2011

A Statistical Analysis of the Factors Affecting University Endowments

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A STATISTICAL ANALYSIS OF THE FACTORS AFFECTING UNIVERSITY ENDOWMENTS

A Thesis Submitted

in Partial Fulfillment

of the Requirements for the Designation

University Honors with Distinction

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This Study by: Lisa Stoecken

Entitled: A Statistical Analysis of the Factors Affection University Endowments

has been approved as meeting the thesis requirement for the Designation

University Honors with Distinction

12/12/11
Date

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12/15/11
Date

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Abstract

The purpose of this study was to discover which, if any, institutional characteristics had a significant impact upon a university's endowment size. This study further explored whether the success of a university's athletic program had an impact on endowment size. The results from the study indicated two variables, operating revenues and student selectivity, were significant at a 99 percent confidence level; and, two additional variables, appropriations and a binary research university variable, were significant at a 95 percent confidence level. The results indicated that an additional one million dollars in total operating revenues and appropriations would decrease the endowment size by 0.01 percent and 0.20 percent, respectively; for each student selectivity point gained by a less selective school, the endowment would decrease by 2.24 percent; and, a research university will have an endowment that is 61.33%. An analysis of covariance further showed that universities that performed well athletically did not have a significantly different endowment.

Introduction

An endowment is a collection of financial assets that have been donated to a university. For the most part, universities use the returns on investment from the endowment to supplement their yearly budget. However, the principal of the endowment can be used to provide assistance to the university, especially when market returns have not been as high as expected. University endowment funds support a variety of purposes on campus. Student financial aid, teaching, research and innovation, public service, and athletics are just a few of the programs that endowments can help fund. In a study, conducted by the National Association of College and University Business Officers (2010), it was found that on average, 10.5 percent of the fiscal year 2010 operating budgets of the participating universities was funded from their respective endowments.

While the endowment funds do offer support to the university, the amount of support that can be offered varies greatly among universities. Although university endowments have increased substantially in recent years, mostly due to investment decisions, there is still a large gap between the sizes of endowments. The University of Northern Iowa, for example, increased its endowment from $615,895 at the end of fiscal year 2003 to $43,772,807 at the end of fiscal year 2009 (IPEDS, 2011). However, that is a drop in the bucket in comparison to an institution like Harvard University who, at the end of fiscal year 2009, had an endowment size of $26,035,389,000. Analyzing data from institutions could help explain why universities have differing endowment sizes and could offer universities a model to help determine goals for the universities' endowment.

Purpose

There are many plausible reasons for the differing sizes of endowments. Although much research has been done to study endowment growth and foundational factors that may impact growth, there has been relatively little research on whether the institution itself plays a role in impacting endowment size. The purpose of this study was to discover which, if any, institutional characteristics had a significant impact upon a university's endowment size. This study further explored whether the success of a university's athletic program had an impact on endowment size.

Endowment Growth

As previously mentioned, much research has been done in the area of endowment growth. A large portion of this research has been focused on the investment strategies of universities. In 2010, the Center for Social Philanthropy and the Tellus Institute released a report showing the investment trends in the past years for universities and described the transition of endowments from an income-gathering machine to a financial tool. In the late 1960's, with the support of the Fod Foundation, a finance professor and the vice president of the Investment Committee at Darthmouth compiled the information for the Barker Report, a publication on endowment management. The report promoted shifting investment goals from securing income to maximizing long-term total returns. The report also urged endowment officers to embrace being less risk-averse. In 1972, the Uniform Management of Institutional Funds Act (UMIFA) was approved by the National Conference of Commissioners on Uniform State Laws (NCCUSL). Under UMIFA, a university could spend up to the amount of appreciation above the historic dollar value, but never below. Since then, wealth began to be measured as endowment market value. This caused endowments to shift the focus of investment policies to total investment return via investment in a broad category of assets with reasonable risk.

Rogers and Strehle (2005) studied the sources of endowment growth of 390 institutions from fiscal year 1993 to fiscal year 2003. They found three key factors affecting long-term investment growth: investment returns, spending policy, and the fundraising approach. They further suggested that investment returns were based upon asset allocation and manager selection. Rogers and Strehle's report also provided some interesting statistics linked to a university's prestige via the ranking in the U.S. News and World Reports Best Colleges Survey. They showed that some of the top universities in the different categories added 76 percent or more to their endowments from gifts alone. This could mean that donors are more likely to donate to more prestigious universities.

