7187	0.0615	0.0007	0.6926	0.7738
MCINTOSH COUNTY	1.0000	0.7030	0.2970	0.1012	0.6685	0.9914
MERIWETHER COUNTY	0.5506	0.5129	0.0377	0.0002	0.4967	0.5474
MILLER COUNTY	0.6981	0.6176	0.0805	0.0027	0.5732	0.6934
MITCHELL COUNTY	1.0000	0.7002	0.2998	0.1045	0.6705	0.9926
MONROE COUNTY	0.9070	0.8142	0.0928	0.0030	0.7614	0.9008
MONTGOMERY COUNTY	0.7013	0.6267	0.0746	0.0018	0.5900	0.6975
MORGAN COUNTY	0.5765	0.5305	0.0460	0.0006	0.5053	0.5731
MURRAY COUNTY	0.9095	0.8389	0.0706	0.0010	0.8037	0.9034
MUSCOGEE COUNTY	0.6976	0.6552	0.0424	0.0003	0.6341	0.6928
NEWTON COUNTY	1.0000	0.8000	0.2000	0.0160	0.7657	0.9926
OCONEE COUNTY	0.6214	0.5636	0.0578	0.0009	0.5407	0.6165
OGLETHORPE COUNTY	0.8008	0.7139	0.0869	0.0025	0.6749	0.7958
PAULDING COUNTY	1.0000	0.7013	0.2987	0.1128	0.6695	0.9943
PEACH COUNTY	0.4882	0.4520	0.0362	0.0002	0.4397	0.4848
PICKENS COUNTY	0.6860	0.6356	0.0504	0.0005	0.6134	0.6809
PIERCE COUNTY	0.8231	0.7602	0.0629	0.0008	0.7275	0.8171
PIKE COUNTY	1.0000	0.6973	0.3027	0.0964	0.6726	0.9941
POLK COUNTY	0.7420	0.6855	0.0564	0.0005	0.6636	0.7374
PULASKI COUNTY	0.7116	0.6421	0.0695	0.0015	0.6065	0.7060
PUTNAM COUNTY	0.6679	0.6173	0.0506	0.0005	0.5925	0.6630
RABUN COUNTY	0.5355	0.4986	0.0369	0.0003	0.4794	0.5325

Table A.8: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
RANDOLPH COUNTY	0.7284	0.6563	0.0720	0.0014	0.6225	0.7229
RICHMOND COUNTY	0.8257	0.7738	0.0519	0.0004	0.7493	0.8200
ROCKDALE COUNTY	0.9218	0.8363	0.0855	0.0020	0.7946	0.9164
ROME CITY	1.0000	0.8416	0.1584	0.0067	0.8272	0.9919
SCHLEY COUNTY	0.6457	0.5880	0.0577	0.0011	0.5527	0.6409
SCREVEN COUNTY	0.9389	0.8582	0.0807	0.0014	0.8218	0.9322
SEMINOLE COUNTY	0.7043	0.6314	0.0729	0.0019	0.5893	0.6991
SOCIAL CIRCLE CITY	0.9271	0.7979	0.1292	0.0078	0.7345	0.9205
SPALDING COUNTY	0.7276	0.6702	0.0574	0.0006	0.6464	0.7221
STEPHENS COUNTY	0.5680	0.5349	0.0331	0.0002	0.5138	0.5641
STEWART COUNTY	0.5572	0.5014	0.0558	0.0009	0.4740	0.5521
SUMTER COUNTY	0.7170	0.6561	0.0609	0.0008	0.6282	0.7119
TATTNALL COUNTY	0.6794	0.6189	0.0605	0.0008	0.5926	0.6743
TAYLOR COUNTY	0.7064	0.6536	0.0528	0.0007	0.6272	0.7029
TELFAIR COUNTY	0.8139	0.7487	0.0652	0.0010	0.7166	0.8077
THOMAS COUNTY	0.7886	0.7253	0.0633	0.0008	0.6975	0.7830
THOMASTON-UPSON	0.7882	0.7208	0.0674	0.0010	0.6926	0.7829
THOMASVILLE CITY	0.9512	0.8045	0.1467	0.0095	0.7492	0.9466
TIFT COUNTY	0.8528	0.7631	0.0897	0.0020	0.7289	0.8467
TOOMBS COUNTY	0.9234	0.8642	0.0592	0.0007	0.8313	0.9170
TOWNS COUNTY	1.0000	0.6987	0.3013	0.1009	0.6731	0.9934
TRUETLEN COUNTY	1.0000	0.6999	0.3000	0.0987	0.6711	0.9928
TRION CITY	0.7610	0.6850	0.0760	0.0015	0.6526	0.7567
TROUP COUNTY	0.7227	0.6592	0.0635	0.0010	0.6328	0.7186
TURNER COUNTY	0.7692	0.6795	0.0897	0.0024	0.6419	0.7625
TWIGGS COUNTY	0.5001	0.4312	0.0689	0.0021	0.3966	0.4963
UNION COUNTY	0.5972	0.5537	0.0434	0.0005	0.5301	0.5933
VALDOSTA CITY	1.0000	0.8240	0.1760	0.0094	0.8002	0.9931
VIDALIA CITY	1.0000	0.6994	0.3006	0.1084	0.6718	0.9954
WALKER COUNTY	1.0000	0.7039	0.2961	0.1044	0.6760	0.9921
WALTON COUNTY	0.7105	0.6634	0.0471	0.0004	0.6383	0.7055

Table A.8: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
WARE COUNTY	0.6542	0.6095	0.0447	0.0005	0.5827	0.6500
WARREN COUNTY	1.0000	0.7097	0.2903	0.0899	0.6741	0.9941
WASHINGTON COUNTY	0.9411	0.8761	0.0650	0.0008	0.8449	0.9354
WAYNE COUNTY	0.8610	0.7354	0.1256	0.0062	0.6847	0.8541
WHEELER COUNTY	0.7946	0.7421	0.0525	0.0011	0.6934	0.7913
WHITE COUNTY	0.6457	0.6056	0.0401	0.0002	0.5892	0.6404
WHITFIELD COUNTY	0.8804	0.8096	0.0708	0.0010	0.7780	0.8747
WILCOX COUNTY	1.0000	0.8135	0.1865	0.0178	0.7538	0.9915
WILKES COUNTY	0.9103	0.8310	0.0793	0.0013	0.7965	0.9043
WILKINSON COUNTY	0.8195	0.7555	0.0640	0.0008	0.7286	0.8128
WORTH COUNTY	0.8213	0.7307	0.0906	0.0024	0.6918	0.8149

