

Understanding Retention among Private Baccalaureate Liberal Arts Colleges

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## **Abstract**

This paper attempts to analyze the explanatory variables that best explain retention among liberal arts colleges. Using the model's estimated parameters, the effects of Standardized Test Scores, average loans, educational related expenditures, average grants, and acceptance rate were calculated. This study concludes that increases in average grants, educational related expenditures, along with increases in Standardized Test Scores will lead to higher levels of retention among Baccalaureate Private Colleges. Taken together, these calculations indicate the degree of importance each explanatory variable has on the retention across Private Liberal Arts Colleges. This study compares the results of a cross sectional data set and a panel data set in order to properly examine the validity of the both outcomes. This analysis is intended to help Baccalaureate Private Colleges understand the factors that lead a student to drop out, as well as the factors that can enhance the college's ability to successfully retain students.

## **Introduction**

The reduced number of high school graduates results in a smaller applicant pool for baccalaureate colleges and this has forced private colleges to find new methods to increase the retention rate of the students already enrolled. According to Marcus (1989), some Baccalaureate Private Colleges have opted to target a new clientele of older students and find new ways to lower their attrition rate. Standardized Test Scores, Acceptance rate, average grants, and educational related expenditures have been cited as important determinants of student retention across Baccalaureate

Private Colleges in the United States. (Marcus, 1989) This study will analyze and discuss theoretical evidences found on literature reviews, formulate a hypothesized a model specification, measure the level of significance that each explanatory variable will have on retention rate, evaluate the validity of these results, and determine the major factors that will cause a student to drop out.

Retaining students is the goal of most Baccalaureate Private Colleges; a private college with a high attrition rate is failing to carry out its mission. Acceptance rates serve as a proxy for selectivity and are closely correlated with retention rate. Attaining a high attrition rate is going to have a negative effect on the appeal of the college so understanding retention is of high importance for Baccalaureate Private Colleges.

The retention rate among American colleges has steadily decreased since the 1980s. (Marcus, 1989) This has significant ramifications on many fronts that directly affect individual institutions. A college's ability to retain its students not only contributes greatly to its financial stability and success, but to its reputation and prestige as well. It is apparent that non-monetary attributes such as reputation and prestige play a vital role in a student's desire and willingness to attend a particular college. Highly reputable colleges are better able to retain students, because they are better equipped to meet the needs of their student body.

Highly reputable colleges are known to have higher net tuition revenue. Consequently, they are likely to offer their student body an environment that is more conducive to academics as well as social interaction and support. Lau (2003) discusses the importance that educational related

expenditures and financial aid have on a college's ability to retain students. There is evidence that suggests that institutional facilities and resources, such as academic advising and academic support programs, as well as career counselors are vital in retaining students (Marcus, 1989). Colleges that invest money to offer resources where students can get academic support, counseling and advising in particular indicate that they care about the wellbeing of their students. It results in students feeling more catered to and it reduces the student dropout rate.

College professors and administrators must strongly encourage students to make full use of these resources and to come forth when they have problems. The need for support and advising is a bigger issue for underclassmen, so it is of vital importance that a college has reliable resources to help freshman. Though increases in educational related expenditures are likely to enhance a college's ability to retain students, there are other indicators that will need to be considered in determining factors that influence the retention rate among private colleges.

Average SAT scores and average high school GPA across the college play a direct role in determining acceptance rate, which suggest that multicollinearity could be a potential issue and that will be discussed later on this paper (refer to the potential problems subsection on page 14). Marcus (1989) argues that acceptance rates play a prime role in determining retention. It is discussed that schools whose current batch of students possesses higher average SAT scores and HSGPA are going to be more far more selective in their admission process. They obviously have an advantage in that most of their students are high quality students, in which case they have the bargaining power to be selective

and accept only those students who meet the standards and 'best fit' their program. Institutions that have lower acceptance rates, by definition, are the ones that are the most difficult to obtain a seat in. Therefore, once a student secures a seat, there is a certain motivation to make best use of the opportunity. Students will be more likely to work hard because they know what it took for them to get the opportunity, and they know how quickly the opportunity can be snatched away. Regarding institutions such as Harvard and Yale that have 6 percent and 7 percent acceptance rates respectively, it is a fantastic achievement to be one of the select few to be admitted. Within these universities, students tend to take their academics more seriously, and are also more determined to overcome academic, social, financial and personal issues. They have greater motivation to stay in the college and reap all the benefits that come with having a diploma from a school such as Harvard. (Randy, 2008)