An investment strategy that many universities had undertaken was to hold assets in alternative investments. Alternative investments are largely unregulated and include private equity, hedge funds, and other risky investment strategies.

According to Fain (2009), nearly a quarter of all college endowment assets were held in alternative investments by fiscal year 2008. During fiscal year 2006, private equity had an annual return of 17.9 percent (Van der Werf, 2007). This showed that correct asset allocation could increase endowments by an incredible amount. However, sometimes these investment strategies did not pay off. The University of Pittsburgh and Carneigie Mellon University held funds in alternative investments, most likely lured by the promise of larger returns. However, the two men that had been managing their assets had been scamming the universities. Other universities have met similar fates with poor choice in outside investment managers. However, very few institutions are financially able to secure in-house investment managers to oversee the endowment. Therefore, Rogers and Strehle's point that sound managers are important to university endowment growth was affirmed.

Another interesting aspect of endowment growth brought up by Lerner, Schoar, and Wang's research in 2008 is the issue of access. For example, Ivy League schools have much better access to more elite and desirable investment groups. In Lerner, Schoar, and Wongsunwai (2007), it was found that top endowments outperformed the rest of the investors when investing in undersubscribed funds, which suggested that top endowments were able to pick better funds even when all investors had access. Once again, prestige of a university showed its ability to help endowment growth.

Most research into the area of endowments has focused on investment strategies and other financial decisions of the universities. The limited availability of literature on the significance of institutional characteristics' impact on endowment sizes shows that more research is necessary in this area.

Literature Review

Lee (2009) analyzed institutional patterns and determined whether those similarities and disparities existing among different institutions provided a plausible explanation for endowment growth. Overall, the significant factors that were found in his study were closely intertwined with institutional quality and the size of the institutions. Lee further discovered that SAT scores, research and development expenditures, and alumni giving ratios were shown to be significant in endowment growth.

Swensen (2000) claimed that the endowment size was strongly correlated with institutional quality. The research he conducted was based on a survey of major private research universities. Swenson's research revealed that larger, better-endowed organizations scored more highly in the *US News and World Report* rankings of educational institutions.

Leslie and Ramey (1988) suggested that institutional size is an important trait to donors, which is likely explained by the fact that benefactors of the university associate the university's public profile with quality. The authors further implied that alumni respond well to emphasis upon the long-standing traditions of the institution and its prestige. Leslie and Ramey also suggested that alumni and non-alumni would respond favorably to shortfalls in state support.

Gaski and Etzel (1984) conducted a study to measure the strength of the relationship between football or basketball success and several measures of monetary contributions for a number of major schools. Gaski and Etzel found that a lack of significant results indicated that athletic performance and monetary donations were not closely related.

Research Methods

The data that was used came from a population of universities and colleges in the United States. The sample consisted of the schools with the 50 largest endowments at the end of fiscal year 2009. Several sources of data were used in this study. The first source was the Integrated Postsecondary Education Data System (IPEDS), which is developed and maintained by the United States Department of Education's National Center for Education Statistics (NCES). It is a system of interrelated surveys conducted annually by NCES. IPEDS gathers information from every college, university, and technical and vocational institution that participates in the federal student financial aid programs.

The second source of information was the Voluntary Support of Education (VSE) report. The US Council for Aid to Education's VSE survey is the authoritative national source of information on private giving to higher education and private K-12 schools, consistently capturing about 85 percent of the total voluntary support to colleges and universities in the United States (CAE, 2011).

The third source of data was the National Science Foundation's (NSF's) Survey of Research and Development Expenditures at Universities and Colleges. The Integrated Science and Engineering Resources Data System (WebCASPAR) is a database system containing the results of the Academic R&D Expenditures Survey.

Other data sources included the Princeton Review, the US Census Bureau, the American Council on Education, the National Association of College and University Business Officers, and the National Association of Collegiate Directors of Athletics.

This study used two different tools, a regression and an analysis of covariance, to analyze the data obtained. First, model selection regressions were run to obtain the best fitting line of the data. Then the coefficients were examined for significance and significant coefficients were analyzed and interpreted. After the regression model was obtained, several diagnostics were run to assure that the assumptions of the model were met and to test the validity of the model. Once those tests were complete, the analysis of covariance began. The analysis of covariance tested whether it was necessary to switch to another model that included a variable measuring the impact of sports.