Table A.9: Model 4 Bootstrap (Graduation Rates)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
APPLING COUNTY	0.9348	0.9248	0.0100	0.0000	0.9138	0.9339
ATKINSON COUNTY	0.9937	0.9723	0.0214	0.0002	0.9471	0.9926
BACON COUNTY	0.9043	0.8952	0.0091	0.0000	0.8856	0.9034
BALDWIN COUNTY	0.8957	0.8788	0.0169	0.0001	0.8599	0.8947
BARROW COUNTY	1.0000	0.9507	0.0493	0.0015	0.8966	0.9992
BARTOW COUNTY	0.9211	0.9007	0.0204	0.0002	0.8741	0.9205
BEN HILL COUNTY	0.9560	0.9418	0.0142	0.0001	0.9254	0.9551
BERRIEN COUNTY	1.0000	0.9501	0.0499	0.0015	0.8921	0.9989
BIBB COUNTY	0.9134	0.8932	0.0201	0.0002	0.8692	0.9126
BLECKLEY COUNTY	1.0000	0.9512	0.0488	0.0015	0.8943	0.9992
BRANTLEY COUNTY	0.9777	0.9515	0.0262	0.0003	0.9199	0.9767
BREMEN CITY	1.0000	0.9684	0.0316	0.0005	0.9327	0.9990
BROOKS COUNTY	0.9306	0.9140	0.0166	0.0001	0.8919	0.9297
BRYAN COUNTY	1.0000	0.9516	0.0484	0.0015	0.8981	0.9992
BUFORD CITY	1.0000	0.9798	0.0202	0.0001	0.9616	0.9989
BULLOCH COUNTY	0.9840	0.9664	0.0174	0.0001	0.9479	0.9830
BURKE COUNTY	0.8712	0.8570	0.0142	0.0001	0.8377	0.8705
BUTTS COUNTY	1.0000	0.9522	0.0478	0.0015	0.8963	0.9992
CALHOUN CITY	0.9948	0.9763	0.0185	0.0001	0.9513	0.9940
CALHOUN COUNTY	1.0000	0.9516	0.0484	0.0015	0.8910	0.9993
CAMDEN COUNTY	0.9160	0.9092	0.0068	0.0001	0.9037	0.9152
CANDLER COUNTY	0.9297	0.9057	0.0240	0.0005	0.8627	0.9290
CARROLL COUNTY	0.9317	0.9175	0.0142	0.0001	0.9041	0.9308
CARROLLTON CITY	0.9718	0.9514	0.0204	0.0001	0.9258	0.9709
CARTERSVILLE CITY	0.9398	0.9221	0.0177	0.0001	0.9016	0.9388
CATOOSA COUNTY	0.8932	0.8838	0.0094	0.0000	0.8731	0.8928
CHARLTON COUNTY	0.9249	0.9119	0.0130	0.0001	0.8994	0.9240
CHATAM COUNTY	0.9448	0.9316	0.0132	0.0001	0.9125	0.9439
CHATTOOGA COUNTY	0.9380	0.9247	0.0133	0.0001	0.9092	0.9373
CHEROKEE COUNTY	0.8990	0.8912	0.0078	0.0000	0.8852	0.8981
CHICKAMAUGA CITY	1.0000	0.9524	0.0476	0.0015	0.8899	0.9989

Table A.9: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
CLARKE COUNTY	1.0000	0.9496	0.0504	0.0015	0.8943	0.9990
CLAYTON COUNTY	1.0000	0.9504	0.0496	0.0015	0.8927	0.9988
CLINCH COUNTY	0.9754	0.9628	0.0126	0.0001	0.9499	0.9745
COBB COUNTY	1.0000	0.9515	0.0485	0.0015	0.8943	0.9992
COFFEE COUNTY	0.9205	0.9082	0.0123	0.0000	0.8956	0.9197
COLUMBIA COUNTY	0.9298	0.9119	0.0179	0.0001	0.8927	0.9291
COMMERCE CITY	0.9405	0.9291	0.0114	0.0000	0.9176	0.9399
COOK COUNTY	0.9553	0.9310	0.0242	0.0003	0.8981	0.9544
COWETA COUNTY	0.9512	0.9345	0.0167	0.0001	0.9149	0.9502
CRAWFORD COUNTY	0.9740	0.9498	0.0242	0.0002	0.9219	0.9730
CRISP COUNTY	0.9214	0.9119	0.0095	0.0000	0.9025	0.9206
DADE COUNTY	1.0000	0.9757	0.0243	0.0002	0.9488	0.9993
DALTON COUNTY	0.9249	0.9186	0.0063	0.0001	0.9122	0.9240
DAWSON COUNTY	1.0000	0.9518	0.0482	0.0015	0.8952	0.9990
DECATUR CITY	0.9442	0.9333	0.0109	0.0000	0.9213	0.9433
DECATUR COUNTY	0.9359	0.9188	0.0171	0.0001	0.8983	0.9350
DEKALB COUNTY	0.9541	0.9389	0.0152	0.0001	0.9172	0.9533
DODGE COUNTY	1.0000	0.9686	0.0314	0.0004	0.9433	0.9990
DOOLY COUNTY	0.8953	0.8856	0.0097	0.0000	0.8740	0.8949
DOUGHERTY COUNTY	0.9148	0.9003	0.0145	0.0001	0.8855	0.9140
DOUGLAS COUNTY	1.0000	0.9514	0.0486	0.0015	0.8955	0.9991
DUBLIN COUNTY	0.9205	0.9040	0.0165	0.0001	0.8862	0.9196
EARLY COUNTY	1.0000	0.9597	0.0403	0.0008	0.9231	0.9990
ECHOLS COUNTY	1.0000	0.9513	0.0487	0.0015	0.8904	0.9991
EFFINGHAM COUNTY	1.0000	0.9517	0.0483	0.0015	0.8903	0.9991
ELBERT COUNTY	0.9501	0.9325	0.0176	0.0001	0.9097	0.9491
EMANUEL COUNTY	1.0000	0.9712	0.0288	0.0004	0.9389	0.9990
EVANS COUNTY	1.0000	0.9520	0.0480	0.0015	0.8921	0.9991
FANNIN COUNTY	1.0000	0.9792	0.0208	0.0001	0.9554	0.9991
FAYETTE COUNTY	0.9554	0.9422	0.0132	0.0001	0.9257	0.9543
FLOYD COUNTY	0.9208	0.9147	0.0061	0.0001	0.9086	0.9199

