Is College Worth It: Determining the Pecuniary Value of a College Education

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Abstract

Rising college costs over the years have motivated a conversation about the value of a college education and which factors to consider when choosing an undergraduate institution. According to research by Pew Social Trends, many Americans with a college degree have indicated that the financial debt incurred from attending an undergraduate institution has caused financial strain in their everyday lives. One way to alleviate the financial stress of college costs is to combat it with higher earnings after graduation. In the following analysis, the Kiplinger's Best College Values data set is used to determine which college-specific factors play a role in determining the median salary of a graduate. Through the creation of an interaction model, the results showed a positive trend between tuition costs and median salary. Our analysis also showed a statistically significant difference in the median salaries of private and public university graduates versus liberal arts graduates.

I. Background and Significance

Over the past 30 years, the cost to receive a college education has risen dramatically. This has necessitated a conversation about the accessibility of a college education and has made Americans more critical of the effects of receiving an undergraduate degree. For example, in a 2011 survey of the general American public, 75% of the respondents disagreed with the statement that "most people are able to afford a college education" (Pew), only 40% of the respondents thought that "the value for their money spent on higher education is good or excellent" (Pew), and almost half of the respondents said that the process of paying back student loans has made "pay[ing] for other bills" and "making ends meet" harder (Pew).

With this in mind, one way that students may try to reconcile steep tuition costs is the possibility of earning more than their counterparts attending more financially affordable institutions. When ranking the earning potential of graduates from certain institutions, another question that follows is which colleges have the top paid graduates? Schools in the Ivy League and Seven Sisters network, in addition to schools that have continually ranked highly on various lists such as U.S. News and World Report and the Wall Street Journal, have not only been coveted for their exclusively low acceptance rates, but also because of the possibility of high salaries post-graduation because of the name recognition. These schools typically come at a high cost, with tuitions often amounting to at least $60,000 per year (Kiplinger), and although the general conception of name brand schools is often tied with high financial success because of the high-earning figures who attend those institutions, like Mark Zuckerberg, Hillary Clinton, and Warren Buffett, there is no guarantee that students who graduate from top ranking institutions will earn more. In addition, because so many of the top-ranking schools are private institutions, either universities or liberal arts colleges, this calls into question the value of a private education, which is more often than not much more financially inaccessible than public institutions. Based on previous conceptions mentioned, we expect that higher cost-institutions may have a positive correlation with median salary. Moving forward to the dataset, we examine how the type of school and other factors may play a role in determining the median salary of graduates.

II. Methods

Data

We used the Kiplinger's Best College Values dataset, which created rankings for the top 300 liberal arts colleges, private universities, and public universities in 2017. This dataset provided multiple measures about a college's cost, accessibility, and value; of interest to our research question were the following variables: admit rate, four-year graduation rate, total cost per year, average need-based aid, average non-need based aid, average debt at graduation, percent of non-need based aid, and a salary yardstick measure. With regard to the variable "average non-need based aid", we refer to scholarships like academic or sports excellence given to matriculating students. The top private schools listed on the reports previously mentioned are not known for giving non-need based aid, i.e. merit scholarships, to students and only offer need-based aid. We also had two indicator variables: type of college (public, private, or liberal arts) and region (Mid-West, Northeast, Southeast/Mid-South, West/Southwest, Mid-Atlantic). We differentiate private and liberal arts by the scale of the institution--private

universities may have multiple undergraduate colleges within it while liberal arts colleges are singular schools. The salary yardstick was our response variable; this value is the median earnings of students who started the college in 2007.

Analytic Approach

We first tested for the existence of severe multicollinearity within our set of predictors as we have multiple variables related to the affordability of a college. Based on this analysis, we removed the variables average need-based aid and four-year graduation rate from our set of predictors as they exhibited severe multicollinearity.

We started our model selection process by fitting first-order models on seven predictors, using the salary measure as the response variable. We fit five different first-order models using Mallow's Cp, adjusted R-squared, backwards stepwise procedure with AIC as the selection criterion, backwards stepwise procedure with BIC as the selection criterion, and the PCA method. Using the PRESS criterion, the backwards stepwise procedure with BIC as the criterion produced the most parsimonious model with the highest prediction power. Equation 1 below shows the best first-order model. Equation 2 is the model produced by backwards stepwise procedure with AIC criterion, included for comparison purposes with equation 3.