Analysis of Variables

Using information from studies that had previously been done, several variables were selected that were thought to have an impact upon endowment sizes. The variables included: governance, institution type, per capita county income, total operating revenues, geographic region, enrollment, research activities, appropriations, and student selectivity.

Endowments (LNEND) were the 50 largest endowments at the end of fiscal year 2009 measured in thousands of dollars. The lognormal of the variable was taken to correct for outliers that existed because of a few relatively large endowments. For example, the top five endowments were all over $12,000,000. However, the average endowment size of the largest 50 endowments was only $4,051,619.

Total operating revenues (TREV) measured the total operating revenues from 2009 for the institutions measured in millions of dollars. It was hypothesized that higher operating revenues would indicate a lower reliance on endowments.

Research universities (RES) was a binary variable that measured the impact of being a research institution according to the Carnegie classification system. For example, the University of Iowa and Iowa State University are research universities and were given a value of one; the University of Northern Iowa is not a research university and was given a value of zero. It was hypothesized that a research university would carry more prestige because of its research. More prestige would suggest that donors would be more likely to donate to the endowment fund. Additionally, research universities require more funds to perform the research; ergo, larger endowment funds would be necessary.

Student selectivity (SS) was measured based upon the number applicants admitted compared to the number of applicants that applied to the school. A low selectivity score indicated a more selective school. For example, the public universities in Iowa had student selectivity rates above 80. Harvard, Yale, and Princeton Universities all had student selectivity rates of ten or less. A university with a low student selectivity rate could imply a more prestigious university. As noted before, universities with more prestige could have higher endowments.

Enrollment (ENROLL) was the number of students enrolled in the university at the beginning of the fall 2008 semester. This variable was included upon the supposition that more students allow for a larger pool of possible donors to the university. For example, Harvard University had an enrollment of approximately 26,500 students, while the University of Northern Iowa only had approximately 13,000 students enrolled for fall 2008. However, the University of Iowa and Iowa State University each had around 29,000 and 27,000 students enrolled, respectively.

Appropriations (APPROP) measured the amount of monetary support the university received from the federal, state, and local governments in millions of dollars. As funding changes, it could potentially force universities to look at alternative means of financing the university, one of which might be increasing voluntary support. To show the difference in funding, Ohio State University had appropriations of around $470,000,000. The University of Northern Iowa had only

$102,000,000, while the other Iowa public universities each had at least twice that amount.

Governance (GOV) was a binary variable used to define being a public school. For example, Harvard University is a private school and was given a value of zero. The University of Northern Iowa is a public school and was given a value of one. This variable was included upon the assumption that the financial needs between public and private schools are different and would therefore affect endowment size.

Research activities (RESEARCH) measured the total amount of expenditures on research and development at the university in thousands of dollars. This variable was included upon the belief that schools that spent more funds on research and development required more funding and might, therefore, have had a larger endowment. In fiscal year 2009, the average amount the top fifty endowment universities spent on research activities was $453,786,000. The University of Northern Iowa spent only around $3,000,000, while the University of Iowa and Iowa State University each spent over $200,000,000.

Model

Multiple model selection regressions, including forward selection, backward selection, backward selection, and R-square selection, were run to select the best fitting model that captured the relationships between the dependent variable, endowment, and the independent variables. The final regression model selected was as follows:

$$LNEND = \beta_0 + \beta_1 TREV + \beta_2 RES + \beta_3 SS + \beta_4 ENROLL + \beta_5 APPROP + \beta_6 GOV + \beta_7 RESEARCH$$

where LNEND is the natural log of the endowments; TREV is the total operating revenues; RES is a research institution by the Carnegie classification; SS is the student selectivity; ENROLL is the number of students enrolled; APPROP is the total federal, state, and local appropriations; GOV is public or private institution; and, RESEARCH is the amount of research and development expenditures. Descriptive statistics for the model's variables are presented in Table 1.

Table 1

Descriptive Statistics: Fiscal Year 2009 Endowment Funds

Variable	Mean	Standard Deviation
TREV	858.37	318.05
RES	0.78	0.06
SS	34.16	3.11
ENROLL	20424.78	2314.48
APPROP	93.36	23.25
GOV	0.32	0.07
RESEARCH	407773.40	44869.90

Regression Results

The estimated relationships between endowments sizes and the independent variables are shown in Table 2. The relationships were consistent with what had been hypothesized. The regression data in Table 2 also shows that there were two variables significant at a 99 percent confidence level; and, there were two variables significant at a 95 percent confidence level.