Table A.9: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
FORSYTH COUNTY	0.9450	0.9334	0.0114	0.0000	0.9210	0.9440
FRANKLIN COUNTY	0.9279	0.9069	0.0210	0.0002	0.8813	0.9269
FULTON COUNTY	1.0000	0.9514	0.0486	0.0015	0.8938	0.9989
GAINESVILLE CITY	0.9846	0.9712	0.0135	0.0001	0.9586	0.9837
GILMER COUNTY	0.9311	0.9228	0.0083	0.0000	0.9149	0.9302
GLASCOCK COUNTY	1.0000	0.9523	0.0477	0.0015	0.8933	0.9991
GLYNN COUNTY	0.8775	0.8690	0.0085	0.0000	0.8606	0.8767
GORDON COUNTY	0.9651	0.9447	0.0204	0.0002	0.9176	0.9641
GRADY COUNTY	0.9483	0.9370	0.0113	0.0001	0.9223	0.9476
GREENE COUNTY	0.9319	0.9211	0.0108	0.0000	0.9090	0.9312
GWINNETT COUNTY	0.9692	0.9518	0.0174	0.0001	0.9296	0.9682
HABERSHAM COUNTY	0.9113	0.8987	0.0126	0.0001	0.8858	0.9106
HALL COUNTY	0.9013	0.8919	0.0094	0.0000	0.8835	0.9005
HANCOCK COUNTY	1.0000	0.9523	0.0477	0.0015	0.8919	0.9992
HARALSON COUNTY	1.0000	0.9506	0.0494	0.0015	0.8940	0.9990
HARRIS COUNTY	0.9217	0.9088	0.0129	0.0001	0.8957	0.9209
HART COUNTY	0.9101	0.8955	0.0146	0.0001	0.8787	0.9094
HOUSTON COUNTY	0.9878	0.9752	0.0126	0.0001	0.9613	0.9871
IRWIN COUNTY	0.9142	0.9053	0.0089	0.0000	0.8954	0.9132
JACKSON COUNTY	0.9316	0.9166	0.0150	0.0001	0.8993	0.9307
JASPER COUNTY	1.0000	0.9522	0.0478	0.0015	0.8947	0.9992
JEFF DAVIS COUNTY	0.9451	0.9341	0.0110	0.0001	0.9219	0.9443
JEFFERSON CITY	0.9966	0.9672	0.0294	0.0004	0.9320	0.9958
JEFFERSON COUNTY	1.0000	0.9607	0.0393	0.0007	0.9291	0.9991
JENKINS COUNTY	0.9418	0.9277	0.0141	0.0001	0.9144	0.9411
JOHNSON COUNTY	0.9942	0.9671	0.0271	0.0003	0.9344	0.9935
JONES COUNTY	0.9261	0.9050	0.0211	0.0002	0.8813	0.9252
LAMAR COUNTY	1.0000	0.9513	0.0487	0.0015	0.8924	0.9991
LANIER COUNTY	1.0000	0.9524	0.0476	0.0015	0.8954	0.9991
LAURENS COUNTY	0.9619	0.9444	0.0175	0.0001	0.9242	0.9610
LEE COUNTY	0.9930	0.9670	0.0260	0.0004	0.9304	0.9921

Table A.9: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
LIBERTY COUNTY	0.9533	0.9382	0.0151	0.0001	0.9238	0.9525
LINCOLN COUNTY	0.9725	0.9586	0.0139	0.0001	0.9434	0.9714
LONG COUNTY	1.0000	0.9508	0.0492	0.0015	0.8933	0.9991
LOWNDES COUNTY	0.9446	0.9324	0.0122	0.0001	0.9177	0.9438
LUMPKIN COUNTY	0.9454	0.9304	0.0150	0.0001	0.9152	0.9445
MACON COUNTY	0.9878	0.9604	0.0274	0.0003	0.9284	0.9870
MADISON COUNTY	0.9463	0.9274	0.0187	0.0001	0.9074	0.9453
MARIETTA CITY	0.9734	0.9617	0.0117	0.0001	0.9467	0.9725
MARION COUNTY	0.9652	0.9467	0.0185	0.0001	0.9275	0.9641
MCDUFFIE COUNTY	0.9516	0.9392	0.0124	0.0000	0.9264	0.9507
MCINTOSH COUNTY	1.0000	0.9515	0.0485	0.0015	0.8959	0.9992
MERIWETHER COUNTY	0.9334	0.9187	0.0147	0.0001	0.9018	0.9326
MILLER COUNTY	1.0000	0.9744	0.0256	0.0003	0.9419	0.9992
MITCHELL COUNTY	1.0000	0.9521	0.0479	0.0015	0.8914	0.9991
MONROE COUNTY	0.9420	0.9260	0.0160	0.0001	0.9013	0.9412
MONTGOMERY COUNTY	0.9743	0.9562	0.0181	0.0001	0.9367	0.9734
MORGAN COUNTY	0.9283	0.9172	0.0111	0.0000	0.9076	0.9276
MURRAY COUNTY	0.8946	0.8807	0.0139	0.0001	0.8646	0.8939
MUSCOGEE COUNTY	0.9203	0.9136	0.0067	0.0000	0.9061	0.9199
NEWTON COUNTY	1.0000	0.9720	0.0280	0.0003	0.9423	0.9992
OCONEE COUNTY	0.9218	0.9102	0.0116	0.0000	0.8992	0.9211
OGLETHORPE COUNTY	0.9338	0.9140	0.0198	0.0001	0.8905	0.9330
PAULDING COUNTY	1.0000	0.9505	0.0495	0.0014	0.8955	0.9991
PEACH COUNTY	0.9155	0.9034	0.0121	0.0001	0.8886	0.9150
PICKENS COUNTY	0.9245	0.9135	0.0110	0.0001	0.8997	0.9238
PIERCE COUNTY	0.9368	0.9239	0.0129	0.0000	0.9111	0.9360
PIKE COUNTY	1.0000	0.9516	0.0484	0.0015	0.8912	0.9990
POLK COUNTY	0.9191	0.9083	0.0108	0.0000	0.8978	0.9183
PULASKI COUNTY	0.9478	0.9314	0.0164	0.0001	0.9115	0.9468
PUTNAM COUNTY	0.9220	0.9135	0.0085	0.0000	0.9067	0.9213
RABUN COUNTY	0.9158	0.9075	0.0083	0.0000	0.8991	0.9155

