College Completion Rates: Does the type of financial aid received influence student college completion?

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Funding for college education and who should pay and benefit from college education has been an endless debate between policymakers and everyday citizens. Numerous research studies have been conducted in trying to understand what contributes to college completion rates, but the research has not always yielded the same results. This is due to each individual student having their own unique college experience while coming from various walks of life. Our nation's future lies within the education we can provide to students who will in turn contribute to and better their societies. However, does the price of college come at a cost to society without the benefit of college graduates? The debate of financing college education has included whether the burden should fall on the students themselves to finance their education, or whether funds from the government provided by taxpayers should help contribute to college student success.

Through this research we have worked to gain an understanding of the multiple factors that contribute to college completion. Our research investigates the influence that different forms of financial aid have on a student's college completion rate by observing the percentage of students with federal loans and those with Pell grants. Along with these variables we also observe the effects of average SAT scores, total undergraduate enrollment, and instructional expenditures per student on college completion rates. We hope that this research can help others understand how we as a society can increase college completion and answer the question of whether the type of financial aid received has an influence on college completion.

II. Literature Review

As we researched academic literature for this paper, we found multiple areas of interest and were able to develop the foundation for our study. There has been copious research done on the subject of college completion, and we have cited several articles throughout our paper to build the basis for our understanding of the different variables that can have an influence on college completion rates. Though our research focuses on financial aid, specifically federal loans and Pell grants, some of the articles we used to assist with our research used student preparation, resources of the institutions attended by students, and other forms of financial assistance as their independent variables.

Through our literature review we have found that more students are enrolling in college than ever before, but with increased college enrollment rates there does not seem to be an increase in college completion (Bound, Lovenheim, and Turner 2010). It has also been observed that financial aid in the form of federal loans have increased, while the college completion rate for students at four-year institutions has decreased (Kim 2007). Past studies have shown that it is possible that students receiving some form of financial aid are able to show higher rates of college completion, because the receival of financial aid has reduced the cost of college for them

(Denning 2019). Though loans can also help reduce the cost of college they must be repaid unlike other forms of aid such as grants, scholarships, and tax benefits. This raises the question of whether financial assistance is beneficial to a student's college completion.

Financial aid allows a student to attend college at a lower cost with the benefit of attaining a college degree (Kim 2007). Studies have shown college completion rates being affected by many factors, but the focus seems to always be brought back to family finances. When considering college and its costs and benefits the price of college, as well as the decision and the ability to attend are influenced by an individual and their family's ability to finance their college education (Ganderton and Santos 1992). Even with financial aid rates rising to meet the increasing tuition costs, students are still suffering from high amounts of financial stress (Robb 2017).

Student loans have become the most feasible way to finance education at a 4-year institution, and research has shown that there is a positive correlation between loans and degree attainment (Kim 2007). However, research conducted by Cohodes and Goodman argues that aid received does not have as much of an impact as college quality does on completion rates. Their study showed that attending a lower quality college lowers on time completion rates by more than 40 percent (2012). Another study conducted by Bound, Lovenheim, and Turner also showed that students that attended lower ranked universities experienced a decline in college completion rates while those students enrolled at higher ranked institutions experienced an increase in completion rates (2010). These multiple studies suggest that the probability of attaining a bachelor's degree increases with the selectivity of the institution attended (Melguizo 2010). When first beginning our research, we believed that there would be a strong positive correlation between the receival of any form of financial aid and college completion. However, after reading through numerous articles to contribute to our literature review, we have begun to notice a trend in the quality of the institution and the individual students themselves that contributes to a pattern of higher rates of college completion.

III. Economic Theory

An education production function defines that student outcomes, which in our case is college completion, is affected by multiple variables such as family, peers, and quality of the school and educators (Hanushek 2020). This means that there are many factors that can exert possible influences on college completion rates, but from our research of previous literature we have chosen to focus on the impact of financial aid received on college completion rates. Hanushek describes that when working with an education production function it can help us understand how skills can be developed and enhanced as we can achieve a desired output by observing the value that each input contributes (2020). Overall, we are trying to observe if there are any disparities between the college completion rates of students receiving a federal loan and students receiving a Pell grant. Our education production function

(1.) $C150\_4 = \alpha + \beta1\ FTFTPCTFLOAN + \beta2\ FTFTPCTPELL + \beta3\ UGDS + \beta4\ INEXPFTE + \beta5\ SAT\_AVG$

shows that our dependent variable is college completion rates for first-time full-time students at four-year institutions completing within six years (C150_4). Our independent variables are percentage of first-time full-time students receiving federal loans (FTFTPCTFLOAN), percentage of first-time full-time students receiving a Pell grant (FTFTPCTPELL), total number of undergraduate students enrolled at an institution (UGDS), the amount instructional expenditures per full-time equivalent student (INEXPFTE), as well as the average SAT score of students (SAT_AVG). By using this education production function, we can try to observe if our chosen independent variables exert any influence on our dependent variable college completion rates.