Table 2

Regression Results

Dependent Variable = LNEND

Endowment Sizes[a]

Variable	SAS Name	Coefficients	t Stat	P-value	Variance Inflation Factor
Total operating revenues[b]	TREV*	-0.00011	-3.13	0.0032	1.03
Research university[c]	RES**	0.47831	2.07	0.0443	1.50
Student Selectivity[b]	SS*	-0.02261	-4.13	0.0002	2.34
Enrollment[c]	ENROLL	0.00001	1.13	0.2663	3.44
Appropriations[b]	APPROP**	-0.00205	-2.58	0.0136	2.76
Institution type[b]	GOV	0.66783	1.67	0.1016	5.68
Research expenditures[c]	RESEARCH	5.136E-7	1.58	0.1217	1.71

Intercept	14.88306	65.53	0.0000	0.00
N=50	dF=42	F-Value	9.27	
R^2	0.6070	Adjusted R^2	0.5415	

Sources of Data

a) NCSE

b) IPEDS Data Source

c) WebCASPAR Data Source

Note: *p<.01, **p<.05

According to the model, the data shows that the TREV variable is significant at a 99 percent confidence level. As was hypothesized, total operating revenues are negatively correlated with endowments. The coefficient for this variable (−1.141E−4) implies that for each additional one million dollars in operating revenues a school has, its endowment decreases by .01 percent. This may suggest that a school that has a larger operating revenue does not need to rely on its endowment funds to run the school. Therefore, there is not as much need to have a larger endowment.

The next significant variable at the 99 percent confidence level was student selectivity (SS). Again, as was hypothesized, the more selective a school is, the higher the endowment fund. In this study, the coefficient (−0.02261) implies that for each selectivity percentage point gained by a less selective school, it will lose 2.24

percent of its endowment. An explanation for this may be that potential donors believe that more selective universities are more prestigious and, therefore, choose to donate their assets and funds to the more selective university.

The next variable, APPROP, was significant at a 95 percent confidence level. The coefficient for appropriations implies that for each additional one million dollars an institution is appropriated, its endowment will decrease by 0.2 percent. This could be explained by the possibility that schools with appropriated funds do not need to rely as heavily on their endowments. As a result, they will not need a large endowment fund.

The last significant variable was RES. This variable was significant at 95 percent confidence level. The coefficient for this variable implies that institutions that are research institutions will have an endowment that is 61.33 percent larger compared to other Carnegie classification institutions. This followed what was hypothesized.

Model Assumptions

Several model assumptions were tested to justify the use of a linear regression model for predictions. The four main principles tested were linearity of the dependent and independent variables, independence of the errors, homoscedasticity of the errors, and normality of the error distribution. If any of the previous principles were violated, it could have been concluded that any forecasts or confidence intervals based upon the regression results would be inefficient or biased.

In order to test the linearity of the data, a plot of the observed versus predicted values was created. In order to meet the requirements for linearity, the points on the plot should have been symmetrically distributed about a diagonal line. Figure 1 shows the observed versus predicted values plot. Although it does not appear to be exactly symmetric, the plot does appear to be cluster around a linear diagonal line. Therefore, it was concluded that the assumption of linearity was not violated.