Table A.9: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
RANDOLF COUNTY	0.9737	0.9552	0.0185	0.0001	0.9352	0.9726
RICHMOND COUNTY	0.9138	0.9027	0.0111	0.0001	0.8865	0.9132
ROCKDALE COUNTY	0.9444	0.9276	0.0169	0.0001	0.9058	0.9436
ROME CITY	0.8652	0.8512	0.0140	0.0001	0.8350	0.8645
SCHLEY COUNTY	0.9668	0.9505	0.0163	0.0001	0.9342	0.9659
SCREVEN COUNTY	1.0000	0.9811	0.0189	0.0001	0.9637	0.9991
SEMINOLE COUNTY	1.0000	0.9729	0.0270	0.0002	0.9472	0.9991
SOCIAL CIRCLE CITY	1.0000	0.9644	0.0356	0.0005	0.9317	0.9990
SPALDING COUNTY	0.8814	0.8640	0.0174	0.0001	0.8466	0.8805
STEPHENS COUNTY	0.9184	0.9073	0.0111	0.0000	0.8966	0.9175
STEWART COUNTY	0.858 0	0.8372	0.0208	0.0002	0.8114	0.8572
SUMTER COUNTY	0.9444	0.9284	0.0160	0.0001	0.9120	0.9434
TATTNALL COUNTY	0.9490	0.9317	0.0173	0.0001	0.9085	0.9483
TAYLOR COUNTY	0.9149	0.9053	0.0096	0.0000	0.8953	0.9139
TELFAIR COUNTY	0.9534	0.9392	0.0142	0.0001	0.9233	0.9524
THOMAS COUNTY	0.9677	0.9494	0.0183	0.0001	0.9279	0.9669
THOMASTON-UPSON	0.9138	0.8978	0.0160	0.0001	0.8786	0.9132
THOMASVILLE CITY	0.9664	0.9432	0.0232	0.0002	0.9148	0.9653
TIFT COUNTY	0.9125	0.8931	0.0194	0.0001	0.8711	0.9118
TOOMBS COUNTY	0.9835	0.9703	0.0132	0.0001	0.9573	0.9826
TOWNS COUNTY	1.0000	0.9523	0.0477	0.0015	0.8966	0.9990
TREUTLEN COUNTY	1.0000	0.9530	0.0470	0.0015	0.8949	0.9991
TRION CITY	1.0000	0.9831	0.0169	0.0001	0.9633	0.9991
TROUP COUNTY	0.9389	0.9276	0.0113	0.0000	0.9171	0.9379
TURNER COUNTY	0.9402	0.9169	0.0233	0.0002	0.8905	0.9392
TWIGGS COUNTY	1.0000	0.9652	0.0348	0.0006	0.9305	0.9991
UNION COUNTY	0.9763	0.9674	0.0089	0.0000	0.9581	0.9755
VALDOSTA CITY	0.9284	0.9121	0.0163	0.0001	0.8920	0.9277
VIDALIA CITY	1.0000	0.9498	0.0502	0.0015	0.8952	0.9991
WALKER COUNTY	1.0000	0.9506	0.0494	0.0015	0.8921	0.9988
WALTON COUNTY	0.9431	0.9333	0.0098	0.0000	0.9236	0.9423

Table A.9: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
WARE COUNTY	0.9137	0.9039	0.0098	0.0000	0.8947	0.9127
WARREN COUNTY	1.0000	0.9517	0.0483	0.0015	0.8957	0.9991
WASHINGTON COUNTY	0.9258	0.9118	0.0140	0.0001	0.8926	0.9252
WAYNE COUNTY	0.9819	0.9572	0.0247	0.0003	0.9225	0.9809
WHEELER COUNTY	0.9060	0.8903	0.0157	0.0001	0.8671	0.9053
WHITE COUNTY	0.9622	0.9528	0.0094	0.0000	0.9457	0.9612
WHITFIELD COUNTY	0.9410	0.9269	0.0141	0.0001	0.9120	0.9402
WILCOX COUNTY	0.9770	0.9515	0.0255	0.0005	0.9111	0.9760
WILKES COUNTY	1.0000	0.9759	0.0241	0.0001	0.9583	0.9991
WILKINSON COUNTY	1.0000	0.9788	0.0212	0.0001	0.9650	0.9991
WORTH COUNTY	0.9347	0.9168	0.0179	0.0001	0.8964	0.9337

Table A.10: Model 5 Bootstrap (All Output Measures)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
APPLING COUNTY	0.9485	0.9397	0.0088	0.0000	0.9286	0.9480
ATKINSON COUNTY	1.0000	0.9876	0.0124	0.0001	0.9711	0.9995
BACON COUNTY	0.9345	0.9255	0.0090	0.0000	0.9124	0.9339
BALDWIN COUNTY	0.9596	0.9516	0.0080	0.0000	0.9408	0.9592
BARROW COUNTY	1.0000	0.9783	0.0217	0.0004	0.9357	0.9995
BARTOW COUNTY	0.9718	0.9622	0.0096	0.0000	0.9481	0.9714
BEN HILL COUNTY	1.0000	0.9885	0.0115	0.0000	0.9769	0.9994
BERRIEN COUNTY	1.0000	0.9786	0.0214	0.0004	0.9356	0.9995
BIBB COUNTY	0.9677	0.9592	0.0085	0.0000	0.9493	0.9671
BLECKLEY COUNTY	1.0000	0.9785	0.0215	0.0004	0.9341	0.9995
BRANTLEY COUNTY	0.9809	0.9689	0.0120	0.0001	0.9500	0.9804
BREMEN CITY	1.0000	0.9839	0.0161	0.0001	0.9594	0.9994
BROOKS COUNTY	0.9365	0.9267	0.0098	0.0000	0.9122	0.9360
BRYAN COUNTY	1.0000	0.9795	0.0205	0.0004	0.9367	0.9996
BUFORD CITY	1.0000	0.9849	0.0151	0.0001	0.9677	0.9995
BULLOCH COUNTY	1.0000	0.9839	0.0161	0.0001	0.9618	0.9996
BURKE COUNTY	0.9723	0.9627	0.0096	0.0000	0.9483	0.9717
BUTTS COUNTY	1.0000	0.9783	0.0217	0.0004	0.9369	0.9994
CALHOUN CITY	0.9950	0.9850	0.0010	0.0001	0.9677	0.9944
CALHOUN COUNTY	1.0000	0.9789	0.0211	0.0004	0.9355	0.9995
CAMDEN COUNTY	0.9511	0.9447	0.0064	0.0000	0.9377	0.9505
CANDLER COUNTY	0.9506	0.9407	0.0099	0.0001	0.9160	0.9501
CARROLL COUNTY	0.9517	0.9442	0.0075	0.0000	0.9371	0.9511
CARROLLTON CITY	1.0000	0.9860	0.0140	0.0001	0.9654	0.9994
CARTERSVILLE CITY	0.9705	0.9612	0.0093	0.0000	0.9501	0.9699
CATOOSA COUNTY	0.9627	0.9555	0.0072	0.0000	0.9468	0.9622
CHARLTON COUNTY	0.9358	0.9263	0.0095	0.0000	0.9132	0.9354
CHATAM COUNTY	0.9514	0.9431	0.0083	0.0000	0.9330	0.9507
CHATTOOGA COUNTY	0.9483	0.9390	0.0093	0.0000	0.9265	0.9477
CHEROKEE COUNTY	0.9482	0.9422	0.0060	0.0001	0.9370	0.9477
CHICKAMAUGA CITY	1.0000	0.9773	0.0227	0.0004	0.9349	0.9995