While the effect of both standardized test scores and high school GPA could potentially be accounted for by acceptance rate. The importance of both of these variables must not be undermined. Many studies and literature reviews written by Marcus (1989) and Lotkowski (2004) insinuate that HSGPA is a better indicator of the likelihood that a student will stay enrolled at a college. Lotkowski (date)'s analysis reveals that HSGPA has a closer correlation to retention than performance. The analysis suggests that HSGPA shows the level of commitment of a student, which is thought to affect how integrated he or she becomes within the school. High school GPA also measures more than just the skill of a student. HSGPA can be thought of as output per student and the fact that HSGPA is closer to retention indicates that HSGPA may capture more than the skill level of a student. HSGPA captures:

the number of hours a student spends studying, the level of persistence of the student, the student's level of commitment, and personality traits that are of high importance while attempting to explain retention rate. Although no data was found, the literature suggests that high school HSGPA is positively correlated with retention and it better indicates the likelihood that a student will stay in school. (Lotkowski, 2004)

The importance of average SAT scores must not be overlooked. Yes, the effect of SAT scores could potentially be accounted for by the acceptance rate, but average SAT scores have a deeper meaning. SAT's measure the skill set a student has prior to enrolling in a college and studies written by Bean (2004) stress the importance of precollege education and how it can influence a student's ability to succeed in college. Since SAT scores, measure the skill set the student has before going into college, it is likely to reflect the quality of education the student received before college. A study done by Marcus (1989) stresses the importance of SAT scores by suggesting that students who receive a high quality high school education are more likely to succeed in college, because the skill set measured by SAT's is also a reflection of the environment that the student grew up in. A student that attended a high school that is less academically inclined is unlikely to have the study habits needed to succeed in a baccalaureate private college.

This study concludes that standardized tests are used to measure a student's preparedness for college. Students who perform well on the SAT's generally reflect attributes such as preparedness, hard work, desire, and good attitude. It certainly does require a few months of hard study and preparation to

do well on a standardized test. Students with higher SAT's are going to be better able to cope with the academic pressure and the social challenges that college life presents. Great emphasis was placed on acceptance rate and SAT scores, as it was believed they would have a larger explanatory power.

The studies written by (Lotkowski, 2004) indicate that acceptance rate will be an important explanatory variable while attempting to explain retention, as the acceptance rate serves as proxy for selectivity. Baccalaureate private colleges that are highly selective tend to be highly reputable and high in demand. The greater the demand for the college, the more power the college has to select the students that are deemed to be the best fit for the college. Colleges that are highly selective also tend to choose students that are more academically inclined. These students are easier to retain, as they enter the college with all the tools needed to succeed.

Furthermore, both Lotkowski (2004) and Marcus (1989) analyzed retention from a more sociological perspective and stressed the importance of social integration. A study done by the University of Michigan (1989) suggests that private colleges can enhance social integration by investing in athletics, clubs, and counseling in order to better retain students. This was accounted with the use of educational related expenditures in the model (refer to equation 1 on the appendix page), as it is theoretically sound.

Many studies have suggested that highly selective colleges are able to get more money. Glater (2009) wrote an article summarizing that this last recession, also known as the worst recession since the great depression has negatively affected many private colleges. The "College in need closes a door to

needy students” article reveals that, Reed College has did not have enough money to offer financial aid to highly capable students that were qualified to enroll the institution. Reed College was forced to choose highly capable students that are well endowed before enrolling high qualified students with greater financial need. This article supports the idea that highly selective colleges can get more money because they have a bigger applicant pool to choose from, which means that they get to decide how much financial aid they will be willing and able to offer.

