Identifying Student Success at a Land Grant Institution

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Abstract

Many higher education institutions use admission criteria to match students with the educational requirements of the institution, thereby increasing the level of success of their students and allocating limited enrollment space in some cases. This study uses two different approaches to identify the affect students' background characteristics have on first year cumulative GPA, and whether differences exist in the impact of high school grades on success in their first year in college between high schools in the state of Washington. Results show that students' particular high schools systematically perform better or worse than the model predicts, holding the other characteristics of the students constant including their high school GPA. This suggests the same GPA from different schools is indicating different levels of preparedness, either reflecting different curriculum available or taken by a student, or grade inflations differences across schools.

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Introduction

Retention and eventual success of their students is a priority of most higher education institutions. In recent years post-secondary schools and others representing student interests have been analyzing retention rates, and the causes of students dropping out of these schools. In most cases, when a college student enrolls their first semester this is their first time living away from home. Numerous students entering college are not aware of the demands of higher education. Many factors may simultaneously determine whether a student will stay in college and eventually graduate. This paper studies the effects of individual student background factors and high school characteristics on the first year cumulative grade point average at WSU.

The individual background characteristics that may factor into the student's decision to stay in college includes characteristics such as sex, race, if the student is an athlete, and the financial status of the student's parents. Measures of a student's performance in high school such as high school grade point average (HSGPA) and the decision to enroll in an Advanced Placement (AP) course may also affect student success in college. AP courses are approved college level courses taught at high schools. Another individual characteristic is the student's score on the Scholastic Aptitude Test (SAT) or American College Testing (ACT) exam. WSU requires domestic high school students to take the SAT or ACT exam and uses the score along with other measures to determine admittance. Each of these individual background characteristics may help predict college performance.

Student success in college partially depends upon their high school experience. The state of Washington requires that each high school student pass specific classes

within different fields in order to graduate (Washington State Board of Education). Some flexibility exists in some fields where the student can choose classes from a list. Each student is exposed to some degree to a minimum level of English, science, math, history, etc. Some students may choose more courses in one field which may be beneficial to their major in college, but all high school graduates must meet the minimum requirements enforced by the state to be admitted to a four year institution in the state. In the field requirement courses the grading standards may vary in schools across the state. In addition to the field requirements, the Washington State Board of Education (SBE) authorizes local school districts to establish additional graduation requirements (Washington SBE, 2009). The additional graduation requirements that local school districts implement may better prepare the student for college.

Besides graduation requirements, state expenditures vary between Washington school districts. From the 2003-04 to 2007-08 school years, the Office of the Superintendent of Public Instruction (OSPI) reports that the annual expenditure per student ranges between $6,147 and 26,634 per student (OSPI Report, 2009). The OSPI data also indicates in the state of Washington that the teachers' average years of experience at a high school ranges from 0 to 23 years, and the percent of teachers with at least a master's degree in a high school ranges from 0 to 100 percent. In the state of Washington private high schools tend to have lower enrollment rates, and lower teacher to student ratio. On average the private high school enrollment rate is 726 students and the teacher to student ratio is 16. On the other hand the average public high school enrollment rate is 1394 and the teacher to student ratio is 19. These differences across

high schools in the state of Washington leads to questions about whether students from particular high schools are better prepared for college.

Currently, university admission websites indicate that high school GPA and the college entrance exam are the leading factors for acceptance into their school. College entrance exams, like SAT and ACT, were developed to provide consistent measures of performance in the exam across students from different high schools. The exam problems do not vary across students at different high schools. Hence, the scores on the exam are more easily compared across students (relative to HSGPA) and it is generally assumed that students with the higher college entrance exam scores are more likely to stay in school and succeed. Use of standardized test scores as the major criterion for college admission is not without controversy (Murtaugh et al. 1999, Ostrowsky 1999, Cohn et al. 2004, and Geiser and Santelices 2007). The vast amount of research on college student retention suggests that consideration be given to additional characteristics in order to predict an individual student's success.

This study identifies the effect students' background characteristics have on first year cumulative GPA, and whether differences exist in the impact of high school grades on success in their first year in college between high schools in the state of Washington. To accomplish this task college students are separated into two groups based upon whether the student attended a public or a private high school. Separating students into two groups enables testing whether background characteristics are different for students coming from public and private high schools. For each student information is gathered about their personal and high school characteristics. A model is estimated and students who did a lot better and worse than expected (as predicted by the model) are grouped

together by high school. The first model examines the hypothesis that there are differences across schools in the ability of the model to predict first year success. Therefore, a second model includes a variable to specifically address whether the effects of school was linked to high school GPA. These results will identify the effect of background characteristics on student success and determine whether the effect of high school GPA is consistent across the state of Washington.

Literature Review

Determining student success in college is a topic researched by many. Langbein et al. (1999), Mitchell et al. (1999), and Reason (2003) find that a higher GPA at the end of the first semester of college, leads to a greater probability the student will stay enrolled. Studies in the review of literature and in this paper use first year cumulative GPA as a proxy for college student success. Some background characteristics identified in the literature that affect first year cumulative GPA, include gender, race, high school curriculum, parent's income, athletic ability, and high school attributes. The review of the literature will emphasize the effect of these different characteristics on student success.

A characteristic identified in many studies is whether the student attended a private or public high school. Noble and Schnelker (2007) find that students from private high schools generally perform better on the ACT. Based on a national survey of students, Evans and Schwab (1995) find the probability that students from private Catholic high schools will attend college is thirteen percentage points higher than from a public high school. At Ball State University, Horowitz and Spector (2005) find that

college students from private religious high schools outperform their private and public school counterparts in the first years of college but this diminishes towards the end of their college career. Another result from their model showed that college GPA is higher for white females holding high school type constant.

The college student success rate by sex is examined within many different reports. One study by Dayioglu and Turut-Asik (2007) analyzes the effect of gender on college GPA in Turkey. Based on one year of data from the Middle East Technical University, the summary statistics reveal that females enrolling in college have lower entrance scores. This leads the authors to estimate two separate models by gender. The model controls for field of study and individual attributes. The results show that at this Turkish university, female's cumulative GPA increases the longer they are in college and they outperform their male counterparts.

Studies on US colleges provide additional information about the influence of sex on student success. Betts & Morell (1999) observe that being male negatively impacts first year cumulative GPA at University of California at San Diego. Based on a national data set, Stratton and Wetzel (2008) find that the difference between the probability of males and females staying in college is modest. Retention of students at Georgia State University engaged in the Freshman Learning Community, which allows entering freshman to build networks, depends on both the gender and race of the student (Hotchkiss et al., 2003).

Various studies identify that retention rates for different racial groups depend on the neighborhood from which they come. Murtaugh et al. (1999) conclude that the retention rate at Oregon State University is higher for whites than for Hispanics,

American Indians, and blacks. However, when age, GPA, SAT score, residency, and major are accounted for, the retention rate is higher for black students than for whites. On a national level Light and Strayer (2002) find the retention rate is higher for minorities than whites when family income, test scores, and college attendance are held constant.

Rose (2005) analyzes how changes in affirmative action policies affect student success. In the mid- to late 1990s the University of Texas and the University of California terminated their affirmative action admissions policies. The court's decision in *Hopwood v. Texas* ended the practice at the University of Texas, and the University of California stopped the practice of race-based admissions when voters passed Proposition 209. At the University of California at San Diego admitted students are separated into three different groups: students selected based on academic scores, students having impressive extracurricular qualifications, and "special admissions" students. The "special admissions" students are admitted due to affirmation action policies. Controlling for HSGPA, SAT score, individual and family demographics, and school district characteristics, Rose (2005) finds that college students in the "special admissions" group admitted under the affirmative action admission policies have lower graduation rate and lower graduating GPA than students from the other two groups.

Croson and Grover (2006) analyze the retention rate at the University of Oregon for several different ethnic groups. They use a bivariate probit model where the retention rate is the dependent variable and gender, resident, contact age, high school type, city type, net HSGPA, net cumulative SAT, first year GPA, average family income, completion of Free Application for Federal Student Aid, eligibility of student aid,

financial aid, and scholarships are the independent variables. They estimate the same model for each ethnic type. They found Hispanics are most likely to stay in college when many members of their hometown community had already earned a bachelor's degree. Scholarship awards, financial aid, and family income are the leading factors for black student's retention rate. Retention rates for Asian students depend on their high school performance, financial aid, and scholarship variables.

Another background characteristic that affects college retention is courses taken while in high school. Klopfenstein and Thomas (2009) find that students with an average GPA in high school who enrolled in AP courses perform poorly their first semester of college. Two national studies (Rose and Betts 2001, and Sadler and Tai 2007) determine that high school students passing the AP Math course receive higher GPAs in college. Dougherty et al. (2006) conclude that while the combined number of AP and Honors courses on a student's transcript does not predict college success, the SAT and AP exams scores do. The number of high school students from low-income families taking AP courses rose from 11.6 percent in the class of 2003 to 17 percent in the class of 2008 (Gewertz, 2009). This paper indicates that the number of students taking AP exams appears to differ across income levels. These studies that measure the impact of AP courses on college success yielded mixed results. This demonstrates that this student characteristic may not be adequate to measure student success at college.