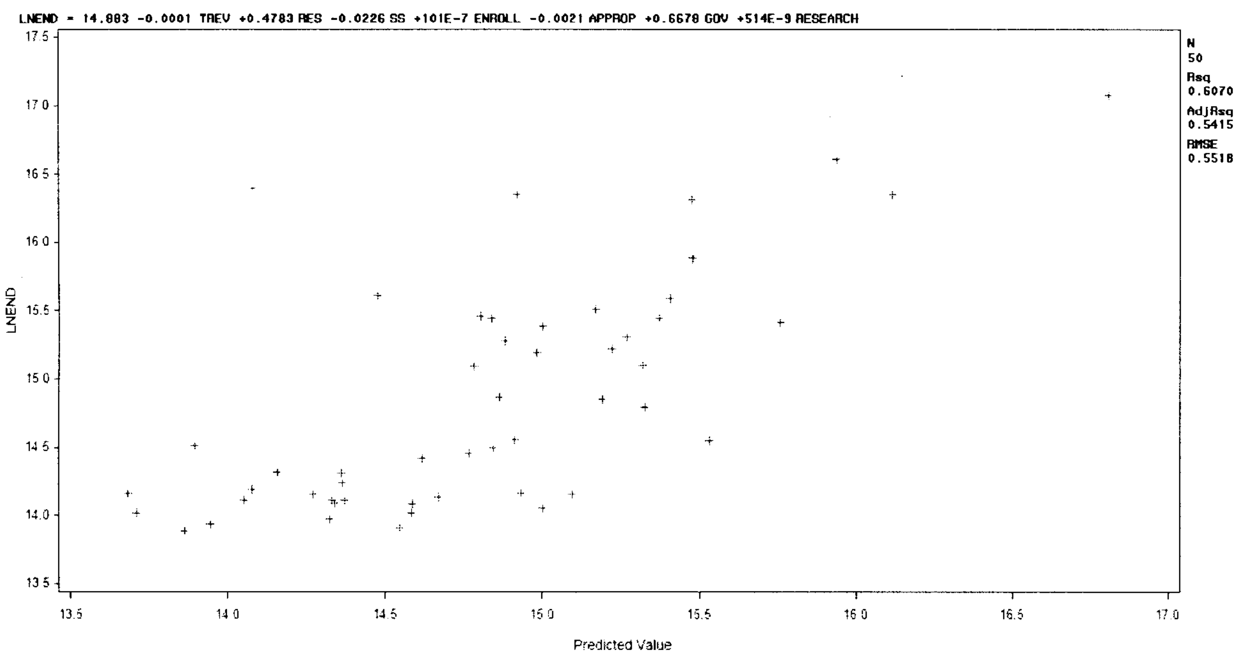


Figure 1. Observed vs. Predicted Plot

The second principle to be tested was for the independence of the errors. A violation of this assumption would have occurred if each error term was related to its immediate predecessor. A violation would be autocorrelation. To test this, the Durbin-Watson statistic was examined. Generally, if error terms were independent, it would be expected that the Durbin-Watson statistic, shown in Table 3, was close to two. Since the Durbin-Watson statistic was 2.251, it could have been concluded that the assumption had not been violated. To be more accurate, the Durbin-Watson statistic from the data was compared to the upper and lower bounds of a test with 50 observations and seven independent variables. The Durbin-Watson statistic from the data set was larger than the upper bound. It was therefore concluded that there was statistical evidence that the error terms were not positively correlated. However, when tested to see if the error terms were negatively correlated, the test was inconclusive. Therefore, it was concluded that the assumption of the independence of the error terms had not been violated.

Table 3:

Durbin-Watson Results

Durbin-Watson Test Statistic	2.251
Upper Bound ($d_{U,.05}$)	1.875
Lower Bound ($d_{L,.05}$)	1.246

Test for Positive Autocorrelation

$2.251 > d_{U,.05}$

Decision: There is statistical evidence that the error terms are not positively autocorrelated.

Test for Negative Autocorrelation

$(4-2.251)=1.749$

$d_{L,.05} < 1.749 < d_{U,.05}$

Decision: The test is inconclusive.

The third principle to be tested was for homoscedasticity of the errors. Violations of homoscedasticity could have resulted in an overestimation of the goodness of fit of the model. To detect homoscedasticity, the plot of the residuals versus predicted values, as seen in Figure 2, was analyzed. A violation would have occured if the residuals became larger as a function of the predicted values. This was not the case for this data set. Therefore, the data did not violate the assumption of homoscedasticity.