This analysis used financial aid as an explanatory variable in the model specification hypothesized on the appendix (refer to equation 1 on the appendix page). A study done by Lau (2003) identifies the importance of financial aid on student’s ability to stay in college. As the costs of college continue to rise, students and families are finding it increasingly difficult to cover this financial burden. This implies that students have to rely heavily on some sort of financial aid to cover the costs of college. It is argued that full- time students, who work part time jobs to help pay for college, are often left so exhausted from working twenty to thirty hours per week that they simply do not have the energy to attend their classes, complete homework assignments, or study adequately. This results in poor grades and declining academic performance, to a point where the student loses all motive, confidence and desire to excel at school, which would cause a student to dropout.

Perna (2009) offers a different view towards aid claiming that in order to achieve a higher retention rate; a college must combine grant aid with work-study. It is discussed that a mix of grant aid to cover tuition costs, and work study earnings to cover textbook and miscellaneous expenses, gives the



student the ability to pay for college, while becoming more socially integrated within the college. A combination of financial aid and work study will better encourage students to get good grades and thus remain at college. Gansemar-Topf (2005) suggests that institutional grants have a far more significant effect on retention than loans because grants are dollar amounts that are given to the student, and loans need to be paid back. The effect of average loans on the retention rate of a college may be ambiguous. Loans help people who would otherwise be unable to afford college, procure or continue their education. Loans help students who are facing financial pressure and offer them an alternative to dropping out. However, even loans that are relatively small can put a burden on the student's post-graduation life, as they need to be paid back with interest.

This study hypothesized that average loans could be positively or negatively correlated with retention, depending on the amount of the loan. There is theoretical base for why they could be positively correlated with retention. In a scenario in which a student has already invested a large amount of money into school, the opportunity costs (both implicit and explicit costs) that come with dropping out may be higher than the costs of taking out a loan. Therefore, the student opts to take on the financial burden as he or she anticipates benefitting more from obtaining a degree. On the other hand, a freshman going into their second semester of college may decide that the overwhelming financial pressure of taking out another loan will be greater than the benefits of staying in college, in which case they would choose to drop out, resulting in loans having a negative correlation with retention.

## **Hypothesis**

A careful examination of the literature reviews, economic theory and common sense helped formulate the following hypothesis:

- 1) One sided hypothesis for acceptance rate (AC): a negative correlation between AC and RR, which means that the beta of AC must have a negative sign.

$$H_0: \beta_{AC} \geq 0$$

$$H_A: \beta_{AC} < 0$$

- 2) One sided hypothesis for average grants (AG): a positive correlation with RR (retention rate), which means that the beta of AG must have a positive sign.

$$H_0: \beta_{AG} \leq 0$$

$$H_A: \beta_{AG} > 0$$

- 3) One sided hypothesis for educational related expenditures (ER): a positive correlation with RR, which means that the beta of ER must have a positive sign.

$$H_0: \beta_{ER} \leq 0$$

$$H_A: \beta_{ER} > 0$$

- 4) One sided hypothesis for standardized test scores (SAT's): a positive correlation between RR, which means that the beta of SAT's must have a positive sign.

$$H_0: \beta_{SAT} \leq 0$$

$$H_A: \beta_{SAT} > 0$$

- 5) Two sided hypothesis for average loans (AL): either a positive or negative correlation with RR, which means that the beta of AL could be either positive or negative.

$$H_0: \beta_{AL} = 0$$

$$H_A: \beta_{AL} \neq 0$$

## **The model**

The model specification listed below shows all the relevant explanatory variables chosen with the respective signs hypothesized in this study. The Ordinary Least Squares estimator was used to gather the results for this study. The functional form was chosen after a careful evaluation of the nature of this model. A linear regression was used, which implies that this equation appears to be linear in the coefficients due to the fact that the  $\beta$ etas are not being raised to any powers and they are not being divided or multiplied by another  $\beta$ eta coefficient.