The two main student characteristics that WSU traditionally has examined to determine acceptance of high school students is high school GPA and SAT score (http://futurestudents.wsu.edu/admission/require-freshman.aspx). A number of research based studies have looked at the effect of high school GPA and SAT on success during

college. Ostrowsky (1999) observes that a significant number of students who perform well on college entrance exams still drop out of college. In one study, high school GPA and SAT scores are found to be better predictors of persistence over the college career than high school curriculum (St. John et al., 2004). High school GPA is a better indicator of a student being retained for four years than the college entrance exam score at Oregon State University (Murtaugh et al., 1999), and at the University of California (Geiser and Santelices, 2007). In addition, high school GPA predicts college GPA better than the college entrance exam score for economic majors at the University of South Carolina (Cohn et al., 2004). Lotkowski et al. (2004) make the distinction between retention and success. Retention is whether the student stays in school and success is if they graduate. Their results show that high school GPA is a better measure for retention, and the ACT score is a better measure for student success.

Bassiri & Schulz (2003) study the effects of high school GPA and the ACT college entrance exam on first year cumulative GPA. An ACT Assessment-Adjusted high school grade point average (AA-HSGPA) variable is constructed for each high school by taking the average ACT score of all students who took the ACT within the high school and adjusting the ACT score to a 0-4 scale (the same as the GPA scale). The results show the best model for predicting college GPA includes both the ACT score and AA-HSGPA.

Financial aid packages are available for graduating high school students with a high HSGPA who come from poor families. Allen (1999) observes at an institution in the Southwest that first year cumulative GPA is marginally lower for minorities awarded financial aid than non-minorities awarded financial aid. One example of a financial aid

program is Helping Outstanding Pupils Educationally (HOPE). HOPE is a financial program for Georgia residents that awards $3,000 a semester per student given they have a 3.00 GPA or higher, and attend a Georgia public university. Cornwell et al. (2005) find that HOPE reduced the probability of full time enrollment and enrolled credit hours, and increased the probability of students withdrawing from courses. Students not enrolled full time will take longer to graduate, and the longer the student is enrolled the more difficult it may be for them to graduate. Stinebrickner and Stinebrickner (2003) give evidence that the probability of a student staying enrolled at Berea College, a private university with no tuition, depends on the income level of the student's parents. After controlling for gender, race, HSGPA, ACT score, family size, and distance to school, the results show that the lower the income of the parents the less likely the student will stay enrolled.

Retention also depends on the type of financial aid the student receives. Singell (2004) finds that grants, subsidized loans, and scholarships increase the probability of the student staying for the second term at the University of Oregon, while unsubsidized loans and work study decreases the probability. Another study analyzing the effect of work study and student loans shows no positive or negative effect on the probability of the student enrolling another term (Wetzel et al. 1999). The impact of the financial aid types vary by university. Kerkvliet and Nowell (2005) conclude that at Oregon State University, a research university, work-study encourages retention, but grants do not. On the other hand, at Weber State University, where most students have been employed in the work force several years and have returned to college, grants support retention, but financial aid specifically for veterans does not (Kerkvliet and Nowell, 2005).

Another variable that affects retention is the decision to enroll in college full or part time. Part-time students are 2.23 times more likely than full-time students to drop out at Niagara County Community College (Feldman 1993). Stratton et al. (2007) conclude that differences exist between full and part-time students in their probability of being retained. This national study finds that retention rates for full-time students are impacted by the timing of initial enrollment, academic performance, parental education, household characteristics, and economic factors. For students in the study enrolled part-time, racial and ethnic characteristics have a greater impact on retention in college than full time students.

A common stereotype is that athletes are in college not for their academic abilities but for their physical abilities, and will likely not be retained. Matheson (2007) tests whether student athletes' graduation rates from each race/ethnicity within each sport are different than the graduation rate of the respective students with the same race/ethnicity. Results of this test show that the money-making college sports, such as basketball and football, consistently yield lower graduation rates than other sports teams. Both Rishe (2003) and Matheson (2007) conclude that male and female basketball athletes are less likely to graduate than non-athletes. For all sports on the national level, female athletes exhibit higher graduation rates than male athletes holding various personal and college characteristics constant (Rishe 2003). Based on the descriptive statistics of Rishe (2003) and Matheson (2007), athletes from Division I schools are more likely to graduate than non-athletes.

College graduation is also affected by the characteristics of the high school that a student attended. College students coming from a high school with a large percent of

students eligible for the free/reduced lunch program are likely to come from a low income household. Based on eleven years of data, Okpala et al. (2001) conclude that the percent of students in free/reduced lunch programs at a school is negatively related to students' academic performance in high school Math. In addition to the percent of students in free/reduced lunch programs, student enrollment numbers affects student success. Raywid (1999), Ayers et al. (2000), Lee et al. (2000), Jones et al. (2008), and Jepsen and Rivkin (2009) find that lower student enrollment numbers at high schools is associated with higher student success at high school. No published studies were found that directly consider the effect of high school enrollment size on college retention. Woodruff and Ziomek (2004), however, compare high school GPA and ACT scores. Their results suggest that students with high GPAs from smaller high schools have lower ACT scores. Given that the ACT is a college entrance exam and that ACT is sometimes found to be positively related to college success suggests that students from lower enrollment high schools will demonstrate lower retention rates.

Family background and neighborhood also influences the college retention rate. Bradley and Corwyn (2002) find that parents' education and income affect the retention of their child. The impact of increased family income on completing school appears to be greater for children in low-income families, as shown by Duncan et al. (1998). Vartanian and Gleason (1999) find that neighborhood conditions are associated with black and white students' likelihood of graduating from high school. The neighborhood conditions, however, only affect white students' likelihood of success in college likely through cost.

Various research articles demonstrate the effects of background characteristics on student success. The current review of literature found no studies that analyze student

success for college students specifically in the state of Washington. Studying the various background variables from different studies and identifying their impact on retention for the state of Washington will help policymakers improve student success in the state of Washington. During the 2008-09 school year Washington taxpayers subsidized around thirty-two percent of in-state WSU student's tuition which equals almost $3,000 per student (Roesler 2009). The results from this paper will determine whether admission standards need to be fine tuned in order to increase student success in Washington. The approaches presented in this paper are generalized for use in other states.

Empirical Model

This report will examine how some of these same variables and additional background characteristics impact first year cumulative GPA at WSU. The model used in this paper is similar to Betts and Morell (1999) where they apply an Ordinary Least Squares (OLS) estimation to show that personal background affects cumulative GPA at the University of California, San Diego. The equation in this paper is specified as

$$FYCGPA_i = f(P_i, HSC_i, HSA_i, Y_i)$$

Here P_i, HSC_i, HSA_i, Y_i represent vectors of personal characteristics, results of high school career, high school attributes, and dummy variables for year initially enrolled, respectively. The vectors P_i, HSC_i, and Y_i are student specific, and HSA_i is high school specific. The subscript *i* denotes the individual student.

The vector P_i is comprised of dummy variables which indicate whether the student is male; Caucasian, Pacific Islander (Pac. Isl.), Hispanic, African American (Afrcn. Amer.), Native American (Nat. Amer.), or unknown; plays on a Division I team

(Athlete); is Pell eligible the first semester of college (PellSem1); is full time both semester of their first year (FT Both); and enrolled or advised in a STEM discipline either semester of their first year (STEM Eith.). HSC_i consists of one dummy variable, indicating whether the student enrolled in AP course in high school (AP). The other high school career variables are high school GPA at graduation (HSGPA), and SAT score or ACT converted (SAT). The remaining variables fall under HSA_i which are total enrollment of high school (Tot Enroll); percent of students at high school that are Asian or Pacific Islander (%API), American Indian or Alaskan Native (%AIA), African American (%Black), and Hispanic (%Hispanic); average number of students per classroom teacher at high school (SPCT); number of students enrolled in free or reduced priced meals at high school (FORPM); average years of educational experience of teachers at high school (AYTEE); percent of teachers with at least a master's degree at high school (%TWM); number of students that dropped out in twelfth grade in high school (D12); and the average expenditure per pupil in the district (Exp Pupil). The data source for each of the background characteristic variables will be explained in the next section.