Table 1. Variable Names and Definitions

Variable Name	Definition
C150_4	Completion rate for first-time, full-time students at four-year institutions (150% of expected time to completion)
FTFTPCTFLOAN	Percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a federal loan
FTFTPCTPELL	Percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a Pell Grant
SAT_AVG	Average SAT equivalent score of students admitted
UGDS	Enrollment of undergraduate certificate/degree-seeking students
INEXPFTE	Instructional expenditures per full-time equivalent student

IV. Data

The data used in this research is the merged 2013-2014 and the merged 2017-2018 data from College Scorecard. To examine the facts of college completion, we used the data from the two-time frames, because it allowed us to observe the completion rates for first-time full-time students who completed their college education within six years. We focus on the cohort entering college in the 2013-2014 school year.

Obtained from the federal reports of institutions, data on federal financial aid, and tax information, the College Scorecard data provides information on not just institutional information but on numerous background categories as well. This data contains information on federal aid, standardized test achievement, institutional expenditure, and characteristic data. This data is available for download at https://collegescorecard.ed.gov/data/. Data definitions for this dataset are available at https://collegescorecard.ed.gov/data/documentation/ .

To investigate college completion rate, we used the longitudinal completion rate. The U.S. Department of Education defines completion rates in this dataset as: The proportion of full-time, first-time, degree/certificate-seeking undergraduates who completed a degree or certificate at the institution within 150 percent of normal time, calculated from the IPEDS

Graduation Rates component. Separate metrics are calculated for 4-year institutions and less-than-4-year institutions. This metric is calculated as the number of full-time, first-time, degree/certificate-seeking undergraduates who completed a degree or certificate divided by the number of full-time, first-time, degree/certificate-seeking undergraduates in the corresponding completion rate cohort (C150_4, C150_L4). For full-time, first-time, bachelor's degree-seeking undergraduates, 150 percent of normal time is typically 6 years, and for full-time, first-time, associate degree-seeking undergraduates it is typically 3 years. For full-time, first-time, certificate-seeking undergraduates, the normal time period varies by the length of the program (for example, 9 months for a certificate with a normal completion time of 6 months). Proportions are expressed as decimals rounded to four decimal places, so, for example, 0.1234 equals 12.34 percent. Pooled figures include two cohorts of students.

V. Statistical Analysis

Table 2 gives us a summary of our dependent and independent variables used in this research. We can observe the count, mean, standard deviation, as well as the minimum and maximum value for each variable. We can see that college completion for first-time full-time students within six years has a mean of about 50.5 percent, and that the mean for percent of students with federal loans and Pell grants are 52.6 percent and 57 percent respectively. Through these summary statistics we can see that for the most part around half of students will receive aid in the form of loans and grants, and that also on average half of students enrolled in college will complete their education within six years.

The average enrollment size of undergraduate students is about 2,522 students, but with a minimum of zero, maximum of 88,921, and a standard deviation of about 5,657 students this

shows that there are major differences in size of student population at universities with some even having no students enrolled. From our summary statistics we can also see that there are large disparities in instructional expenditures per full-time student with a minimum of $0, maximum of $542,922, and a mean of about $8,477. The summary statistics of undergraduate enrollment and instructional expenditures gives us a rough understanding of the quality of the institutions within our dataset.

To understand how the capabilities and preparedness of the student themselves affects their college completion, we also needed to create a summary about the SAT scores in our data. The average SAT equivalent score for students admitted had a mean of 1141.2 with the lowest score accounted for being 785 and the highest score at 1566. The statistical analysis for this research does not explain how these variables are related or if they have an effect on one another, but provides us with a better understanding of how many statistical variables we have to work with and their average results. It is also important to note that the values for C150_4, FTFTPCTFLOAN, and FTFTPCTPELL are in percentages. UGDS and SAT_AVG are numerical values while INEXPFTE is expressed as currency.