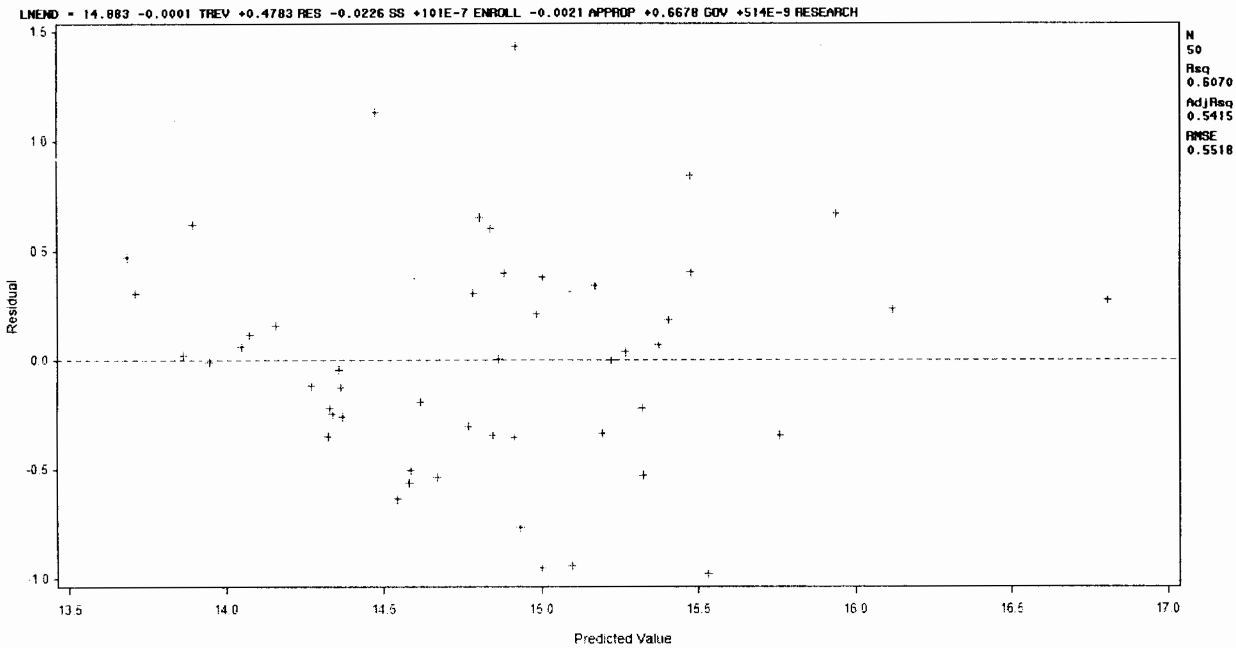


Figure 2. Residuals vs Predicted Plot

The fourth principle to be tested was for normality of the error distribution. Calculation of confidence intervals and various significance tests for coefficients were all based on the assumption of normality. Therefore, a violation of normality could have affected several parts of the study. The easiest way to test for normality was to analyze the normal probability plot, shown in Figure 3. If the distribution was normal, the points of the plot should have formed a linear line. The points of this data set did form a linear line and, therefore, the assumption of normality was not violated.