Data

To determine the impact of different background characteristics on first year cumulative GPA, this study will examine in-state, non-transfer, freshman cohorts entering fall semester at WSU from the 2003-04 to 2007-08 academic school years. Out-of-state students are not included since part of the focus is on high schools and detailed high school information is not available for out-of-state students. Students transferring to

WSU from other colleges are excluded as they have had some exposure to college. Students not entering fall semester are not similar to students starting fall semester and therefore are dropped. The number of in-state, non-transfer, freshman cohorts during this time contained 12,424 students. Some students enrolled at WSU did not take the SAT or ACT, this reduced the number of students to 12,328. These students come from 329 different public high schools and 72 private high schools. WSU records individual, high school, and college characteristics of each student. The information for each of these characteristics is student specific. The individual background characteristics consist of gender and race/ethnicity. High school background characteristics for the student includes the high school GPA, SAT score, and the number of AP courses taken in high school. College characteristics are whether the student enrolled full time both semesters of their freshman year, eligible the first semester for the Pell grant[1], enrolled in STEM[2] disciplines both semesters, and if an athlete played on a Division I team. WSU also reports the cohort the student belongs, and the high school they attended.

Each high school in the state of Washington is categorized into one nine Educational Service Districts (ESD). The purpose of the ESD is to assure equal education opportunities within the districts (www.k12.wa.us). The locations of the nine ESD are shown in Figure 1. The number of students in the data for this research from each ESD is presented in Figure 2, and the percentage of students from each ESD is presented in Figure 3. The largest contingent of students attending WSU originates from ESD 121 which has the largest population of high school students. Although most

[1] Pell Grant is a federal grant awarded to undergraduate students with low-income.
[2] Science, Technology, Engineering, & Mathematics (STEM) refer to a student being advised or pursuing a degree in one of the science, technology, engineering, and mathematics degree programs.

students attending WSU come from ESD 121, only around 3% of high school students attend WSU from ESD 121.

In addition to the WSU student data, information was gathered for each high school in the state of Washington. The OSPI in Washington State (www.k12.wa.us) reports the total enrollment, percent of students of different ethnicity[3], average number of students per classroom teacher, percent of students on free or reduced priced meals, average years of teachers' educational attainment, percent of teachers with at least a master's degree, and the number of students that drop out in 12th grade annually for each public school. The OSPI also reports annually the average expenditures per pupil by district. Comparable detailed information about private high schools is not publicly available. Total enrollment and the average number of students per classroom for private high schools were obtained from the respective high school website, or at www.schooltree.org. High school information is assigned to each student in the WSU dataset that graduate from the specified high school.

The individual student and high school variables are described more fully in Table 1, with summary statistics for all students, and by type of high school attended in Tables 2, 3, and 4, respectively. The summary statistics show that the in-state, non-transfer freshman starting fall semester cohort size at WSU is similar throughout the five years, and the actual values are in Table 5. The 2007-08 freshman cohort is the largest and the 2006-07 cohort has the fewest students. Of the incoming resident new freshman at WSU about 5.7% attended a private high school. The percentage of students enrolling in AP courses in high school is higher at public high schools than at private high schools. On

[3] The ethnicities are categorized as Asian or Pacific Islander, American Indian or Alaskan, Black, Hispanic, and White.

average high school GPA is higher for students who attend public high schools, while SAT scores are on average higher for students from private high schools. In general, the high school enrollment and the number of students per classroom teacher are lower for students from private high schools. The cumulative college GPA of the first year is on average slightly higher for students who attended public high schools.

Estimation Method

To evaluate the effect of background characteristics on the first year cumulative GPA and to assess whether there are differences in how HSGPA impacts college cumulative GPA between specific high schools in the state of Washington, two approaches (sequential) are taken. The first approach estimates the general model introduced in the model section using OLS, and identifies the effects of different background characteristics. The first approach is used to identify observations students with large positive and negative residuals are categorized by high school. The results for students with residuals that lie outside one standard deviation suggest that something outside of the model is explaining their first year cumulative GPA, and this (these) factors vary systematically across high schools. A number of explanations could result in these high schools having a large number of outliers.

To help answer why certain high schools have a large number of outliers, a second approach is introduced that includes intercept and slope shifter terms in the aforementioned model. Dummy variables for those high schools that have a certain percent of students attending WSU were used as intercept shifters, and slope shifters are created as the interaction between the high school intercept term and high school GPA.

Estimating the model using OLS with intercept and slope values helps isolate the effects of the high schools on first year success.

High schools that are identified from both approaches that have the same positive or negative sign provide evidence that HSGPA explains student preparedness for college. The residual approach captures high school differences that are not controlled for by the independent variables. The dummy variable approach allows assessment of whether the high school impact on college GPA includes impacts through an intercept shifter and the HSGPA, holding everything else constant. Both approaches may give some indication whether high school grading standards in Washington vary across public and private high schools.

Approach 1: The Residual Approach

The data is separated into two groups, students attending public and students attending private high schools, for estimation purposes. The literature contends that students attending private high schools perform better in college. A general F test is applied to the model to determine if the model for students from the public high schools should be estimated separately from the model for students from private high schools. The test statistic is in the following equation.

$$F_{df_d}^{df_a - df_d} \sim \frac{(RSS_a - RSS_d)/(df_a - df_d)}{RSS_d / df_d}$$

where *RSS* is the sum squared residuals, and *df* is the associated degrees of freedom. The subscript *a* represents all of the students aggregated, and the subscript *d* is the sum of the relevant values from the separate estimations for the public and private high school groups. The same specification for the public and private is used for the F test. The test

statistic value lies outside of the 99% interval rejecting the null hypothesis, and suggests the need for estimating the model separately by students from public and private high schools.

As indicated in the empirical model section, the model is broken into three vectors, personal characteristics, high school career, and high school attributes. The personal characteristics and high school career vectors are the same for both the public and private high schools groups, but the variables differ within the high school attributes vector. The high school attributes vector for the public schools group is as shown in the empirical model section. Total enrollment and the number of students per classroom teacher are the only two variables within the high school attributes vector available for the private high school group.

For both groups the dependent variable first year cumulative GPA, ranges from 0 to 4. The Tobit estimation may be more appropriate since the dependent variable is censored. Thus, a Tobit estimation was initially used for the model with a downward of 0 and upward of 4 censoring. The marginal effects from the Tobit and OLS estimation differ by less than 0.01. Since the coefficients are almost the same the report will only analyze the OLS results.

The assumption of constant error variance in the classical model was examined. A Breusch-Pagan/Cook-Weisburg test (based on the OLS results) was used to test for heteroscedasticity. The results indicated the violation of this assumption in both the public and private high school groups. To correct for heteroscedasticity the variance covariance matrix was adjusted by using the Huber/White/sandwich estimate of variance.

Model estimations for each group are used to identify observations (students) where the residual lies outside one positive or negative standard deviation, which are then grouped together by high school. The rest of the report will refer to these residuals as outliers. High schools that have less than 5% of their total enrollment attending WSU are dropped. High schools with ten or more outliers of the same sign are documented. High schools with more than ten positive and negative large outliers are also documented. Hence, the residual approach identifies whether omitted variables or included variables have differential impacts by high school.

Approach 2: The Dummy Variable Approach

In the dummy variable approach, a dummy variable is created for all high schools that have a particular percentage of students attending WSU which are used as intercept and slope shifters for both the public and private high school groups. The dummy variables are created for high schools that have at least 5% of the total enrollment attending WSU. The slope shifters are interaction terms between HSGPA and the high school dummy variables. A Wald test was used to test whether the mode that includes the intercept and slope shifters was preferred to an otherwise comparable model. The results of the test indicated to reject the null hypothesis that the subset of coefficients was jointly equal to zero indicating the need to use the model with both the intercept and slope shifters. The model for the second approach, therefore, is

$$FYCGPA_i = f(P_i, HSC_i, HSA_i, Y_i, J_i, S_i)$$

All the previous vectors represent the same characteristics. J_i represents the intercept shifter, and S_i represents the interaction between the high school and the student's high

school GPA in the model. The model is estimated using OLS. The general F test applied to the model in the residual approach (discussed above) was run to determine whether students from the public and private high schools should be estimated jointly or separately. The same specification for the public and private is used for the F test. Based on the results, the two groups should be estimated separately. Similar to the residual approach, the personal characteristics and high school career vectors are the same for both the public and private high schools groups for the dummy variable approach. The high school attributes vector for the public high school group is the same as the residual approach consisting of only the total enrollment and students per classroom teacher.

The Tobit estimation procedure was also applied to the dummy variable approach. The coefficients from the OLS and Tobit estimations were almost identical, and hence the report will only focus on the OLS results. As with the first approach, the Breusch-Pagan/Cook-Weisburg test detected heteroscedasticity in both the public and private high school groups. The variance covariance matrix was adjusted by using the Huber/White/sandwich estimate of variance to correct for heteroscedasticity for both groups.

Results

The two approaches are used to examine background characteristics and whether HSGPA vary across the state of Washington. The results of the residual approach are presented in Table 6. The results of the dummy variable approach are presented in Tables 7, with the coefficients for the intercept and slope shifters for high school reported in Table 13. The results from the residual approach and the dummy variable approach

are similar in terms of magnitude of the significant coefficients and the overall fit of the models. Similarities also exist for the public and private high schools results from both approaches, indicating that the significant marginal effects for the individual variables, holding the other variables constant, are similar for both types of high schools.