Table 2. Summary Statistics

	C150_4	FTFTPCTFLOAN	FTFTPCTPELL	UGDS	INEXPFTE	SAT_AVG
Count	2300	5740	5740	6041	6304	1298
Mean	0.505	0.526	0.570	2522.161	8477.335	1141.174
Std	0.219	0.321	0.239	5657.459	14025.056	125.517
Min	0	0	0	0	0	785
Max	1	1	1	88921	542922	1566
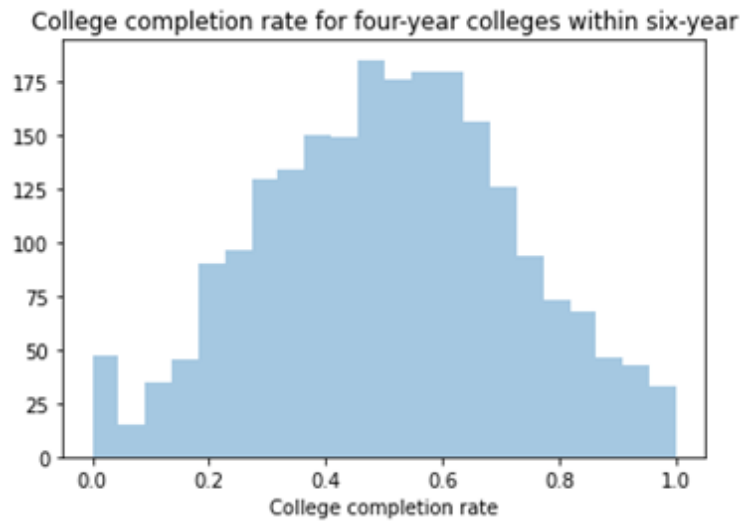
Figure 1. Histogram for the Dependent Variable: College Completion Rate

We summarize the distribution of completion rates for four-year colleges by students within six years in a histogram shown in Figure 1 above. The minimum rate of college completion is 0 percent and the maximum value is 100 percent. When looking at Figure 1, we see that they are highly concentrated near the mean rate of 51 percent which is right above the median rate of 50 percent. This histogram follows a normal distribution in which 68 percent of observations in the data are within one standard deviation of the mean, 95 percent are within two standard deviations of the mean, and 99.7 percent are within three standard deviations of the mean. This normal distribution is beneficial when conducting our research because it shows us that we have sufficient data to focus on college completion as our response variable.
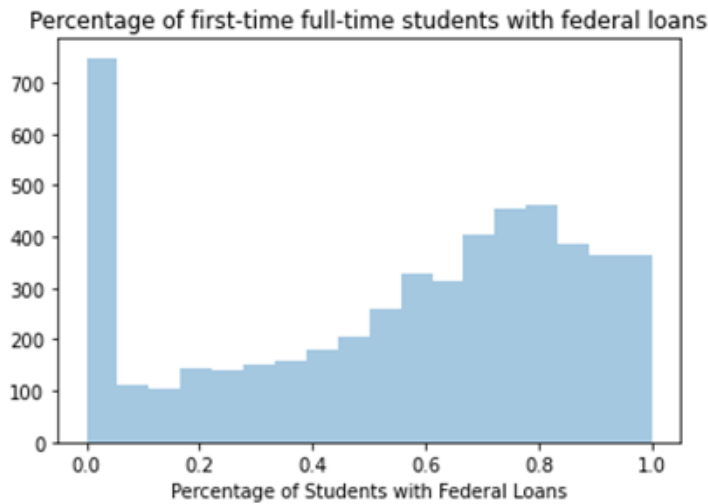

Figure 2. Histogram for Key Independent Variable: Percentage of Students with Federal Loans

The histogram in Figure 2 represents the percentage of students who received federal loans with a minimum of 0 percent and maximum of 100 percent. We see that the data is skewed left with many outliers at 0 percent representing students who did not receive any federal loans. With the percentage of students receiving loans being so large on both sides of the scale as shown in the histogram, a mean of 53 percent is not surprising. However, this skewed data helps us see that many students do not always choose federal loans to help finance their college education. This could be due to students having to pay back federal loans, so instead they seek out alternative forms of financial assistance such as grants or scholarships. Many college students also work part-time to finance their education. The stress caused by the financial debt incurred from student loans is something previously researched and the avoidance of loans may increase or stay at this high amount as a response to the rise in tuition costs (Robb 2017).