Table A.10: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
CLARKE COUNTY	1.0000	0.9786	0.0214	0.0004	0.9381	0.9995
CLAYTON COUNTY	1.0000	0.9789	0.0211	0.0004	0.9359	0.9993
CLINCH COUNTY	0.9971	0.9888	0.0083	0.0000	0.9794	0.9966
COBB COUNTY	1.0000	0.9783	0.0217	0.0004	0.9379	0.9994
COFFEE COUNTY	0.9496	0.9418	0.0078	0.0000	0.9337	0.9491
COLUMBIA COUNTY	0.9985	0.9890	0.0095	0.0000	0.9774	0.9979
COMMERCE CITY	0.9744	0.9669	0.0075	0.0000	0.9591	0.9738
COOK COUNTY	0.9824	0.9715	0.0109	0.0001	0.9534	0.9818
COWETA COUNTY	0.9903	0.9798	0.0105	0.0001	0.9630	0.9898
CRAWFORD COUNTY	1.0000	0.9793	0.0207	0.0003	0.9434	0.9994
CRISP COUNTY	0.9819	0.9740	0.0079	0.0000	0.9640	0.9814
DADE COUNTY	1.0000	0.9861	0.0139	0.0001	0.9689	0.9994
DALTON CITY	0.9642	0.9580	0.0062	0.0000	0.9506	0.9637
DAWSON COUNTY	1.0000	0.9785	0.0215	0.0004	0.9352	0.9995
DECATUR CITY	0.9672	0.9598	0.0074	0.0000	0.9529	0.9668
DECATUR COUNTY	0.9569	0.9469	0.0100	0.0001	0.9317	0.9564
DEKALB COUNTY	0.9637	0.9549	0.0088	0.0000	0.9411	0.9632
DODGE COUNTY	1.0000	0.9797	0.0203	0.0003	0.9482	0.9994
DOOLY COUNTY	0.9712	0.9646	0.0066	0.0000	0.9580	0.9707
DOUGHERTY COUNTY	0.9935	0.9857	0.0078	0.0000	0.9778	0.9930
DOUGLAS COUNTY	1.0000	0.9780	0.0220	0.0004	0.9354	0.9995
DUBLIN CITY	1.0000	0.9794	0.0206	0.0003	0.9448	0.9995
EARLY COUNTY	1.0000	0.9783	0.0217	0.0004	0.9362	0.9994
ECHOLS COUNTY	1.0000	0.9785	0.0215	0.0004	0.9373	0.9994
EFFINGHAM COUNTY	1.0000	0.9789	0.0211	0.0004	0.9372	0.9994
ELBERT COUNTY	0.9815	0.9696	0.0119	0.0001	0.9510	0.9810
EMANUEL COUNTY	1.0000	0.9844	0.0156	0.0001	0.9607	0.9994
EVANS COUNTY	1.0000	0.9786	0.0214	0.0004	0.9373	0.9995
FANNIN COUNTY	1.0000	0.9854	0.0146	0.0001	0.9644	0.9995
FAYETTE COUNTY	0.9909	0.9828	0.0081	0.0000	0.9745	0.9903
FLOYD COUNTY	0.9754	0.9680	0.0074	0.0000	0.9599	0.9749

Table A.10: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
FORSYTH COUNTY	0.9782	0.9693	0.0089	0.0000	0.9550	0.9777
FRANKLIN COUNTY	0.9684	0.9580	0.0104	0.0000	0.9420	0.9680
FULTON COUNTY	1.0000	0.9784	0.0216	0.0004	0.9358	0.9994
GAINESVILLE CITY	0.9909	0.9822	0.0087	0.0000	0.9731	0.9903
GILMER COUNTY	0.9558	0.9482	0.0076	0.0000	0.9392	0.9553
GLASCOCK COUNTY	1.0000	0.9783	0.0217	0.0004	0.9361	0.9995
GLYNN COUNTY	0.9564	0.9492	0.0072	0.0000	0.9420	0.9558
GORDON COUNTY	0.9779	0.9677	0.0102	0.0000	0.9550	0.9774
GRADY COUNTY	0.999	0.99150	0.0075	0.0000	0.9840	0.9984
GREENE COUNTY	0.9319	0.9225	0.0094	0.0001	0.9025	0.9314
GWINNETT COUNTY	0.9693	0.9591	0.0102	0.0001	0.9411	0.9687
HABERSHAM COUNTY	0.9869	0.9792	0.0077	0.0000	0.9704	0.9864
HALL COUNTY	0.9331	0.9269	0.0062	0.0000	0.9206	0.9326
HANCOCK COUNTY	1.0000	0.9787	0.0213	0.0004	0.9343	0.9994
HARALSON COUNTY	1.0000	0.9790	0.0210	0.0004	0.9366	0.9995
HARRIS COUNTY	0.9666	0.9604	0.0062	0.0001	0.9552	0.9662
HART COUNTY	0.9226	0.9136	0.0090	0.0000	0.8982	0.9221
HOUSTON COUNTY	1.0000	0.9843	0.0157	0.0001	0.9671	0.9994
IRWIN COUNTY	0.9735	0.9666	0.0069	0.0000	0.9598	0.9730
JACKSON COUNTY	0.9696	0.9601	0.0095	0.0000	0.9475	0.9691
JASPER COUNTY	1.0000	0.9788	0.0211	0.0004	0.9369	0.9995
JEFF DAVIS COUNTY	0.9862	0.9778	0.0084	0.0000	0.9682	0.9856
JEFFERSON CITY	1.0000	0.9775	0.0225	0.0004	0.9352	0.9994
JEFFERSON COUNTY	1.0000	0.9789	0.0211	0.0003	0.9372	0.9992
JENKINS COUNTY	0.9869	0.9781	0.0088	0.0000	0.9686	0.9864
JOHNSON COUNTY	1.0000	0.9791	0.0209	0.0004	0.9365	0.9995
JONES COUNTY	0.9616	0.9510	0.0106	0.0001	0.9365	0.9610
LAMAR COUNTY	1.0000	0.9788	0.0212	0.0004	0.9370	0.9994
LANIER COUNTY	1.0000	0.9783	0.0217	0.0004	0.9373	0.9995
LAURENS COUNTY	0.9840	0.9751	0.0089	0.0000	0.9650	0.9836
LEE COUNTY	1.0000	0.9797	0.0203	0.0004	0.9365	0.9995