The independent variables that are significant and happen to be similar from all four estimations are as follows. The variable, Male, is negative showing that females tend to have higher college GPAs, and this finding is consistent with Betts & Morell (1999). From all four estimations, enrolling full time has a positive impact on their first year cumulative GPA. Students with a major that falls under STEM will have a lower first year cumulative GPA than other students. Taking at least one AP course in high school positively affects their first year cumulative GPA. Both the students' high school GPA and SAT has a positive relationship to first year cumulative GPA.

The specific public and private high schools identified from each of the two different approaches are identified in the next two sections. These results are based on students attending WSU over a five year period. During this time, the learning atmosphere, technology, the education process, and other important factors may have changed for the different high schools. The data in the public high school attributes vector changes each year to capture some of these changes. Private high schools only report the current total enrollment and students per classroom teacher for one year, so these variables do not change across cohorts. The state of Washington has established certain general guidelines for public high schools, but much is left to the district and the school how knowledge should be attained for their students.

Results of Approach 1: The Residual Approach

The results from the residual approach of the specified residual model, identified students from 306 of the 329 public high schools and 47 of the 72 private high schools as outliers that are greater than one standard deviation. To show a general result of the residual approach, summary statistics for observations (students) having negative outliers are shown in Table 8, and for students having positive outliers are shown in Table 9. The summary statistics show the average first year cumulative GPA is higher for students who are positive outliers than students who are negative outliers. The average SAT score is higher for the negative outliers than the positive outliers. The average high school GPA for the negative outliers is almost 3.40, and the average high school GPA for the positive outliers is 3.33. This result might suggest that high schools that have many outliers could be ones where grade inflation is a problem and/or their curriculum is not as challenging and hence does not prepare students for college as well as otherwise equivalent schools.

The outliers are identified by high school to show a direct comparison of high schools in the state of Washington. In order to consider only high schools with a large enough enrollment at WSU so as to not draw conclusions based on non-representative samples (due to small numbers), some high schools are dropped. High schools that have less than 5% of their total student body population enrolled at WSU are dropped and reduced the number of public high schools to 91 and 11 for the private high schools. High schools that have at least ten negative and/or positive outliers are listed in Table 10 with the ESD in the second column. The number of positive outliers is listed in the third column and the number of negative outliers in the fourth column. The fifth column

reports the ratio of positive outliers to the total number of students attending WSU from each high school within the dataset, and the sixth column reports the ratio of negative outliers to the total number of students attending WSU from each high school within the dataset. The seventh column gives the ratio of students attending WSU from the dataset to the total enrollment of the specified high school.

High schools that have at least ten students with a positive outlier (student is over performing) are primarily from ESD 121. The thirteen high schools having more than ten students with negative outliers (students under performing) are located in various parts of the state. Most high schools having more than ten students with positive and negative outliers are from ESD 121. Table 11 presents summary statistics on the high school demographics of the schools listed in Table 10 that have at least 10 positive outliers and less than 10 negative outliers. Table 12 presents summary statistics on the high school demographics of the schools listed in Table 10 that have at least 10 negative outliers and less than 10 positive outliers. The private high schools are not included in Tables 11 and 12 since the variables percent white, free or reduced meals, and average expenditures per pupil are unknown for private high schools. Of the variables listed in the table, there does not appear to be large differences between groups.

Results of Approach 2: The Dummy Variable Approach

The intercept and slope shifters included in the second approach are for high schools that have at least 5% of the total enrollment attending WSU. Three private high schools intercept and slope shifters were dropped due to less than three students attending WSU from those high schools. The results are reported in Table 7 and Table 13 (the

intercept and slope shifter coefficients by school along with the ESD location of the school). Twenty-seven high schools had an intercept or slope shifter's with a p-value less than 0.20.

To show a general result of the dummy variable approach, summary statistics on the demographics of the twenty-three[4] public high schools are separated by significant negative and positive intercept shift coefficients and are listed in Table 14. Twenty of these twenty-seven high schools had a negative intercept shift coefficient. In addition, the table lists the summary statistics for all public high schools in the state of Washington that have students attending WSU. From Table 14, the average total enrollment and student per classroom teacher is higher for the high schools having positive significant intercept shifter coefficients. Table 14 also demonstrates the average percent of whites, students eligible for free or reduced price meals, and expenditure per pupil is lower for the high schools having a negative significant intercept shifter coefficients.

To show a direct comparison of high schools in the state of Washington from the dummy variable approach, the relationship between high school GPA and first year cumulative GPA is shown for specific high schools holding all other variables in the model at their mean. This relationship is shown in Table 15, and only includes the high schools that have either or both the high school dummy coefficient or the interaction between the high school and high school GPA coefficient significant at the 80%. This reduced the number of high schools from one hundred four to twenty-seven high schools. High schools not specifically identified in Table 15 are categorized in the base for the public or private high school depending on the high school type. The high school GPA relative range is from 2.0 to 4.0, since a high school graduate with a high school GPA

[4] Due to the limited data on private high schools, these schools are not included in the summary statistics.

lower than 2.0 may not be admitted into WSU. For some high schools the slope coefficient is negative. This result occurs since it is assumed that all variables are held constant, but except for the high school type. For the different high school types, the effect of high school GPA on first year cumulative GPA in relation to other high schools depends on the student's high school GPA.

Conclusion

Two different approaches are applied to determine how background characteristics influence the first year cumulative GPA. In addition, the report shows how a collection of students from a specific high school in the state of Washington perform at WSU. For each approach students from public and private high schools are estimated separately. Minor differences appear in the coefficients between the different models, suggesting that given the nature of the model marginal effects are the same for students coming from public and private high schools. Students eligible for a Pell Grant first semester and enrolled in a STEM discipline have a negative influence on first year cumulative GPA.

The first approach, the residual approach, identifies observations (students) with large outliers and groups them by high school. The largest percentage of high schools with many positive outliers comes from high schools located in ESD 121, the largest service district. Total enrollment, number of minorities, number of students per classroom, percent of students on free or reduced meals, and the average expenditure per pupil is not distinguishable between the high schools with many positive and negative outliers.

The second approach, the dummy variable approach, includes high school slope shifters and an interaction term between high school and high school GPA. The high schools with positive coefficients on average have lower high school enrollment rates. In addition, those high schools with positive coefficients on average have a higher percentage of minorities and expenditures spent per pupil than the average high school. The relationship between high school GPA and first year cumulative college GPA are specifically identified for a number of high schools holding all other variables in the model at their mean.

Fourteen high schools are identified from both the residual and dummy variable approach. These two separate approaches determine if the students from a specific high school have the same success rate. From all fourteen high schools, holding all other variables constant, the effect of high school GPA on first year cumulative GPA in relation to other high schools depends on the individual student's high school GPA. However, some high schools' effect on first year cumulative GPA strictly dominate other high schools from the 2.0 to 4.0 GPA range. Since WSU does not admit students with a high school GPA lower than 2.0, the students from one high school could be better prepared for college than a student from another high school. The variation in the level of preparation could be due to the different curriculum offered at the school or taken by the student, or grade inflations across different schools. The different possibilities in college preparation might suggest that the state of Washington and/or school districts evaluate the curriculum being taught within the same classes at the different high schools.

Finding that the level of preparation of students varies across different high schools is based on the student enrollment over five years at WSU. Some districts within

the state of Washington may currently be changing their curriculum, or adopting technological devices that will enhance their student's learning. Repeating the two approaches presented in this study in the future may yield different results. In addition, the methodology used in this study can be applied other universities to help them identify student success at their schools.