## **(Equation 1)- cross sectional data set**

Equation 1 (refer to the appendix) subscript  $i$  indexes schools across sections. The variables in the model are defined as follows, acceptance rate (AC) is defined as the number of students that get

accepted into the college divided by admissions total; this percentage is intended to capture the level of selectivity of a college. Retention rate (RR) is the dependent variable, we are attempting to explain and it is defined as the number of students a college is able to retain. This rate is calculated by taking the total number of students that are retained at the college and dividing it by the total number of students that were enrolled at the college for a given year. Educational related expenditures (ER) are defined as the dollar amount a school spends on providing students with resources to succeed both socially and academically. Average grants (AG) and average loans (AL) are defined as the average dollar amount of loans and grants across the student body within a particular college. SAT stands for average standardized test scores across all students within a college, based on the math and writing components.

**Empirical Analysis- refer to equation 1 on the appendix page**

**Cross sectional data**

The data was drawn from the US department of Integrated Postsecondary Education Data Systems (IPEDS) for year 2010. The data is cross sectional as it was constructed after identifying 269 private liberal art colleges, also known as the Baccalaureate schools under the Carnegie classification system. Since the data was cross-sectional, we expect heteroskedasticity to be an issue. Therefore in forming our results, the HAC standard of errors and covariance was used.

**Results derived from cross sectional data set- refer to equation 1 on the appendix page**

**The t-statistic test and the p-value test:**

Educational related expenditures (refer to figure A) was hypothesized to have a positive correlation with retention rate, but the coefficient of ER did not have the sign implied by theory. ER has a coefficient of .00008 which states that for every one unit dollar increase in educational related expenditures, all else held equal; retention will increase by .00008 percentage points. Using a one sided test, the t-statistic of ER turned out to be insignificant because it is less than the critical value of  $T_{crit} = 1.658$  ( $1.314920 < 1.658$ ), which means that we fail to reject the null hypothesis. E-views prints out p-values for two sided alternative hypotheses. The marginal significant test reveals that educational related expenditures turned out to be insignificant with both a 10% and 5% level of significance, because it has a p-value of 0.1912.

Average grants are expected to have a positive correlation with retention because students with more grants are more likely to cover the costs of college. The coefficient has the sign implied by the hypothesis that was previously stated, which was positive. The t-statistic is greater than  $T_{crit}$  (1.658), which implies that the null hypothesis can be rejected. The P-value of average grants is significant with 10 % level of significance. The coefficient of average grants state that for every one unit dollar increase in average grants, ceteris paribus, retention will increase by about .0002 percentage points.

The results derived from the cross sectional data show that AG is statistically significant in relation to explaining retention.

The coefficient of average loans shows a positive correlation between average loans and retention rate. The coefficient of loans has a positive sign that is theoretically sound. The sign was expected to be either positive or negative so the positive sign suggests that the more a student takes out, the more he/she has invested in school, the higher the investment, the higher the opportunity costs of dropping out. A two sided hypothesis reveals a positive correlation between AL and RR and the t-statistic of AL turned out to be greater than the critical value (1.6580), which implies that the null hypothesis can be rejected. The P-value of average loans is significant with a 5% level of significance, as loans have a p-value of 0.0230. The coefficient of loans state that, all else held equal, a one dollar unit increase in average loans, translates into a 0.0012 percent increase in retention.

The coefficient of SAT's shows a positive correlation between SAT's and retention, which is the sign implied by the hypothesis stated above. Standardized test scores (SAT's) are statistically significant; the TK of SAT is larger than critical value (1.658). The p-value of standardized test scores is significant with a 5 % level of significance so this study concludes that SAT's are statistically significant with a 95% level of confidence. The coefficient of SAT's shows that, all else held equal, a one unit point increase in average SAT scores will lead to a .12 percent increase in retention.

The t-statistic of acceptance rate (AC) showed an unexpected sign. The coefficient of acceptance rate did not have the sign hypothesized on equation 1 (refer to equation 1 on the appendix

page), which means that we fail to reject the null hypothesis. Acceptance rate was expected to be negatively correlated with retention rate. As previously stated, this study hypothesized a negative relationship between AC and RR because prestigious colleges on average have a lower acceptance rates and thus higher retention rates. The sign of acceptance rate (AC) is counter intuitive and it is clearly inconsistent with the hypothesis stated on the appendix page (refer to equation 1).