Table A.10: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
LIBERTY COUNTY	1.0000	0.9890	0.0110	0.0001	0.9703	0.9995
LINCOLN COUNTY	0.9865	0.9772	0.0093	0.0000	0.9639	0.9859
LONG COUNTY	1.0000	0.9788	0.0212	0.0004	0.9380	0.9996
LOWNDES COUNTY	0.9845	0.9773	0.0072	0.0000	0.9695	0.9840
LUMPKIN COUNTY	0.9720	0.9636	0.0084	0.0000	0.9554	0.9715
MACON COUNTY	1.0000	0.9783	0.0217	0.0004	0.9367	0.9995
MADISON COUNTY	0.9620	0.9528	0.0092	0.0000	0.9401	0.9615
MARIETTA CITY	1.0000	0.9847	0.0153	0.0001	0.9644	0.9994
MARION COUNTY	1.0000	0.9820	0.0180	0.0002	0.9557	0.9994
MCDUFFIE COUNTY	0.9818	0.9736	0.0082	0.0000	0.9650	0.9813
MCINTOSH COUNTY	1.0000	0.9782	0.0218	0.0004	0.9355	0.9995
MERIWETHER COUNTY	0.9566	0.9475	0.0091	0.0000	0.9372	0.9561
MILLER COUNTY	1.0000	0.9861	0.0139	0.0001	0.9656	0.9995
MITCHELL COUNTY	1.0000	0.9783	0.0217	0.0004	0.9360	0.9994
MONROE COUNTY	0.9801	0.9701	0.0100	0.0000	0.9550	0.9795
MONTGOMERY COUNTY	1.0000	0.9880	0.0120	0.0001	0.9743	0.9993
MORGAN COUNTY	0.9434	0.9354	0.0080	0.0000	0.9252	0.9429
MURRAY COUNTY	0.9751	0.9663	0.0088	0.0000	0.9548	0.9746
MUSCOGEE COUNTY	0.9574	0.9498	0.0076	0.0000	0.9409	0.9569
NEWTON COUNTY	1.0000	0.9794	0.0206	0.0004	0.9371	0.9995
OCONEE COUNTY	0.9797	0.9733	0.0064	0.0001	0.9676	0.9790
OGLETHORPE COUNTY	0.9897	0.9799	0.0098	0.0000	0.9662	0.9892
PAULDING COUNTY	1.0000	0.9778	0.0222	0.0004	0.9360	0.9994
PEACH COUNTY	0.9706	0.9635	0.0071	0.0000	0.9569	0.9701
PICKENS COUNTY	0.9557	0.9483	0.0074	0.0000	0.9406	0.9553
PIERCE COUNTY	0.9752	0.9662	0.0090	0.0000	0.9554	0.9748
PIKE COUNTY	1.0000	0.9784	0.0216	0.0004	0.9362	0.9994
POLK COUNTY	0.9898	0.9808	0.0090	0.0000	0.9707	0.9893
PULASKI COUNTY	0.9793	0.9696	0.0097	0.0000	0.9592	0.9788
PUTNAM COUNTY	0.9285	0.9203	0.0082	0.0000	0.9117	0.9280
RABUN COUNTY	0.9682	0.9621	0.0061	0.0001	0.9578	0.9677

Table A.10: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
RANDOLPH COUNTY	0.9787	0.9681	0.0106	0.0000	0.9546	0.9781
RICHMOND COUNTY	0.9542	0.9456	0.0086	0.0000	0.9344	0.9538
ROCKDALE COUNTY	0.9913	0.9813	0.0100	0.0000	0.9666	0.9908
ROME CITY	1.0000	0.9787	0.0213	0.0004	0.9370	0.9994
SCHLEY COUNTY	0.9995	0.9912	0.0083	0.0000	0.9779	0.9990
SCREVEN COUNTY	1.0000	0.9816	0.0184	0.0002	0.9576	0.9994
SEMINOLE COUNTY	1.0000	0.9841	0.0159	0.0001	0.9611	0.9995
SOCIAL CIRCLE CITY	1.0000	0.9810	0.0190	0.0002	0.9505	0.9995
SPALDING COUNTY	0.9450	0.9378	0.0072	0.0000	0.9299	0.9446
STEPHENS COUNTY	0.9442	0.9371	0.0071	0.0000	0.9277	0.9438
STEWART COUNTY	0.8891	0.8798	0.0093	0.0000	0.8679	0.8887
SUMTER COUNTY	0.9786	0.9699	0.0087	0.0000	0.9601	0.9781
TATTNALL COUNTY	0.9614	0.9516	0.0098	0.0000	0.9365	0.9608
TAYLOR COUNTY	0.9559	0.9488	0.0071	0.0000	0.9419	0.9553
TELFAIR COUNTY	0.9776	0.9683	0.0093	0.0000	0.9579	0.9770
THOMAS COUNTY	0.9918	0.9817	0.0101	0.0000	0.9703	0.9914
THOMASTON-UPSON	0.9661	0.9595	0.0066	0.0000	0.9520	0.9656
THOMASVILLE CITY	0.9925	0.9807	0.0118	0.0001	0.9605	0.9919
TIFT COUNTY	0.9929	0.9825	0.0104	0.0000	0.9693	0.9924
TOOMBS COUNTY	1.0000	0.9885	0.0115	0.0001	0.9738	0.9996
TOWNS COUNTY	1.0000	0.9788	0.0212	0.0004	0.9363	0.9994
TREUTLEN COUNTY	1.0000	0.9787	0.0213	0.0004	0.9377	0.9994
TRION CITY	1.0000	0.9838	0.0162	0.0001	0.9661	0.9994
TROUP COUNTY	0.9769	0.9695	0.0074	0.0000	0.9627	0.9764
TURNER COUNTY	0.9900	0.9796	0.0104	0.0000	0.9662	0.9894
TWIGGS COUNTY	1.0000	0.9825	0.0175	0.0001	0.9571	0.9994
UNION COUNTY	0.9927	0.9855	0.0072	0.0000	0.9761	0.9922
VALDOSTA CITY	1.0000	0.9778	0.0222	0.0004	0.9356	0.9995
VIDALIA CITY	1.0000	0.9789	0.0211	0.0004	0.9368	0.9995
WALKER COUNTY	1.0000	0.9789	0.0211	0.0004	0.9339	0.9995
WALTON COUNTY	0.9556	0.9492	0.0064	0.0000	0.9428	0.9550

Table A.10: (continued)

District	Efficiency Score	Eff. Bias-Corrected	$\widehat{BIAS}$	$\hat{\sigma}$	Lower Bound	Upper Bound
WARE COUNTY	0.9506	0.9436	0.0070	0.0000	0.9371	0.9501
WARREN COUNTY	1.0000	0.9782	0.0218	0.0004	0.9360	0.9995
WASHINGTON COUNTY	1.0000	0.9902	0.0098	0.0000	0.9765	0.9994
WAYNE COUNTY	1.0000	0.9812	0.0188	0.0002	0.9523	0.9995
WHEELER COUNTY	0.9329	0.9228	0.0101	0.0001	0.9052	0.9325
WHITE COUNTY	0.9753	0.9677	0.0076	0.0000	0.9590	0.9747
WHITFIELD COUNTY	0.9674	0.9592	0.0082	0.0000	0.9488	0.9669
WILCOX COUNTY	1.0000	0.9772	0.0228	0.0004	0.9351	0.9993
WILKES COUNTY	1.0000	0.9799	0.0201	0.0003	0.9456	0.9994
WILKINSON COUNTY	1.0000	0.9827	0.0173	0.0001	0.9594	0.9993
WORTH COUNTY	0.9723	0.9632	0.0091	0.0000	0.9524	0.9718