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Figures

Figure 1: Educational Service Districts in Washington State

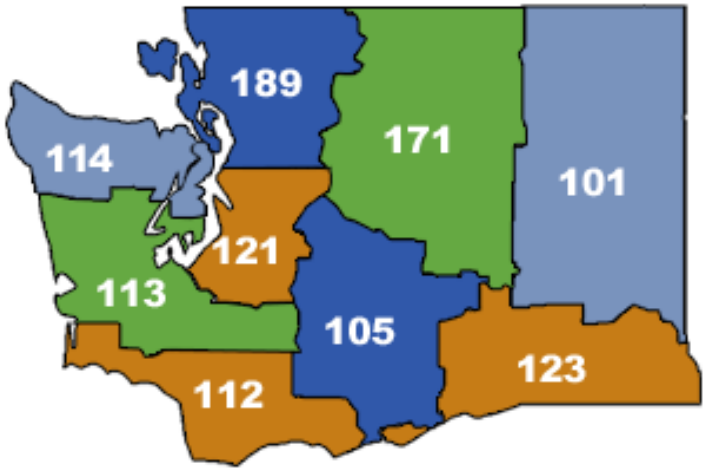


Figure 2: Number of Students from Each ESD for Public and Private HS

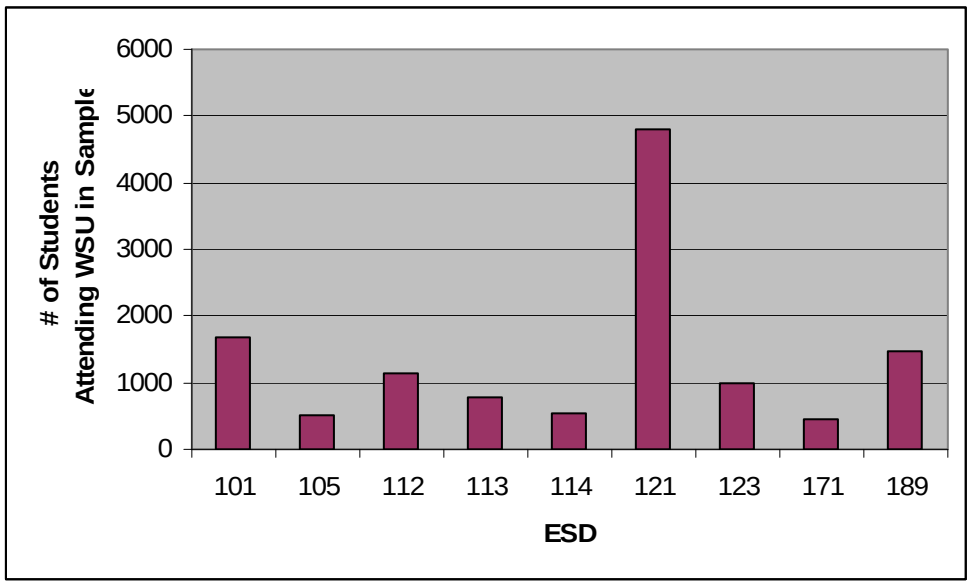
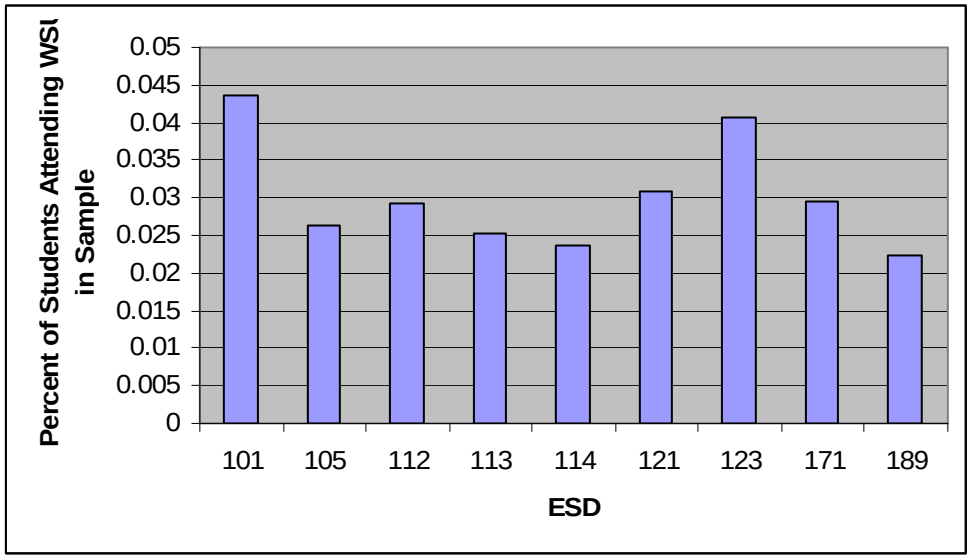


Figure 3: Percent of Students from Each ESD for Public and Private HS



Tables

Table 1: Data Descriptions

Variables	**Description**
Individual Characteristics	
FYCGPA	First Year Cumulative Grade Point Average
Male	Dummy variable if the student is male
Caucasian	Dummy variable if the student is Caucasian
Pac Isl	Dummy variable if the student is Pacific Islander
Hispanic	Dummy variable if the student is Hispanic
Afrcn Amer	Dummy variable if the student is African American
Nat Amer	Dummy variable if the student is Native American
	(Omitted variable is if the student is White)
Athlete	Dummy variable if the student is an athlete
PellSem1	Dummy variable if the student received a Pell grant first semester
FT Both	Dummy variable if the student enrolled full time both semesters of the first year
STEM Eith	Dummy variable if the student was in a STEM discipline either semester first year
AP	Dummy variable if the student enrolled in Advanced Placement courses in high school
HSGPA	Students high school Grade Point Average at the end of high school
SAT	Students score on the Standardized Achievement Test
High School Characteristics	
Tot Enroll	Student's high school total enrollment
%API	Student's high school percent of students that are Asian Pacific Islander
%AIA	Student's high school percent of students that are Native American or Alaskan
%Black	Student's high school percent of students that are Black
%Hispanic	Student's high school percent of students that are Hispanic
SPCT	Student's high school number of students per classroom teacher
FORPM	Student's high school percent of students that are on free or reduced priced meals
AYTEE	Student's high school average number of years of the teachers' educational experience
%TWM	Student's high school percent of teachers that have at least a Master's degree
D12	Student's high school number of students that dropped out senior year
Exp Pupil	Student's school district average annual expenditure per student
Y04-05	Dummy variable if the student enrolled as freshman fall semester 04-05
Y05-06	Dummy variable if the student enrolled as freshman fall semester 05-06
Y06-07	Dummy variable if the student enrolled as freshman fall semester 06-07
Y07-08	Dummy variable if the student enrolled as freshman fall semester 07-08
	(Omitted variable is if the student enrolled as freshman fall semester 03-04)

Table 2: Summary Statistics for Students from both Public & Private High Schools[5]

Variable	Mean	Std. Dev.	Min.	Max.
FYCGPA	2.89	0.666	0.09	4
Male	0.49	0.500	0	1
Caucasian	0.81	0.394	0	1
Pac Isl	0.06	0.245	0	1
Hispanic	0.04	0.204	0	1
Afrcn Amer	0.02	0.146	0	1
Nat Amer	0.01	0.104	0	1
Athlete	0.03	0.180	0	1
PellSem1	0.16	0.365	0	1
FT Both	0.98	0.132	0	1
STEM Eith	0.31	0.462	0	1
AP	0.19	0.389	0	1
HSGPA	3.45	0.362	2.13	4
SAT	1090	138.149	500	1600
Tot Enroll	1355	573.757	5	12672
SPCT	19	3.322	0	59
Y04-05	0.21	0.404	0	1
Y05-06	0.19	0.393	0	1
Y06-07	0.18	0.388	0	1
Y07-08	0.22	0.415	0	1

[5] Number of observations: 12328.

Table 3: Summary Statistics for Students from Public High Schools[6]

Variable	Mean	Std. Dev.	Min.	Max.
FYCGPA	2.89	0.663	0.09	4
Male	0.49	0.500	0	1
Caucasian	0.81	0.394	0	1
Pac Isl	0.06	0.246	0	1
Hispanic	0.04	0.205	0	1
Afrcn Amer	0.02	0.146	0	1
Nat Amer	0.01	0.103	0	1
Athlete	0.03	0.179	0	1
PellSem1	0.16	0.369	0	1
FT Both	0.98	0.130	0	1
STEM Eith	0.31	0.462	0	1
AP	0.19	0.390	0	1
HSGPA	3.45	0.359	2.13	4
SAT	1088	138.228	500	1600
Tot Enroll	1393	552.037	33	3142
%API	0.07	6.753	0	48.85
%AIA	0.02	2.917	0	94.87
%Black	0.04	4.679	0	59.97
%Hispanic	0.08	12.079	0	94.06
SPCT	19	3.177	0	59
FORPM	0.23	14.213	0	100
AYTEE	13	2.521	0	23.30
%TWM	61	12.933	0	100
D12	0.05	0.039	0	0.50
Exp Pupil	7889.97	1119.733	6147.52	26633.45
Y04-05	0.21	0.405	0	1
Y05-06	0.19	0.393	0	1
Y06-07	0.19	0.389	0	1
Y07-08	0.22	0.414	0	1

[6] Number of observations: 11625.

Table 4: Summary Statistics for Students from Private High Schools[7]

Variable	Mean	Std. Dev.	Min.	Max.
FYCGPA	2.87	0.638	0.14	4
Male	0.52	0.500	0	1
Caucasian	0.82	0.383	0	1
Pac Isl	0.06	0.232	0	1
Hispanic	0.04	0.189	0	1
Afrcn Amer	0.02	0.145	0	1
Nat Amer	0.02	0.124	0	1
Athlete	0.03	0.182	0	1
PellSem1	0.09	0.288	0	1
FT Both	0.97	0.158	0	1
STEM Eith	0.30	0.457	0	1
AP	0.17	0.375	0	1
HSGPA	3.30	0.381	2.35	4
SAT	1122	132.873	780	1590
Tot Enroll	726	559.978	5	12672
SPCT	15	3.963	5	40
Y04-05	0.18	0.385	0	1
Y05-06	0.21	0.407	0	1
Y06-07	0.17	0.379	0	1
Y07-08	0.25	0.431	0	1

[7] Number of Observations: 703.