There are a number of reasons that could have caused AC to have the wrong sign; however, since having an omitted variable bias is the most common error made among econometricians, the procedures for the omitted variable bias formula was used to further examine this unexpected sign:

$$\text{Expected bias } \mathbf{Bom} = f(\mathbf{Bin}, \mathbf{Bom})$$

College conforms to the sign requirements of expected bias formula stated above, because tuition is negatively correlated with acceptance rate and negatively correlated with retention rate. The following equation shows the procedure that was used for the omitted variable bias formula:

$$\text{Expected bias Retention rate} = \text{tuition} * (\text{tuition}, \text{acceptance rate})$$

$$(- * -) = \text{Positive bias}$$

**AC and tuition are negatively correlated, tuition is also negatively correlated with RR, and a negative multiplied by a negative equals a positive**

Although tuition satisfied the omitted variable bias formula, adding tuition did not change the sign of acceptance rate. Tuition turned out to be statistically insignificant with little to no explanatory power. After a careful analysis of all the possible factors that could have caused the unexpected sign, this analysis concludes that the unexpected sign was attributed to the nature of the model specification. The use of cross-sectional data for a model that is attempting to explain retention can cause more than just heteroskedascity. A model specification that attempts to explain retention rate has a time component. By not using a panel data set, one is essentially failing to capture changes over time, which would have the same effect as omitting a relevant variable. Most of the independent variables used to explain retention tend to change over time. Including the trend that each of these variables has had over time, is likely to change the unexpected sign of acceptance rate.

### **R- SQUARE and model specification evaluation**

The R-square derived from the cross sectional data for year 2010 was .70, which suggests that the model specification hypothesized (refer to equation 1) was a good fit and the null hypothesis for most of the explanatory variables specified in the model were rejected. The p-value test revealed that most of the explanatory variables used for this paper were significant with a 90% level of confidence. The unexpected sign of AC was the only major problem with the results derived from the cross sectional data set.



### **Panel date set**

The conclusion derived after examining the results of the cross sectional model for year 2010 led to the introduction of a panel date set. The data for this was drawn from the US department of Integrated Postsecondary Education Data Systems and it includes the following years: 2006, 2007, 2008, 2009 and 2010. The panel data set was constructed after identifying 269 private liberal art colleges, also known as the Baccalaureate schools under the Carnegie classification system. This five year data set did not turn out as expected. The results for this model (refer to equation 2 on the appendix page) did not change the unexpected sign of AC.

### **Results derived from the panel data set and hypothesis- refer to equation 2**

The results hypothesized for both data sets remain the same because the model hypothesized (refer to equation 2) was supported by theoretical evidences found on literature reviews and common sense. Although the results derived from the panel data did not fully support the model hypothesized, the model remained unchanged. If theoretical evidences and logic suggest that a variable belongs in the equation, the explanatory variable should not be taken out.

### **Examining the t-statistics derived from 5 year panel data set**

Acceptance rate was expected to have a negative sign (refer to equation 2 for the hypothesized model). The panel date set shows that the TK of AC is greater than TC ( $57.34 > 1.645$ ), but the beta of

AC does not have the sign implied by theory so this study fails to reject the null hypothesis of AC. The t-statistic of SAT's is greater than the TC of SAT ( $6.44 > 1.645$ ) so this study can reject the null hypothesis of standardized test scores. The TK of AL is - 2.608 and the absolute value would be 2.608. The absolute value of the TK of AL is greater than TC (1.960) so this analysis fails to reject the null hypothesis that the beta of AL equals zero. The negative sign of  $\beta_{AL}$  implies that AL is negatively correlated with RR. The t-statistic of average grants is greater than TC ( $7.48 > 1.645$ ) and it has the sign implied by theory so the null hypothesis of  $\beta_{AG}$  can be rejected. The sign of ER does not have the sign implied by theory so this study fails to reject the null hypothesis of  $\beta_{ER}$ .