VI. Scatterplot and Regression Line

Figures 3 and 4 represent scatterplots of completion rates against federal loans and Pell grants. The Y-axis shows our dependent variable of C150_4, Completion rate for first-time, full-time students at four-year institutions (150 percent of expected time to completion). The X-axis shows our first independent variable of FTFTPCTLOAN, Percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a federal loan. Our second independent variable on our scatterplot is FTFTPCTPELL, Percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a Pell Grant. Different forms of federal aid differ between each student due to their individual characteristics (Kim 2007). This shows that some students do not rely on either Pell grants or federal loans to finance their education, while some students will use one or the other or even both to finance their college education.
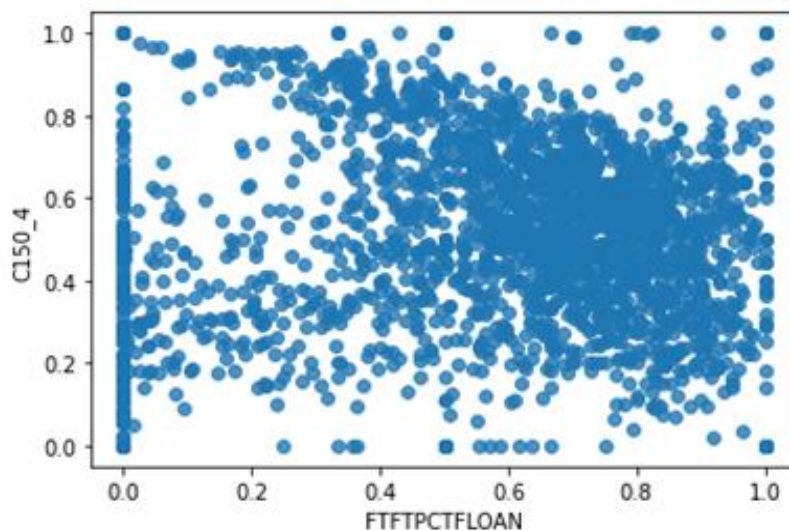
Figure 3. Scatterplot of completion rates and percent of federal loans

The variable, FTFTCTFLOAN, is defined as the Percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a federal loan. Figure 3 has an undetermined relationship since no correlation is visibly shown. A large portion of the data is on the right side of the figure, but the data seems to have no trend. We can observe that there are many outliers at zero indicating a large percentage of students do not take out federal loans to finance their education. The outliers indicate that the graph is skewed to the left which also draws our conclusion to be no correlation. Many students within our data set attain a college degree taking out more than half of federal loans. A small number of student's complete college taking out only federal loans by the end of their college career. If the two variables indicated a positive correlation of college completion rates, then the graph would show a positive linear relationship. The graph is considered undetermined due to the fact that some students do not use federal loans to finance their higher education and others do use loans.
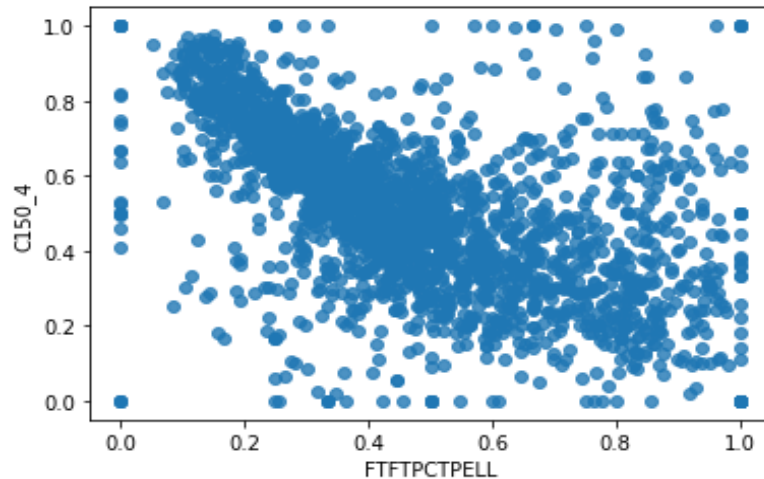
Figure 4. Scatterplot of completion rates and percent of Pell grants

The variable, FTFTPCTPELL, is defined as the percentage of full-time, first-time degree/certificate-seeking undergraduate students awarded a Pell Grant. Figure 4 shows a weak negative correlation between college completion and Pell grants. The scatterplot above shows outliners along the perimeter of the graph which indicates that the correlation is not strong. We observe that those students who receive a Pell grant for that year tend to not receive the aid throughout the following years, which would decrease the rate of college completion of first-time, full time students. Overall, both federal loans and Pell grants do not show a positive correlation towards college completion. Even though most first-time, full time student's complete college with federal aid, a moderate portion of first-time, full time students do not complete college with federal aid under their name.