Table 5: Sample WSU Enrollment by In-state Freshmen

Cohort	Fall Enrollment
03-04	2437
04-05	2532
05-06	2359
06-07	2279
07-08	2721

Table 6: Student Success Model – Approach 1 - Residual Approach Results

VARIABLES	PUBLIC HIGH SCHOOL	PRIVATE HIGH SCHOOL
Male	-0.0978***	-0.0902***
	(0.011)	(0.043)
Caucasian	-0.0003	-0.0149
	(0.023)	(0.093)
Pac Isl	-0.0680***	-0.0433
	(0.029)	(0.124)
Hispanic	0.0088	-0.2046*
	(0.033)	(0.137)
Afrcn Amer	-0.0332	-0.0504
	(0.041)	(0.167)
Nat Amer	0.0521	0.2092
	(0.053)	(0.182)
Athlete	0.0825***	0.0247
	(0.028)	(0.109)
PellSem1	-0.0466***	-0.0001
	(0.014)	(0.071)
FT Both	0.3318***	0.3836***
	(0.038)	(0.124)
STEM Eith	-0.2020***	-0.2062***
	(0.011)	(0.045)
AP	0.1126***	0.0963**
	(0.014)	(0.058)
HSGPA	0.9038***	0.8672***
	(0.016)	(0.059)
SAT	0.0008***	0.0004***
	(0.000)	(0.000)
Tot Enroll	-0.0000	0.0000
	(0.000)	(0.000)
%API	0.0062***	
	(0.001)	
%AIA	-0.0055***	
	(0.002)	
%Black	-0.0073***	
	(0.002)	
%Hispanic	0.0014***	
	(0.001)	
SPCT	0.0074***	-0.0098**
	(0.002)	(0.005)
FORPM	-0.0026***	
	(0.001)	

AYTEE	0.0004	
	(0.002)	
%TWM	0.0002	
	(0.000)	
D12	-0.0778	
	(0.136)	
Exp Pupil	0.0000**	
	(0.000)	
Y04-05	-0.0554***	-0.0608
	(0.016)	(0.065)
Y05-06	-0.1220***	-0.0956*
	(0.016)	(0.063)
Y06-07	-0.0879***	-0.0763
	(0.017)	(0.065)
Y07-08	-0.1201***	-0.0280
	(0.017)	(0.060)
Constant	-1.4095***	-0.5537**
	(0.103)	(0.283)
Observations	11625	703
R-squared	0.355	0.363
Adjusted R-squared	0.353	0.345

Standard errors in parentheses
*** p<0.05, ** p<0.10, * p<0.20

Table 7: Student Success Model – Approach 2 - Dummy Variable Approach Results[8]

VARIABLES	PUBLIC HIGH SCHOOL	PRIVATE HIGH SCHOOL
Male	-0.0933***	-0.0911***
	(0.011)	(0.044)
Caucasian	-0.0024	-0.0350
	(0.023)	(0.111)
Pac Isl	-0.0675***	-0.0761
	(0.029)	(0.137)
Hispanic	0.0094	-0.2550**
	(0.033)	(0.140)
Afrcn Amer	-0.0369	-0.0625
	(0.041)	(0.166)
Nat Amer	0.0469	0.2383*
	(0.053)	(0.167)
Athlete	0.0774***	0.0432
	(0.028)	(0.131)
PellSem1	-0.0455***	-0.0144
	(0.014)	(0.077)
FT Both	0.3304***	0.3789***
	(0.038)	(0.122)
STEM Eith	-0.1992***	-0.1992***
	(0.011)	(0.046)
AP	0.1233***	0.1107**
	(0.015)	(0.063)
HSGPA	0.9092***	0.9298***
	(0.022)	(0.090)
SAT	0.0007***	0.0004**
	(0.000)	(0.000)
Tot Enroll	-0.0000	0.0000
	(0.000)	(0.000)
%API	0.0069***	
	(0.001)	
%AIA	-0.0057***	
	(0.002)	
%Black	-0.0069***	
	(0.002)	
%Hispanic	0.0010*	
	(0.001)	
SPCT	0.0059***	-0.0003
	(0.003)	(0.006)
FORPM	-0.0011*	

[8] Intercept & Slope Significant Coefficients are Reported in Table 13.

	(0.001)	
AYTEE	0.0031	
	(0.003)	
%TWM	-0.0006	
	(0.001)	
D12	-0.1066	
	(0.148)	
Exp Pupil	0.0000*	
	(0.000)	
Y04-05	-0.0600***	-0.0715
	(0.016)	(0.067)
Y05-06	-0.1279***	-0.1271**
	(0.017)	(0.068)
Y06-07	-0.0960***	-0.1086*
	(0.018)	(0.067)
Y07-08	-0.1316***	-0.0843*
	(0.019)	(0.064)
Constant	-1.4051***	-0.7763***
	(0.137)	(0.369)
(Refer to Table 13 for High School Slope and Intercept Shifters)		
Observations	11625	703
R-squared	0.374	0.403
Adjusted R-squared	0.362	0.370

Standard errors in parentheses
*** p<0.05, ** p<0.10, * p<0.20

Table 8: Summary Statistics for Students Exhibiting a Negative Residual Less Than One Standard Deviation from the Residual Approach[9]

Variables	Mean	Std. Dev.	Min.	Max.
FYCGPA	1.889826	0.577455	0.09	3.15
Male	0.537435	0.498741	0	1
Caucasian	0.788160	0.408731	0	1
Pac Isl	0.073128	0.260423	0	1
Hispanic	0.050493	0.219024	0	1
Afrcn Amer	0.020894	0.143070	0	1
Nat Amer	0.010447	0.101704	0	1
Athlete	0.025537	0.157795	0	1
PellSem1	0.178758	0.383261	0	1
FT Both	0.973883	0.159530	0	1
STEM Eith	0.345908	0.475802	0	1
AP	0.175856	0.380808	0	1
HSGPA	3.395206	0.333666	2.16	4
SAT	1091.428	137.6855	690	1590

Table 9: Summary Statistics for Students Exhibiting a Positive Residual Less Than One Standard Deviation from the Residual Approach[10]

Variables	Mean	Std. Dev.	Min.	Max.
FYCGPA	3.486328	0.347355	2.33	4
Male	0.566421	0.495721	0	1
Caucasian	0.776138	0.416959	0	1
Pac Isl	0.076876	0.266476	0	1
Hispanic	0.050431	0.218899	0	1
Afrcn Amer	0.025215	0.156827	0	1
Nat Amer	0.012300	0.110256	0	1
Athlete	0.019680	0.138942	0	1
PellSem1	0.202952	0.402321	0	1
FT Both	0.974170	0.158677	0	1
STEM Eith	0.359779	0.480083	0	1
AP	0.142066	0.349226	0	1
HSGPA	3.327546	0.381168	2.15	4
SAT	1079.526	133.0363	520	1540

[9] Number of Observations: 1723
[10] Number of Observations: 1626

Table 10: High Schools with at Least 10 Positive and Negative Outliers from the Residual Approach

High School Name	ESD	# of positive outliers	# of negative outliers	Positive Outliers as Percent of HS Students Attending WSU*	Negative Outliers as Percent of HS Students Attending WSU*	HS Students Attending WSU* as Percent of Total Enrollment of HS
High Schools with at least 10 NEGATIVE AND POSITIVE outliers						
PULLMAN HIGH	101	43	24	0.23	0.13	0.26
ISSAQUAH HIGH	121	25	13	0.19	0.10	0.11
BOTHELL HIGH	121	25	14	0.20	0.11	0.08
LEWIS AND CLARK HIGH	101	25	20	0.18	0.14	0.07
HANFORD HIGH	123	23	18	0.19	0.15	0.09
MOUNTAIN VIEW HIGH	112	22	12	0.21	0.11	0.05
MEAD HIGH	101	21	12	0.18	0.10	0.08
EASTLAKE HIGH	121	21	16	0.14	0.11	0.12
UNIVERSITY HIGH	101	20	11	0.18	0.10	0.07
RICHLAND HIGH	123	20	21	0.11	0.12	0.09
TAHOMA HIGH	121	18	21	0.14	0.17	0.10
SKYVIEW HIGH	112	16	16	0.13	0.13	0.07
LIBERTY HIGH	101	15	19	0.15	0.19	0.09
CENTRAL VALLEY HIGH	101	13	20	0.12	0.18	0.07
INGLEMOOR HIGH	121	13	20	0.11	0.18	0.06
BELLARMINE HIGH+	121	12	11	0.11	0.12	0.10
LAKE WASHINGTON HIGH	121	11	11	0.14	0.14	0.07
WALLA WALLA HIGH	123	11	12	0.11	0.12	0.05
CURTIS HIGH	121	11	15	0.14	0.19	0.06
PUYALLUP	121	11	16	0.10	0.15	0.07