The coefficient of AC is 0.899502, which means that for every one unit increase in acceptance rate, ceteris paribus, retention will increase by 0.899502. The coefficient of standardized test scores on the other hand, states that for every one unit increase in SAT's, all else held equal, retention rate will increase by 0.005346. The coefficient of average loans indicates that for every one unit increase in AL, all else held equal, retention will decrease by -0.001012. The coefficient of average grants states that for every one unit increase in AG, ceteris paribus; RR will increase by 0.0017840. The coefficient of ER on the other hand is counter intuitively, because it indicates that for every one unit increase in educational related expenditures, all else held equal, the retention rate will decrease by -0.000150.

#### **Examining the P-values derived from the 5 year panel data set**

The P-value of: AC, SAT's, and AG show statistical significance with a five percent level of significance. Average loans are statistically significance with a 10 percent level of significance and this study concludes that with an 80% percent level of confidence, educational related expenditures are statistical significant. The marginal significance level test was a huge success so the results derived from the panel data set shown on the appendix page (refer to figure B) show evidences that support the theoretical underpinnings of the model hypothesized (refer to equation 2 on the appendix page).

#### **R-square derived from the five year data set:**

The R-square of this panel data is .99 (refer to figure B on the appendix page) and it suggests that the model specified (refer to equation 2 on the appendix page) is a good fit. The results derived from the panel data does more to support the theoretical evidences to support the model specification hypothesized because it has a higher R-square and the explanatory variables shown on figure B of the appendix page have higher explanatory power.

#### **Potential problems**

While the regression of the panel data set did a lot supported the model specification hypothesized (refer to equation 2) in this study, AC still has the wrong sign, and there are a number of factors to will need to considered while examining this unexpected sign. As previously stated, AC and SAT's are very closely correlated and multicollinearity is a potential problem. The simple correlation coefficient between SAT's and AC is relatively high:  $r_{SAT, AC} = 63.7819$ . This high correlation causes the standard of errors to be high when both of these variables are included. Most econometricians pick

an arbitrary number of .80 as the cutoff to indicate that multicollinearity is in fact severe. Although a high  $r$  signals high correlation, this study concludes that this high correlation is not severe. Most explanatory variables are going to be correlated to a certain extent so a high  $r$  does not have to be a reason to become concern. This analysis concludes that although both SAT's and AC are highly correlated, the variables are not redundant and they are not measuring the same thing so both variables belong in the model.

While increasing the size of the variables did lead to more accurate results, the larger sample revealed the high correlation between AC and SAT, which made intuitive sense from the very beginning. The causes of the unexpected sign are hard to pinpoint, but this study concludes that there are numerous relevant explanatory variables that cannot be quantified and that is captured by the stochastic error term. The error term is likely to change when the omitted variable changes and if the omitted variable is correlated with an independent variable, which is very likely to happen, then the error term would be correlated with the error term and that is a would violate classical assumption III, which states that the error term must be uncorrelated with the error term. Unfortunately, all the potential omitted variables did nothing to change the unexpected sign.

All that is required for the violation of classical assumption III is that there be endogenous variables that are jointly determine in a system of simultaneous equations, which could very well be the case with AC. Acceptance rate can capture a number of things, the article written by Glater (2009) mentioned that private colleges having to choose students that can pay full freight tuition over well

qualified low income students. The current state of the economy has caused private colleges to have lower retention rates. According to a study done by ACT Inc. (2011), “retention rates at private colleges (72 percent) fell behind those at four-year public institutions (74 percent), possibly reflecting continuing strains in the economy and the ability of families to afford higher tuition.” There are numerous reasons that cause a student to drop out and the model specification hypothesized (refer to equation 1) simply accounted the major factors that could on average lead a student to drop out of college.

This study accounted for the factors that were quantifiable, but the study done by Marcus (1989) used simultaneous equations to study retention, because many explanatory variables used for explain retention were captured by AC. Marcus (1989) managed to quantify the persistent rate of students, which is a student’s drive and willingness to stay in college; however, no data for this was found for this analysis. The findings written by: Lotkowski (2004), Perna (2009) and Marcus (1989) have studied retention from an economic and sociological perspective. Their studies evaluate numerous factors that influence a student’s decision to stay in college and most of their findings were difficult to quantify so this paper analyzed the major determinants that best explain the retention rate among private colleges.