1. $$Salary = \beta_0 + \beta_1 * Type + \beta_2 * AdmitRate + \beta_3 * TotalCostPerYear + \varepsilon$$
2. $$Salary = \beta_0 + \beta_1 * Type + \beta_2 * AdmitRate + \beta_3 * TotalCostPerYear + \beta_4 * PercentOfNonNeedBasedAid + \beta_5 * AvgDebtAtGraduation + \varepsilon$$

Next, we created two interaction models using the backwards stepwise procedure with AIC and BIC as the selection criterion. Based on PRESS criterion, the AIC interaction model (see Equation 3) performed the best.

3. $$Salary = \beta_0 + \beta_1 * Type + \beta_2 * Region + \beta_3 * AdmitRate + \beta_4 * TotalCostPerYear + \beta_5 * PercentageOfNonNeedBasedAid + \beta_6 * AvgDebtAtGraduation + \beta_7 * Type * AvgDebtAtGraduation + \beta_8 * Region * AdmitRate + \beta_9 * Type * TotalCostPerYear + \beta_{10} * TotalCostPerYear * AvgDebtAtGraduation + \beta_{11} * AdmitRate * AvgDebtAtGraduation + \varepsilon$$

To determine the importance of the interaction terms in the model, we conducted partial F-tests on terms interacted with indicator variables Region and Type, as well as on interaction terms composed of two quantitative terms. This analysis revealed that all interaction terms in the final model were significant.

Once we chose our final AIC interaction model, we conducted residual analysis by examining a studentized residual plot to verify the constant variance assumption. We did not notice any curvilinear patterns and noticed the majority of clustering around 0, and we took both as signs that a box-cox transformation on the response variable was unnecessary. Looking at the normality assumption of the error terms, we noticed that although there was a slight skew in the QQ-plot, it was nothing of major concern and the outlying observations marked by R were not deemed to be influential observations by methods such as Cook's distance. See figure 1a and 1b.

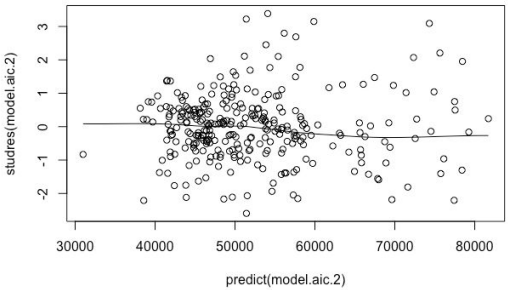

Figure 1a: Studentized residual plot

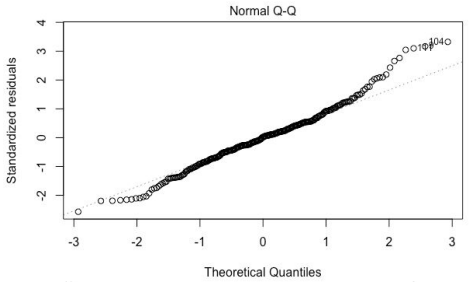

Figure 1b: Q-Q Plot of Errors

III. Results + Interpretation

From the summary results of our final model, we reach a few key findings. Based on the highly significant t-statistic regarding the admit rate predictor variable, we see that there is a negative correlation between admit rate and salary. This result shows that a one percent increase in the admission rate is associated with a decrease of $455.60 in the median salary of a graduate. This implies the relationship between exclusivity in admission and high salary prices corresponds to the general conception of prestigiousness and future financial success. In addition, the coefficient of the variable Percentage of Non-need Based Aid shows that for every one percent increase in non-need based aid offered, the median salary of a graduate from a certain school decreases by $49.50. This is in line with our understanding of the variable as non-need based aid is often not offered at top-ranking, well-funded schools such as Princeton, Harvard, and Wellesley.

Since we used liberal arts colleges as our baseline for the Type variable, we see that for a private institution with a $1 increase per year, the median salary of the graduate increases by $56.71. In addition, for a public institution with a $1 increase per year, the median salary of the graduate increases by $47.38. These findings show that both private and public universities with higher tuition costs have a more positive relationship with median salary than their liberal arts counterparts. The model's adjusted R^2 value is 0.6369.

IV. Discussion and Conclusion

Our analysis suggests that there is a positive relationship between the cost of college and the pecuniary return of a college. We also conclude that the type of college plays a statistically significant role in salary determination of students who attended that college, and that in relation to liberal arts colleges, both private universities and public universities with higher tuition costs have higher median salaries.

While our findings do not directly support the idea posited earlier that name brand schools typically have graduates with higher median salaries, it does show that markers typically associated with high ranking private schools, like low admission rate and low non-need based aid, are related to higher median salaries.

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