HIGH						
MOUNT SI HIGH	121	10	10	0.14	0.14	0.06
KENT LAKE HIGH	121	10	14	0.11	0.15	0.08
EMERALD RIDGE HIGH	121	10	19	0.13	0.24	0.06
JOEL E FERRIS HIGH	101	10	24	0.08	0.20	0.07
High Schools with at least 10 POSITIVE outliers, and less than 10 NEGATIVE outliers						
SKYLINE HIGH	121	36	8	0.18	0.04	0.15
REDMOND HIGH	121	27	7	0.24	0.06	0.09
CAMAS HIGH	112	23	7	0.23	0.07	0.07
BISHOP BLANCHET HIGH+	121	17	8	0.19	0.09	0.09
SNOHOMISH HIGH	189	15	9	0.15	0.09	0.05
NORTH KITSAP HIGH	114	13	7	0.16	0.08	0.06
WOODINVILLE HIGH	121	13	7	0.12	0.06	0.09
KENTWOOD HIGH	121	13	9	0.10	0.07	0.08
WEST VALLEY HIGH (YAKIMA)	105	13	9	0.15	0.10	0.08
MOUNT SPOKANE HIGH	101	12	5	0.16	0.07	0.06
BURLINGTON-EDISON HIGH	189	10	5	0.15	0.08	0.06
OLYMPIA HIGH	113	10	8	0.10	0.08	0.06
GIG HARBOR HIGH	121	10	9	0.10	0.09	0.06
OLIVER M HAZEN HIGH	121	10	9	0.14	0.13	0.06
High Schools with at least 10 NEGATIVE outliers, and less than 10 POSITIVE outliers						
PRAIRIE HIGH	112	6	10	0.08	0.13	0.05
OLYMPIC HIGH	114	4	10	0.07	0.17	0.05
COLFAX HIGH	101	2	11	0.11	0.27	0.18
NEWPORT HIGH (BELLEVUE)	121	9	13	0.11	0.15	0.06

SOUTHRIDGE HIGH	123	9	14	0.09	0.14	0.07
BELLEVUE HIGH	121	7	14	0.08	0.16	0.07
JOHN F KENNEDY HIGH+	121	4	14	0.06	0.22	0.08
COLUMBIA RIVER HIGH	112	9	15	0.12	0.19	0.07
TIMBERLINE HIGH	113	6	15	0.08	0.21	0.06
SHADLE PARK HIGH	101	4	15	0.05	0.17	0.05
CAPITAL HIGH	113	5	17	0.06	0.19	0.06
KENTRIDGE HIGH	121	7	18	0.07	0.18	0.07
KAMIAKIN HIGH	123	7	19	0.08	0.22	0.06
CENTRAL KITSAP HIGH	114	8	23	0.07	0.20	0.09

*HS Students Attending WSU represents the number of all students attending WSU in data set from the respective HS

+Indicates Private School

Table 11: Summary Statistics for Characteristics of Public High Schools Which Have at Least 10 Positive Outliers, and Less Than 10 Negative Outliers

Variables	Mean	Std. Dev.	Min.	Max.
Total Enrollment	1413.54	256.81	1075	1939
Percent White	83.5700	7.3100	68.30	94.10
Students Per Classroom Teacher	19.9200	1.8000	17	24
Free or Reduced Priced Meals	13.0100	6.9800	2.07	26.77
Average Expenditure Per Pupil	7320.88	608.12	6692.24	8681.28

Table 12: Summary Statistics for Characteristics of Public High Schools Which Have at Least 10 Negative Outliers, and Less Than 10 Positive Outliers

Variables	Mean	Std. Dev.	Min.	Max.
Total Enrollment	1265.23	341.64	232	1654
Percent White	80.42	9.37	62.58	95.69
Students Per Classroom Teacher	18.69	3.12	11	23
Free or Reduced Priced Meals	17.10	6.18	6.10	28.53
Average Expenditure Per Pupil	7836.48	686.83	6948.16	9414.01

Table 13: Intercept and Slope Shifter Results from the Dummy Variable Approach[11]

High School	ESD	Intercept Shifter Coefficient	Slope Shifter Coefficient
CENTRAL VALLEY HIGH	101	-0.9004**	0.2314**
		(0.480)	(0.135)
COLFAX HIGH	101	-1.1384*	0.2672
		(0.804)	(0.225)
COLTON HIGH	101	-1.7425	0.333
		(2.040)	(0.568)
DAVENPORT HIGH	101	-2.5631**	0.7309***
		(1.315)	(0.362)
FREEMAN HIGH	101	0.7653	-0.1876
		(1.453)	(0.413)
GARFIELD-PALOUSE HIGH	101	-0.4978	0.1813
		(1.219)	(0.340)
GONZAGA HIGH+	101	-0.7247	0.1941
		(0.721)	(0.209)
HARRINGTON HIGH	101	0.5011	-0.1536
		(6.003)	(1.603)
JOEL E FERRIS HIGH	101	0.0367	-0.0339
		(0.541)	(0.153)
LA CROSSE HIGH	101	0.3522	-0.1128
		(2.820)	(0.750)
LEWIS AND CLARK HIGH	101	0.3119	-0.0608
		(0.441)	(0.127)
MARY WALKER HIGH	101	-5.6329**	1.5639**
		(3.397)	(0.947)
MEAD HIGH	101	0.3717	-0.0616
		(0.508)	(0.145)
MOUNT SPOKANE HIGH	101	0.3839	-0.0806
		(0.593)	(0.169)
NORTHPORT HIGH	101	-1.2552	0.3537
		(6.013)	(1.569)
OAKESDALE HIGH	101	0.3763	-0.1252
		(3.520)	(0.942)
ODESSA HIGH	101	2.7623	-0.7995
		(3.065)	(0.821)
PULLMAN HIGH	101	0.6704**	-0.1382
		(0.387)	(0.110)
PULLMAN CHRISTIAN HIGH+	101	-5.3429***	1.3756***
		(2.400)	(0.644)
REARDAN HIGH	101	-3.0667	0.8228

[11] All other coefficient results are shown in Table 7.

		(3.161)	(0.817)
REPUBLIC HIGH	101	-7.7365	1.9196
		(7.506)	(1.917)
RITZVILLE HIGH	101	-4.6056*	1.2363*
		(3.353)	(0.898)
SAINT JOHN/ENDICOTT HIGH	101	1.3409	-0.3488
		(1.379)	(0.379)
SHADLE PARK HIGH	101	-0.7204	0.1904
		(0.624)	(0.174)
SPRAGUE HIGH	101	17.7226	-4.4775
		(26.657)	(6.806)
TEKOA HIGH	101	-1.1593	0.3204
		(1.560)	(0.435)
UNIVERSITY HIGH	101	-0.4461	0.1598
		(0.551)	(0.154)
WEST VALLEY HIGH	101	-0.3723	0.0853
		(0.698)	(0.200)
WILBUR HIGH	101	-6.1845**	1.5748**
		(3.595)	(0.939)
BICKLETON HIGH	105	1.7673	-0.5353
		(2.871)	(0.882)
KITTITAS HIGH	105	1.5324	-0.3976
		(1.705)	(0.465)
MABTON HIGH	105	0.1861	-0.1086
		(1.484)	(0.432)
SELAH HIGH	105	-1.7989**	0.4963**
		(0.987)	(0.268)
WEST VALLEY HIGH	105	-0.498	0.1646
		(0.652)	(0.181)
ZILLAH HIGH	105	-3.9596***	1.0850***
		(1.996)	(0.537)
CAMAS HIGH	112	0.0887	0.0284
		(0.478)	(0.139)
COLUMBIA HIGH	112	-0.9067	0.27
		(1.705)	(0.469)
COLUMBIA RIVER HIGH	112	0.0749	-0.0157
		(0.564)	(0.167)
MOUNTAIN VIEW HIGH	112	0.2076	-0.0225
		(0.472)	(0.138)
PRAIRIE HIGH	112	-0.8541	0.2442
		(0.687)	(0.202)
RIDGEFIELD HIGH	112	0.3578	-0.109
		(0.664)	(0.194)
SKYVIEW HIGH	112	-0.451	0.1395
		(0.454)	(0.133)