Table A.11: Model 1 Bottom 25 Bootstrap vs. Original DEA Results

District	Eff. Bias Corrected	Original Eff. Score	Original Ranking	Lower Bound	Upper Bound
142. GILMER COUNTY	0.9182	0.9233	147	0.9140	0.9225
143. THOMASVILLE CITY	0.9174	0.9366	138	0.8959	0.9357
144. TWIGGS COUNTY	0.9170	0.9376	135	0.8914	0.9367
145. PICKENS COUNTY	0.9151	0.9228	149	0.9099	0.9218
146. CHATHAM COUNTY	0.9141	0.9325	141	0.8966	0.9316
147. RICHMOND COUNTY	0.9133	0.9198	152	0.9081	0.9189
148. BROOKS COUNTY	0.9124	0.9260	145	0.8959	0.9252
149. VALDOSTA CITY	0.9124	0.9310	142	0.8893	0.9300
150. WHITFIELD COUNTY	0.9109	0.9260	146	0.8988	0.9249
151. WALTON COUNTY	0.9106	0.9219	150	0.8994	0.9210
152. DEKALB COUNTY	0.9102	0.9205	151	0.8976	0.9197
153. BACON COUNTY	0.9071	0.9154	155	0.9001	0.9145
154. HALL COUNTY	0.9056	0.9155	154	0.8977	0.9145
155. CHATTOOGA COUNTY	0.9034	0.9143	157	0.8954	0.9133
156. DADE COUNTY	0.9013	0.9194	153	0.8809	0.9186
157. CARROLL COUNTY	0.9012	0.9153	156	0.8901	0.9143
158. TATTNALL COUNTY	0.8929	0.9040	160	0.8826	0.9032
159. WHEELER COUNTY	0.8917	0.9002	161	0.8805	0.8994
160. MILLER COUNTY	0.8916	0.9119	158	0.8664	0.9109
161. HART COUNTY	0.8907	0.9043	159	0.8774	0.9033
162. CHARLTON COUNTY	0.8883	0.8963	162	0.8827	0.8955
163. PUTNAM COUNTY	0.8853	0.8941	163	0.8785	0.8932
164. DECATUR COUNTY	0.8793	0.8918	164	0.8702	0.8910
165. STEWART COUNTY	0.8696	0.8856	165	0.8539	0.8848
166. GREENE COUNTY	0.8416	0.8498	166	0.8362	0.8487

Table B.1: Transition Matrix of Contemporaneous Trough Estimates Using Different Reference Majors

	Biology	Business	Education	Engineering	English	Fine Arts	Health	History	Humanities	Math	Phys Sci	Social Sci	Tech
Biology	.	3.54***	0.94	1.86*	2.74**	2.10*	1.43	2.84***	4.70***	2.34	3.32***	2.95***	0.36***
Business	0.28***	.	0.27***	0.53**	0.78	0.59	0.40	0.80	1.33	0.66	0.94	0.84	0.10***
Education	1.06	3.74***	.	1.97*	2.90**	2.22**	1.52	3.01***	4.98***	2.47	3.51***	3.13	0.39**
Engineering	0.54*	1.90**	0.51**	.	1.48	1.13	0.77	1.53	2.53**	1.26	1.78	1.59	0.20***
English	0.36**	1.29	0.34**	0.68	.	0.76	0.52	1.04	1.72	0.85	1.21	1.08	0.13***
Fine Arts	0.48*	1.69	0.45**	0.89	1.31	.	0.68	1.36	2.24*	1.11	1.58	1.41	0.17***
Health	0.70	2.47***	0.66	1.30	1.92	1.46	.	1.98**	3.28***	1.63	2.31*	2.07**	0.25***
History	0.35***	1.24	0.33**	0.65	0.97	0.74	0.50**	.	1.66	0.82	1.17	1.04	0.13***
Humanities	0.21***	0.75	0.20***	0.40**	0.58	0.45*	0.30***	0.60	.	0.50	0.70	0.63	0.08***
Math	0.43	1.51	0.40	0.80	1.17	0.90	0.61	1.22	2.01	.	1.42	1.27	0.16***
Phys Sci	0.30***	1.07	0.29***	0.56	0.83	0.63	0.43*	0.86	1.42	0.70	.	0.89	0.11***
Social Sci	0.32***	1.20	0.32***	0.63	0.93	0.71	0.48**	0.96	1.59	0.79	1.12	.	0.12***
Technology	2.75***	9.71***	2.60**	5.10***	7.53***	5.76***	3.93***	7.80***	12.92***	6.41***	9.10***	8.12***	.

Notes: The column headings are the reference majors and the row headings are the majors of interest. These estimates are using a 20 percent sample of the data.

Table B.2: Multinomial Logit Relative Risk Ratios for 20 Percent Sample of Students

	Biology	Business	Education	Engineering	Fine Arts	Health
Trough _t	2.74** (1.28)	0.76 (0.34)	2.90** (1.41)	1.48 (0.70)	1.31 (0.67)	1.91 (0.87)
Trough _{t-1}	1.73*** (0.38)	1.15 (0.24)	1.45*** (.34)	1.14 (0.26)	1.10*** (0.27)	1.15*** (0.25)
Trough _{t-2}	0.88 (0.23)	0.83 (0.20)	0.47*** (0.13)	0.72 (0.19)	0.62* (0.18)	0.83*** (0.21)
Trough _{t-3}	2.35** (0.86)	0.70 (0.24)	1.61 (0.61)	1.28 (0.47)	1.23*** (0.43)	1.86* (0.66)
Trough _{t-4}	1.74* (0.56)	0.67 (0.20)	1.74* (0.58)	1.25 (0.40)	1.23*** (0.43)	1.76* (0.55)
High Unemp _t	1.06 (0.06)	1.11** (0.06)	1.07 (0.06)	1.09* (0.06)	0.97*** (0.06)	1.11** (0.06)
High Unemp _{t-1}	1.03 (0.06)	1.02 (0.06)	1.09 (0.07)	1.08 (0.06)	0.99*** (0.07)	1.03 (0.06)
High Unemp _{t-2}	1.04 (0.06)	1.05 (0.06)	1.02 (0.06)	1.09 (0.06)	0.99 (0.06)	1.05 (0.06)
High Unemp _{t-3}	0.94 (0.05)	0.99 (0.05)	1.02 (0.06)	1.00*** (0.05)	1.02*** (0.06)	1.03 (0.05)
High Unemp _{t-4}	1.01 (0.04)	0.99 (0.04)	0.99 (0.05)	1.02 (0.05)	0.92*** ()	1.04 (0.04)
Neg. PI Growth _t	0.98 (0.04)	0.95 (0.03)	1.03 (0.04)	0.93** ()	1.04*** (0.04)	1.00 (0.04)
Neg. PI Growth _{t-1}	1.05 (0.04)	0.99 (0.04)	1.06 (0.04)	1.01*** (0.04)	1.02*** (0.04)	1.00 (0.04)
Neg. PI Growth _{t-2}	1.05 (0.04)	1.02 (0.04)	1.07* (0.04)	0.98 (0.04)	1.08*** (0.04)	1.06 (0.04)
Neg. PI Growth _{t-3}	1.06 (0.04)	1.03 (0.04)	1.08** (0.04)	1.03 (0.04)	1.10** (0.)	1.06*** (0.04)
Neg. PI Growth _{t-4}	1.06 (0.04)	1.03 (0.04)	1.07 (0.05)	0.97 (0.97)	1.08* (0.05)	0.99 (0.04)
Male	1.40*** (0.03)	2.53*** (0.05)	0.68*** (0.02)	8.09*** (0.19)	1.64*** (0.04)	0.94*** (0.02)
American Indian	0.73 (0.06)	0.56*** (0.05)	0.64*** (0.06)	0.64*** (0.06)	0.98 (0.09)	0.69*** (0.06)
Asian	2.81*** (0.13)	2.21*** (0.10)	0.75*** (0.05)	2.83*** (0.13)	1.53*** ()	2.96*** (0.13)
Pacific Islander	0.60** (0.13)	0.66* (0.15)	0.78 (0.21)	0.54*** (0.13)	0.71*** (0.18)	0.81 (0.18)
Black	1.67 (0.08)	1.93*** (0.09)	0.94 (0.05)	1.83*** (0.09)	1.12*** (0.06)	1.80*** (0.09)
Mexican	1.10 (0.08)	1.17** (0.08)	0.94 (0.08)	1.06 (0.08)	0.85* (0.08)	1.19*** (0.09)
Puerto Rican	1.23* (0.15)	1.20 (0.15)	1.06 (0.14)	1.04 (0.13)	1.04 (0.14)	1.34*** (0.16)
Other Latino	1.52*** (0.14)	1.82*** (0.17)	0.80** (0.09)	1.52 (0.15)	1.36*** (0.15)	1.42*** (0.13)
Other	1.35*** (0.09)	1.08 (0.07)	0.75*** (0.06)	1.20*** (0.08)	1.16** (0.08)	1.20*** (0.08)
Family Income	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)
Age	0.88*** (0.02)	1.01 (0.02)	1.03 (0.02)	0.91*** (0.02)	0.98 (0.02)	0.94*** (0.02)
Constant	8.07 (26.45)	6.80 (21.06)	1773.3** 6061.42	31.40 (104.25)	15.64 (56.41)	2642.20*** (8457.31)
CPS Data	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	419,925	419,925	419,925	419,925	419,925	419,925