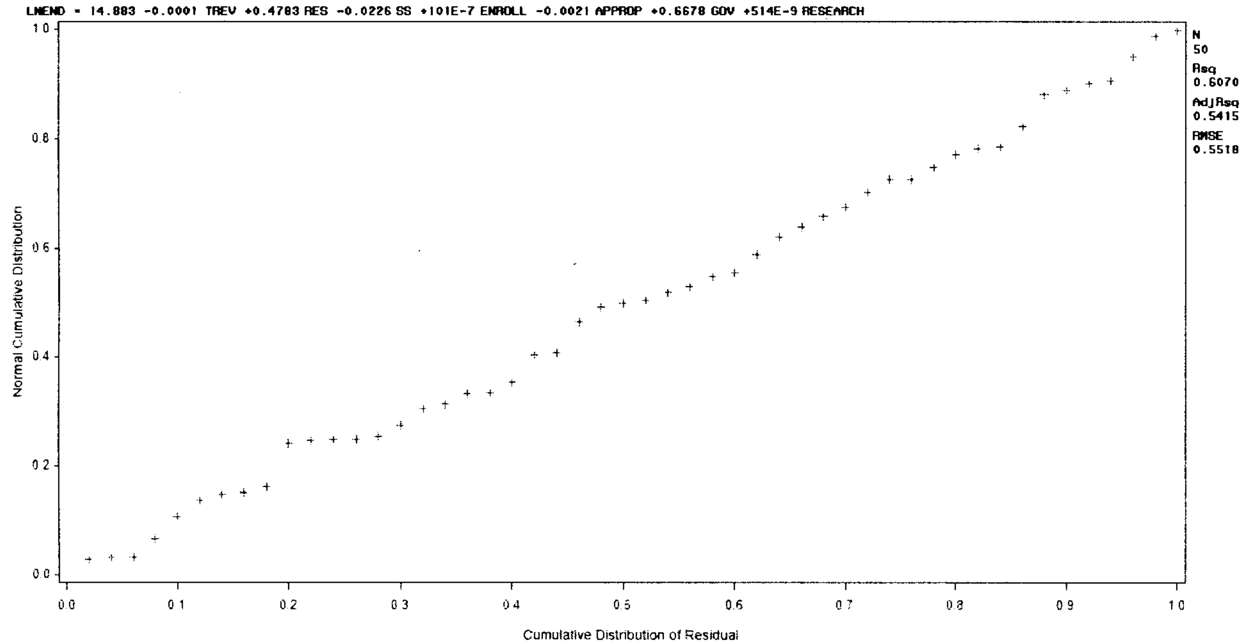


Figure 3. Normal Probability Plot

Model Validity

Other tests were run on the data to determine the validity of the model. In particular, tests for multicollinearity and influence of the data points were run. Multicollinearity would have occurred if two variables were highly correlated with each other. The presence of multicollinearity would not have reduced the reliability of the model; however, multicollinearity could have affected individual predictions. The variance inflation factors, shown previously in Table 2, were examined to determine the presence of multicollinearity. Common cutoffs for the variance inflation factors are values of five or ten. Any variable with a variance inflation factor higher than five or ten could be shown to cause multicollinearity in the model. As shown in Table 2, the variable GOV had a variance inflation factor of 5.69. Since the value was close to five but less than the cutoff of ten, multicollinearity in the model could have been a factor.

Another test that occurred was to check for the influence of the data points. To determine if certain data points were highly influential in the model, the Cook's Distance values were examined. It has been suggested that a Cook's Distance greater than one could indicate a highly influential point. Another cutoff point that has been suggested is a value greater than $4/n$, where n is the number of observations in the data set. In this study, a value greater than 0.08 would have indicated an influential point. There were a total seven data points with a Cook's Distance value greater than 0.08. However, two of them were very close to a value of 0.08 and only one point had a value greater than one. The remaining five data points that were significantly larger than 0.08 were examined to confirm that no data had been entered incorrectly.

Once the data points were validated, the group of values with points greater than 0.08 was examined as a whole to determine if any distinguishing group characteristics could be found. Four of the influential data points belonged to the top ten endowments. Harvard, Yale, and Princeton Universities, along with the University of Michigan were influential data points in the model. This was not surprising since Harvard, Yale, and Princeton Universities claimed the top three endowment sizes. These endowment sizes were also significantly larger than the other members of the data set.

Analysis of Covariance

To take the study one step further, the impact of a school's athletic success on the endowment was tested. *Athletic success* (SPORTS) meaured athletic success according to the National Association of Collegiate Directors of Athletics (NACDA) Learfield Sports Directors' Cup ratings system. NACDA points are based upon order of finish in various National Collegiate Athletic Association (NCAA) sponsored championships or, in the case of Division I Football, media-based polls. When the points had all been collected, the schools were split into two groups based upon how high they scored so that an analysis of covariance could be run. Therefore, the test studied whether schools that performed well athletically had larger endowments or different significant variables.

The first test to be run was a parallel model. The formula for this model was:

$$LNEND = \beta_0 + \beta_1 TREV + \beta_2 RES + \beta_3 SS + \beta_4 ENROLL + \beta_5 APPROP + \beta_6 GOV + \beta_7 RESEARCH + \beta_8 SPORTS,$$

where the variables from the previous regression were the same, and a binary variable, SPORTS, was added to capture athletic success.

In order to test whether there was a significant reason to switch from the original regression model to the parallel regression model, a hypothesis test was performed between the two models. The results, shown in Table 5, indicated that the original model was preferred over the parallel regression model.

Table 5

Analysis of Covariance

Information Drawn from Regression Results				
	Original Model	Parallel Model	Separate Models	
			Sports=0	Sports=1
Sum of Squares Error	12.79052	12.05335346	3.39385354	6.68923585
Degrees of Freedom	42	41	17	17
Mean Square Error	0.30454	.2939842	0.19963844	0.39348446
Hypothesis Tests				

Test 1

H_0: Original Model

H_A: Parallel Model

T.S.: $\frac{(12.79052-12.05335)/(42-41)}{12.05335/41} = 2.5075$

CV= $F_{.05,1,41}$=4.078546

TS<CV

Decision: Fail to Reject H_0: Original Model is Preferred

Test 2

H_0: Original Model

H_A: Separate Model

T.S.: $\frac{(12.79052-(3.39385354+6.68923585))/(42-(17+17))}{(3.3938535+6.68923585)/(17+17)} = 1.141176$

CV= $F_{.05,8,34}$=2.2253

TS < CV

Decision: Fail to Reject H_0: Original Model is Preferred

The next step was to run a separate regression model on each group. The next hypothesis tested whether the original model was preferred over the separate regressions models. The result, shown in Table 5, indicated that the original model was preferred over the separate regression models. Therefore, the analysis of covariance indicated that institutions that perform well athletically do not have higher endowments compared to institutions that do not perform as well.