CAPITAL HIGH	113	-0.7299*	0.2028*
		(0.490)	(0.144)
OLYMPIA HIGH	113	0.1137	-0.0012
		(0.540)	(0.160)
SOUTH BEND HIGH	113	1.1886	-0.396
		(1.469)	(0.422)
TIMBERLINE HIGH	113	0.4784	-0.1632
		(0.695)	(0.200)
TUMWATER HIGH	113	-0.5407	0.1973
		(0.688)	(0.191)
WILLAPA VALLEY HIGH	113	-0.5957	0.1376
		(1.672)	(0.453)
CENTRAL KITSAP HIGH	114	0.1566	-0.0702
		(0.453)	(0.132)
NORTH KITSAP HIGH	114	0.5853	-0.1223
		(0.591)	(0.170)
OLYMPIC HIGH	114	-1.0481*	0.2599
		(0.726)	(0.210)
BAINBRIDGE HIGH	121	0.4337	-0.0743
		(0.602)	(0.187)
BELLARMINE HIGH+	121	0.7818*	-0.2518**
		(0.513)	(0.152)
BELLEVUE HIGH	121	0.101	-0.0487
		(0.491)	(0.152)
BISHOP BLANCHET HIGH+	121	1.1611***	-0.2935**
		(0.580)	(0.172)
BOTHELL HIGH	121	0.6960*	-0.1694
		(0.454)	(0.135)
CEDARCREST HIGH	121	0.446	-0.148
		(1.048)	(0.309)
CURTIS HIGH	121	0.0773	-0.0331
		(0.596)	(0.177)
DECATUR HIGH	121	0.8444	-0.2327
		(0.697)	(0.198)
EASTLAKE HIGH	121	-0.3761	0.1419
		(0.445)	(0.137)
EASTSIDE CATHOLIC HIGH+	121	-0.0581	0.0461
		(1.091)	(0.318)
EMERALD RIDGE HIGH	121	-1.5545***	0.4094**
		(0.744)	(0.209)
GIG HARBOR HIGH	121	-0.5758	0.1771
		(0.565)	(0.167)
INGLEMOOR HIGH	121	0.3471	-0.1229
		(0.520)	(0.155)
ISSAQUAH HIGH	121	0.7947**	-0.1838*

		(0.431)	(0.133)
JOHN F KENNEDY HIGH+	121	0.0497	-0.0552
		(0.534)	(0.159)
JUANITA HIGH	121	0.1105	-0.0191
		(0.601)	(0.178)
KENT LAKE HIGH	121	0.1471	-0.0406
		(0.539)	(0.154)
KENTRIDGE HIGH	121	-0.2571	0.0422
		(0.494)	(0.145)
KENTWOOD HIGH	121	0.2606	-0.0441
		(0.459)	(0.135)
LAKE WASHINGTON HIGH	121	0.7269	-0.2046
		(0.637)	(0.193)
LIBERTY HIGH	121	-0.2402	0.0575
		(0.539)	(0.162)
MOUNT SI HIGH	121	0.3343	-0.0821
		(0.654)	(0.191)
NEWPORT HIGH	121	0.3622	-0.111
		(0.590)	(0.185)
ODEA HIGH+	121	1.2663	-0.3916
		(1.159)	(0.349)
OLIVER M HAZEN HIGH	121	-0.2913	0.0869
		(0.714)	(0.210)
PUYALLUP HIGH	121	0.4431	-0.1207
		(0.606)	(0.172)
REDMOND HIGH	121	0.531	-0.1065
		(0.604)	(0.183)
SEATTLE LUTHERAN HIGH+	121	-0.192	0.0601
		(2.019)	(0.571)
SEATTLE PREP SCHOOL+	121	-0.1805	0.1048
		(0.967)	(0.305)
SKYLINE HIGH	121	0.8824***	-0.2060**
		(0.376)	(0.117)
TAHOMA HIGH	121	0.8377*	-0.2309*
		(0.530)	(0.153)
WOODINVILLE HIGH	121	0.071	0.0153
		(0.538)	(0.161)
CHARLES F ADAMS HIGH	123	-0.9591*	0.2743*
		(0.681)	(0.191)
DAYTON HIGH	123	-2.3634*	0.5603
		(1.676)	(0.453)
HANFORD HIGH	123	0.078	0.002
		(0.400)	(0.119)
KAMIAKIN HIGH	123	-0.9191*	0.2583*
		(0.609)	(0.174)

POMEROY HIGH	123	-2.3059*	0.6309*
		(1.669)	(0.453)
PROSSER HIGH	123	-0.4722	0.1414
		(0.833)	(0.228)
RICHLAND HIGH	123	-0.4949	0.1724*
		(0.465)	(0.131)
SOUTHRIDGE HIGH	123	0.6923	-0.2107
		(0.574)	(0.165)
WAITSBURG HIGH	123	2.1609	-0.5017
		(6.601)	(1.703)
WALLA WALLA HIGH	123	-0.4586	0.1396
		(0.564)	(0.160)
EPHRATA HIGH	171	-3.1608***	0.7987**
		(1.527)	(0.408)
LIBERTY BELL HIGH	171	0.6953	-0.1416
		(1.493)	(0.420)
QUINCY HIGH	171	-3.1668***	0.8677***
		(1.124)	(0.315)
TONASKET HIGH	171	-0.8572	0.2721
		(0.976)	(0.284)
WARDEN HIGH	171	-0.4889	0.1317
		(1.780)	(0.487)
WATERVILLE HIGH	171	1.2777	-0.2765
		(1.848)	(0.509)
BURLINGTON-EDISON HIGH	189	0.6124	-0.1343
		(0.745)	(0.209)
DARRINGTON HIGH	189	-5.1152***	1.3524***
		(1.834)	(0.508)
LACONNER HIGH	189	-1.5217	0.427
		(1.395)	(0.375)
ORCAS ISLAND HIGH	189	0.7167	-0.1659
		(1.704)	(0.529)
SNOHOMISH HIGH	189	0.1736	-0.0053
		(0.568)	(0.172)

Standard errors in parentheses
*** p<0.05, ** p<0.10, * p<0.20
+Indicates Private High School

Table 14: Summary Statistics for High Schools Having a Significant Positive Intercept Shifter Coefficient, Significant Negative Intercept Shifter Coefficient & All Public High Schools in WA Having Students Attending WSU

High Schools (5) with a Significant POSITIVE Intercept Shifter Coefficient				
Variables	Mean	Std. Dev.	Min.	Max.
Total Enrollment	1141.2	334.7181	705	1562
Percent White	74.92648	13.66051	51.1475	85.7
Students Per Classroom Teacher	19	1.581139	17	21
Free or Reduced Priced Meals	17.56441	20.34445	2.07171	50.9091
Average Expenditure Per Pupil	7881.575	500.8348	7301.37	8534.058
High Schools (18) with a Significant NEGATIVE Intercept Shifter Coefficient				
Variables	Mean	Std. Dev.	Min.	Max.
Total Enrollment	640.4444	541.652	116	1657
Percent White	82.33014	14.243	37.9	96.55
Students Per Classroom Teacher	14.2	4.302	6	21
Free or Reduced Priced Meals	30.66289	13.264	14.1	59.3
Average Expenditure Per Pupil	8674.434	1673.696	6147.52	12632.58
All Public High Schools (329) in WA Having Students Attending WSU				
Variables	Mean	Std. Dev.	Min.	Max.
Total Enrollment	859.9605	606.2564	33	2502
Percent White	76.47451	20.10506	3.84615	100
Students Per Classroom Teacher	16.50751	5.620238	0	59
Free or Reduced Priced Meals	31.01579	17.69116	0	85.42
Average Expenditure Per Pupil	8714.97	2594.383	6147.52	26633.45

Table 15: Relationship between HSGPA and First Year Cumulative GPA from the Dummy Variable Approach

High School	ESD	Intercept	Slope
Base for Private High Schools		3.006518	-0.0575
Base for Public High Schools		3.210656	-0.0070
CENTRAL VALLEY HIGH	101	1.975234	0.2314
COLFAX HIGH	101	1.621107	0.2672
DAVENPORT HIGH	101	0.280383	0.7309
MARY WALKER HIGH	101	-3.080930	1.5639
PULLMAN CHRISTIAN HIGH+	101	-1.941880	1.3756
PULLMAN HIGH	101	3.513930	-0.1382
RITZVILLE HIGH	101	-1.807170	1.2363
WILBUR HIGH	101	-3.434540	1.5748
SELAH HIGH	105	1.113266	0.4963
ZILLAH HIGH	105	-1.050100	1.0850
CAPITAL HIGH	113	1.995442	0.2028
OLYMPIC HIGH	113	1.758145	0.2599
BELLARMINE HIGH+	121	3.796315	-0.2518
BISHOP BLANCHET HIGH+	121	4.246174	-0.2935
BOTHELL HIGH	121	3.387628	-0.1694
EMERALD RIDGE HIGH	121	1.249260	0.4094
ISSAQUAH HIGH	121	3.476911	-0.1838
SKYLINE HIGH	121	3.537834	-0.2060
TAHOMA HIGH	121	3.585911	0.2309
CHARLES F ADAMS HIGH	123	1.836032	0.2743
DAYTON HIGH	123	0.518347	0.5603
KAMIAKIN HIGH	123	1.914296	0.2583
POMEROY HIGH	123	0.658922	0.6309
RICHLAND HIGH	123	2.380858	0.1724
EPHRATA HIGH	171	-0.173730	0.7987
QUINCY HIGH	171	-0.374670	0.8677
DARRINGTON HIGH	189	-2.271980	1.3524

+ Indicates Private High School