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Standard errors in parentheses.

20 percent sample using English as the reference major.

Table B.3: Multinomial Logit Relative Risk Ratios for 20 Percent Sample of Students

	History	Humanities	Math	Phys. Sci	Social Sci	Technology
Trough _t	0.97 (0.46)	0.58 (0.32)	1.17 (0.89)	0.83 (0.47)	0.93 (0.43)	7.53*** (4.06)
Trough _{t-1}	0.085 (0.19)	1.86** (0.48)	1.49*** (0.53)	0.79*** (0.21)	1.15*** (0.26)	5.14*** (1.31)
Trough _{t-2}	0.79 (0.21)	1.37 (0.18)	0.69*** (0.28)	0.83*** (0.26)	0.88 (0.23)	0.80 (0.45)
Trough _{t-3}	0.87 (0.32)	0.50 (0.21)	1.09*** (0.65)	0.91*** (0.41)	0.90 (0.33)	3.06*** (1.29)
Trough _{t-4}	0.84 (0.27)	0.56 (0.21)	1.39*** (0.71)	0.91 (0.35)	0.81 (0.26)	2.23** (0.83)
High Unemp _t	1.02 (0.06)	1.04 (0.06)	1.04 (0.08)	0.97*** (0.06)	1.06 (0.06)	1.22*** (0.07)
High Unemp _{t-1}	1.05 (0.06)	1.04 (0.07)	0.93 (0.08)	0.98*** (0.07)	0.96 (0.06)	1.07 (0.07)
High Unemp _{t-2}	1.04 (0.06)	1.01 (0.07)	1.02*** (0.09)	1.01 (0.07)	1.05 (0.06)	1.10*** (0.07)
High Unemp _{t-3}	0.95 (0.05)	1.02 (0.06)	0.98 (0.08)	0.94 (0.06)	1.00 (0.05)	0.91*** (0.05)
High Unemp _{t-4}	0.99 (0.04)	1.04* (0.05)	1.01 (0.07)	1.06 (0.06)	1.00 (0.04)	0.97*** (0.05)
Neg. PI Growth _t	0.96 (0.04)	1.04 (0.04)	0.93 (0.05)	1.03 (0.06)	1.02 (0.04)	0.91** (0.04)
Neg. PI Growth _{t-1}	0.98 (0.04)	1.05 (0.05)	1.03 (0.06)	1.00 (0.04)	1.06 (0.04)	0.97 (0.04)
Neg. PI Growth _{t-2}	1.01 (0.04)	1.03** (0.05)	0.98 (0.06)	1.09*** (0.05)	1.05 (0.04)	0.97 (0.04)
Neg. PI Growth _{t-3}	1.04 (0.04)	1.14*** (0.05)	1.15** (0.07)	1.13 (0.05)	1.09** (0.04)	1.05 (0.05)
Neg. PI Growth _{t-4}	1.00 (0.04)	0.98* (0.05)	1.05 ()	1.15 (0.05)	1.06 (0.04)	1.00 (0.05)
Male	1.81*** (0.04)	1.15*** (0.03)	2.00*** (0.07)	3.13 (0.08)	0.85*** (0.02)	4.37*** (0.11)
American Indian	0.78*** (0.07)	1.13 (0.11)	0.53*** (0.09)	0.89 (0.09)	0.71*** (0.06)	0.71*** (0.07)
Asian	1.18*** (0.06)	0.91 (0.05)	1.53*** (0.11)	1.61*** (0.09)	1.60*** (0.08)	3.46*** (0.18)
Pacific Islander	0.86 (0.20)	0.73 (0.20)	0.48*** (0.21)	0.57** (0.17)	0.56** (0.13)	0.50*** (0.14)
Black	1.48*** (0.07)	1.03 (0.06)	1.05*** (0.08)	1.01*** (0.06)	1.76*** (0.09)	2.48*** (0.13)
Mexican	1.21*** (0.09)	0.95 (0.08)	0.97*** (0.12)	0.86*** (0.08)	1.38*** (0.10)	1.01*** (0.09)
Puerto Rican	1.20 (0.15)	1.14 (0.16)	0.80 (0.17)	0.90 (0.14)	1.40*** (0.17)	1.12*** (0.16)
Other Latino	1.54*** (0.15)	1.29*** (0.14)	0.99 (0.16)	0.92 (0.11)	1.62*** (0.15)	1.51*** (0.17)
Other	1.12* (0.08)	1.26*** (0.09)	1.00 (0.11)	1.03*** (0.08)	1.24*** (0.08)	1.24*** (0.09)
Family Income	1.00** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00** (0.00)	1.00*** (0.00)
Age	0.97 (0.02)	0.99 (0.02)	0.80*** (0.03)	0.87*** (0.02)	1.03 (0.02)	0.93*** (0.02)
Constant	78.36 (264.82)	0.00*** (0.00)	6.64 (34.92)	4.37 (17.29)	0.65 (2.13)	0.56 (2.16)
CPS Data	Yes	Yes	Yes	Yes	Yes	Yes
Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs						

Notes: * $p < 0.10$, ** $p < 0.05$ level, *** $p < 0.01$ level.

Standard errors in parentheses.

20 percent sample using English as the reference major.