From our research, we expected both federal loans and Pell grants to have a positive correlation on college completion. Since federal aid acts as a discount to a college education, most would expect a higher rate of degree attainment (Kim 2007). We generated our scatter plots based on the 2017-2018 college scorecard data which then resulted in the below figures. After calculating our data to generate the scatterplot, we find that federal loans and Pell grants do not have a positive correlation on college completion. After discussing the results, we concluded that the outcome is unexpected because federal aid should encourage a student to complete a college degree.

VII. Correlation and Regression

When looking at the correlation matrix, we can observe that there is a small negative correlation between the college completion rate of first-time full-time students completing within six years and the percent of first-time full-time students receiving a federal loan. This correlation of -0.011 tells us that as more students receive federal loans, there is a slight decrease in college

completion rates for students within six years. This correlation differs from our multiple regression results when controlling for all our independent variables, because once creating our

Model 5 we now see that federal loans increase college completion by a small percentage. In this correlation matrix of our data, students receiving Pell grants showed an even stronger negative correlation with a value of -0.55. This relationship holds true when creating our scatterplots and conducting our multiple regression analysis. Throughout all observations of the data, there is a consistent negative correlation between college completion and the percent of first-time full-time students awarded a Pell grant.
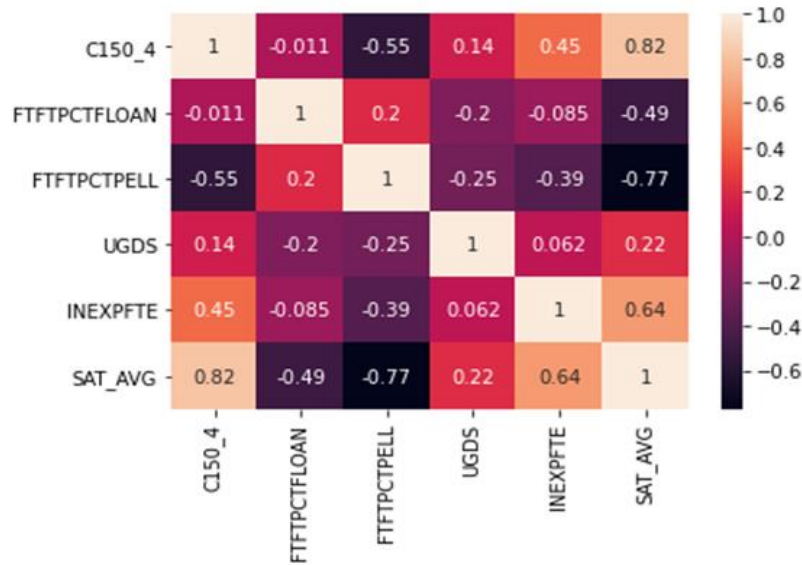
Figure 5. Correlation matrix

Another finding that is interesting to observe in the Figure 5 correlation matrix is that there is a strong negative correlation between average SAT scores and both the percentages of students with Federal loans or Pell grants, and this relationship is also shown in Figure 6. This information suggests that students scoring higher on the SAT exam are less likely to have federal loans or Pell grants. However, there is a strong positive correlation between average SAT scores and college completion rates, which indicates that students scoring higher on the SAT exhibit higher rates of college completion. This suggests that students who are academically inclined complete college at greater rates than those who are not academically inclined. Those students that are academically inclined also do not rely on federal loans or Pell grants to finance their higher education.
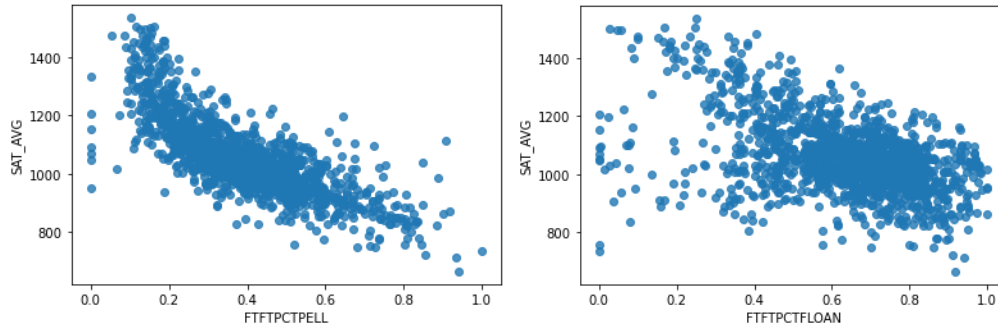
Figure 6. Scatterplots comparing the average SAT score of students to the percentage of students with Pell grants or federal loans