**Conclusion:**

This analysis has examined the major factors that best explain the retention rate among private baccalaureate private colleges. This paper analyzed several literature reviews written by

econometricians in order to find theoretical evidences to hypothesize a model for retention. The following explanatory variables were calculated to understand retention: acceptance rate, average loans, average grants, educational related expenditures, and SAT's. The results provided this study with theoretical evidences that support the validity of the hypothesized model derived on the appendix page (refer to equation 2). This analysis concludes that increases in: educational related expenditures, average grants and standardized test scores will lead to higher retention rates.

A double sided test revealed that average loans are negatively correlated with retention and there is theoretical base for that because both household debt and consumer confidence are at an all-time high, which means that students are going to be less likely to take out loans. Acceptance rate had an unexpected sign, but the P-value test showed AC as having statistical significance. This paper relied on theory and statistically significance to evaluate the factors that influence a student's decision to stay in college.

# Appendix

## For cross sectional data

Let:

**RR<sub>i</sub>** = Retention Rate (%)

**AC<sub>i</sub>** = Acceptance Rate (%)

**ER<sub>i</sub>** = Educational Related expenditure (\$)

**AG<sub>i</sub>** = Average grants across college (\$)

**AL<sub>i</sub>** = Average Loans across college (\$)

**SAT<sub>i</sub>** = Average SAT score across college (Math and Writing)

**E<sub>i</sub>** = Stochastic error term

### (Equation 1)

The following model was hypothesized after a careful evaluation of literature reviews written by econometricians, theoretical evidences, and the use of common sense.

$$RR_i = B_0 + B_1AC_i + B_2ER_i + B_3AG_i + B_4AL_i + B_5SAT_i + E_i$$

**Figure A**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.39887	9.484645	-1.834425	0.0692
AC	0.083035	0.046277	1.794291	0.0754
ER	8.88E-05	6.76E-05	1.314910	0.1912
AG	0.000223	0.000123	1.817501	0.0717
AL	0.001293	0.000561	2.304079	0.0230
SAT	0.126773	0.013318	9.519191	0.0000

**T- Critical value= 1.658**

**R-square= .70**



## For the panel data set

Let:

$RR_T$  = Retention Rate (%)

$AC_T$  = Acceptance Rate (%)

$ER_T$  = Educational Related expenditure (\$)

$AG_T$  = Average grants across college (\$)

$AL_T$  = Average Loans across college (\$)

$SAT_T$  = Average SAT score across college (Math and Writing)

$E_T$  = Stochastic error term

(Equation 2)

$$RR_t = B_0 + B_1AC_t + B_2ER_t + B_3AG_t + B_4AL_t + B_5SAT_t + E_t$$

### Figure B

Dependent Variable: RR  
 Method: Least Squares  
 Date: 04/18/12 Time: 09:30  
 Sample (adjusted): 2 1078  
 Included observations: 431 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.85381	3.358574	4.422654	0.0000
AC	0.899502	0.015687	57.34120	0.0000
SAT	0.005346	0.000830	6.440701	0.0000
AL	-0.001012	0.000388	-2.608337	0.0094
AG	0.001784	0.000238	7.484536	0.0000
ER	-0.000150	9.77E-05	-1.532887	0.1260

  

R-squared	0.991477	Mean dependent var	231.8097
Adjusted R-squared	0.991376	S.D. dependent var	250.5423
S.E. of regression	23.26616	Akaike info criterion	9.145700
Sum squared resid	230058.4	Schwarz criterion	9.202305
Log likelihood	-1964.898	Hannan-Quinn criter.	9.168049
F-statistic	9887.670	Durbin-Watson stat	1.551983
Prob(F-statistic)	0.000000		

For a one-sided test under a 5% level of significance:

Degrees of freedom: 425

T-critical value= 1.645

R-square= .99

For a two-sided test under a 5% level of significance:

Degrees of freedom: 425

T-critical values: 1.960 or -1.960

R-square= .99

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