When graphing the relationships between academic performance through SAT averages provided and Pell and loan receival, we do see an overall trend of higher academic performance and lower receival (seen in scatterplots above). However, be that as it may, without more information on institutional grants we cannot draw any conclusions from this.

Table 3 below describes our multiple regression results. By using a multiple regression model, we can try to observe the effects that multiple independent variables have on a selected dependent variable. When we create our first model by regressing college completion rates (C150_4) with the percent of students with federal loans (FTFTPCTFLOAN), we see that for every 1 percent increase in the receival of federal loans by students the college completion rate would decrease by 0.0087 percentage points. When we create our Model 2 and additionally regress for percent of first-time full-time students awarded Pell grants, we now see that for every 1 percent increase in the receival of federal loans results in an increase in the college completion rate by 0.0712 percentage points. In Model 2 we can also see that for a 1 percent increase in the percent of first-time full-time students awarded a Pell grant, there is a decrease in college completion by 0.5330 percentage points.

As we continue to regress our other independent variables (UGDS, INEXPFTE, SAT_AVG) into our model we continue to observe changes in our response variable, C150_4. When we regress the variables for undergraduate enrollment (UGDS) and instructional expenditures per student (INEXPFTE) we see that they do not have a large effect on our response variable since their values are very small and near zero. This means that when plugging numerical values into our new education production function no matter the size of the undergraduate enrollment or amount invested by institutions on their students, they will not contribute to a change in our response variable of college completion. The average SAT scores of students admitted was the last variable we regressed in our Model 5. In Model 5 for every 1 point increase in the average SAT score of students there is a 0.08 percentage point increase in college completion, and we now see that our other variables FTFTPCTFLOAN and FTFTPCTPELL have changed by adding SAT_AVG to our regression model. After controlling for all independent variables in our Model 5, we are able to create our new function

(2.) $C150\_4 = -0.1896 + 0.0903(X1) - 0.3191(X2) + 0(X3) + 0(X4) + 0.0008(X5)$

Table 3. Multiple Regression Results

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Intercept	0.5129	0.7164	0.7001	0.5601	-0.1896
FTFTPCTFLOAN	-0.0087 (0.0171)	0.0712 (0.0144)	0.0788 (0.0146)	0.1094 (0.0141)	0.0903 (0.0164)
FTFTPCTPELL		-0.5330 (0.0168)	-0.5250 (0.0169)	-0.4152 (0.0179)	-0.3191 (0.0249)
UGDS			0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.0000)
INEXPFTE				0.0000 (0.000)	0.0000 (0.000)
SAT_AVG					0.0008 (0.0000)
n	2240	2240	2240	2240	1364
R – squared	-0.0003	0.3105	0.3132	0.3717	0.7092
Adj. R – squared	-0.00	0.31	0.31	0.37	0.71

Standard Error represented in parenthesis ()

Our new function describes that college completion (C150_4), our dependent variable will be plotted on the Y-axis and all of our independent variables in our models constructed from our multiple regression results (FTFTPCTFLOAN, FTFTPCTPELL, UGDS, INEXPFTE, SAT_AVG) will each be plotted on the X-axis. With this function we can plug in the corresponding variables for each independent variable as X and we can use it to estimate the rate of college completion. Our function has a Y-intercept at -0.1896 and the values before each X variable is the beta coefficient which in turn represents how they affect the response variable, C150_4. In our final model for every 1 percent increase in percent of students with federal loans, college completion for first-time full-time students within six years will increase by 0.0903 percentage points. For every 1 percent increase of percent of students with Pell grants college completion rates will decrease by 0.3191 percentage points. From our model we can also see that undergraduate enrollment and instructional expenditures will not have any effect on our new

formulated education production function. The average SAT score of students was able to help us control and regress for the main explanatory variables we wanted to focus on which was FTFTPCTFLOAN and FTFTPCTPELL, and we see that for every 1-point increase in the average SAT score of students there is a 0.0008 percentage point increase in the rate of college completion.

VIII. Empirical Results

With a final adjusted R-squared value of 0.71, our regression output table indicates our model explains 71 percent of the variation in completion rates using our chosen variables. Our coefficient estimates for loan and Pell grant receival, SAT average, undergraduate class size and average expenditures spent on students are all statistically significant with P-values of 0.00 each in our final model but they do vary in amounts with some being very small in value. With these results, we can reject the null hypothesis as there is a statistically significant relationship between college completion rate and loan receival. With a correlation coefficient of 0.09 (after controlling for other variables) the association between completion rate and loan receival is quite small suggesting that when trying to achieve higher rates of completion, increasing loans given is not the only path to follow. Another interpretation could suggest that students who are more likely to need loans are also students who are not offered high amounts of performance-based grants from the attended institutions. These students with lower standardized test performance will not be as prepared for higher education as their higher performing and grant receiving counterparts. This resurfaces previous research performed by Bound, Lovenheim, and Turner which suggests that higher ranked universities have a positive impact on completion rate (2010).

The variables INEXPFTE and UGDS were chosen to represent institution quality as they are variables that define institutional characteristics in a numerical way that is not only easier to observe but is also available in our dataset. Higher quality institutions tend to be characterized by smaller class sizes and higher expenditure per student, both characteristics that are more likely when an institution is not only smaller as a result of selectivity but also higher in tuition costs. Looking at their coefficients in our final model, we see that they are positive suggesting that the quality of the institution does come into play when investigating completion rate.

With a positive coefficient of .08, SAT average is a variable with a larger effect on completion rate in our analysis. A higher SAT performance would lead to a higher chance of acceptance at a more selective institution which can indicate higher rates of completion as mentioned in previous research performed by Melguizo (2010). A student who has already taken the steps towards successful academic performance in earlier years may already be inclined to perform well in later years. These students are more likely to have developed the skills needed to adapt to a higher-level course load which would result in not only increased academic performance but increased completion rates as well. When looking to increase college completion rates, this stresses the need for not only identifying lower performing students but also the need for academic intervention in earlier K-12 school years.

IX. Conclusion

The results that are shown from our research conclude that federal loans and Pell grants do not encourage the increase in college completion rates as we had first assumed. By merging data from College Scorecard from the years 2013-2014 and 2017-2018, we were able to create different tables, figures, and functions to understand whether the type of financial aid received influenced college completion and what other underlying variables have an effect on an individual completing a college education. Studies done on college completion rates show disparities between their results with some finding that college completion is decreasing while the amount of federal loans is increasing, and others finding that the receival of some form of financial aid is correlated with higher rates of college completion (Kim 2007; Denning 2019). However, our research shows that federal loans have a weak correlation to the college completion rate of first-time full-time students completing within six years. This outcome indicates that even though most college students depend on federal loans to attain a college degree, this does not necessarily mean they will complete their college education.

After running the relationship between a student's college completion and a student being given a Pell grant, we show that there is a weak negative correlation between the two indicating that an institution awarding more Pell grants will experience lower rates of college completion compared to a university awarding very few Pell grants to students. Both variables do not contribute to higher rates of college completion even though federal loans and Pell grants act as an assistive aid for students to finance their education. The additional variables that were included in our research (INEXPFTE, UGDS, SAT_AVG) acted as sub variables that could help us control for the percentages of students with federal loans and Pell grants while furthering our research. Though FTFTPCTFLOAN and FTFTPCTPELL did not correlate with higher rates of college completion, the average SAT score of students (SAT_AVG) and instructional expenditures per student (INEXPFTE) had positive correlations with college completion rates.

These findings further concluded that the type of institution attended, and a student's academic capabilities play a major role in their educational success compared to the financial aid received. Financial aid plays a role in giving students, without the necessary financial resources, an opportunity to pursue a college education, but it is not money that guarantees a student's success. Since college completion positively correlates with a student's capabilities, it is possible that focusing financial aid on high achieving students could also have a positive influence on college completion.

X. References

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