Predictions

Using the results from the original regression, three schools were selected to run a predictive analysis on. The model was as follows:

LNEND= 14.88306 – 0.00011*TREV + 0.47831*RES – 0.02261*SS + 0.00001*ENROLL – 0.00205*APPROP + 0.66783*GOV + 5.136E-7*RESEARCH.

The University of Iowa, Iowa State University, and the University of Northern Iowa were the schools selected. Using data from all three schools, the linear endowments they were predicted to have were 13.1461, 13.0785, and 12.8456, respectively. This means that for fiscal year 2009, the University of Iowa was predicted to have an endowment of $512,035,618. In actuality, the endowment for that year was $675,705,000. Iowa State University was predicted to have an endowment of $478,560,060 and the University of Northern Iowa was predicted to have an endowment of $379,135,304. However, their actual endowments for fiscal year 2009 were $452,209,000 and $43,773,000, respectively.

Since the R^2 value was only 0.6070, approximately 60 percent of the variation in endowments was explained by the variables. Therefore, 40 percent of the model's variation was still unexplained, which could account for the differences in the predicted values and the actual values here. Also, the model was constructed with only the largest endowments in the data set. This could mean that the model was less accurate when calculating endowments of smaller sizes.

Conclusion

The purpose of this study was to determine which institutional characteristics impacted university endowment sizes and whether athletic success of a university also impacted the endowment. In the first stage of the analysis, several variables were shown to have a significant impact upon the endowment size. Two of the significant variables, institution type and student selectivity, were variables often associated with a university's prestige. Meanwhile, the remaining significant variables, operating revenues and appropriations, say more about a school's financial position.

Both institution type and student selectivity were correlated with endowment sizes in such a manner that indicated more prestigious schools had higher endowments. This could lead to the conclusion that schools with more prestige are better able to increase their endowment sizes.

Both operating revenues and appropriations were correlated with endowment sizes in such a manner which indicated that schools that do not need to rely on their endowments, do not require large endowments. Among the sample, higher operating revenues tended to lead to lower endowment sizes. Also, in this study, higher appropriations from the federal, state, and local governments led to lower endowment sizes. Therefore, financial independence leads to less reliance on the endowment and a smaller endowment.

Further study was done to see if athletic success impacted endowment sizes. However, it was shown that universities that perform well athletically do not have significantly higher endowments than those that do not perform as well.

Recommendations

This study focused on university endowments and how the characteristics of the university itself impacted the endowment. Much research has been done in the area of university endowments. However, most of the research has focused on the financial moves that the endowment makes. Since financial decisions have been something that the universities could control, the previous research has been extremely useful. Nevertheless, it is useful to look at what impacts the size of an endowment in the first place.

For further research, it would be valuable to expand the data set. Since only the largest endowments were chosen for this study, it could possibly have had an effect on the determined coefficients. A larger data set would also provide a more accurate model.

In the future, it would also be helpful to include the endowments over a period of time. This would allow the researcher to study the growth of endowments based upon university characteristics. Since endowments have grown tremendously in the past ten years, it would be practical to ascertain if most of this growth came from the investment decisions that the university endowment made.

Another characteristic to study that would provide valuable information would be how universities obtain their funds, especially since that is an important factor for endowment growth. For example, some universities hire experienced fund raising companies to help obtain funds from potential donors. The different strategies used in obtaining funds could prove to significantly impact the endowment size.

Table 1

Descriptive Statistics:

Fiscal Year 2009 Endowment Funds

Variable	Mean	Standard Deviation
TREV	858.37	318.05
RES	0.78	0.06
SS	34.16	3.11
ENROLL	20424.78	2314.48
APPROP	93.36	23.25
GOV	0.32	0.07
RESEARCH	407773.40	44869.90

Table 2

Regression Results

Dependent Variable = LNEND

Endowment Sizes$_a$

Variable	SAS Name	Coefficients	t Stat	P-value	Variance Inflation Factor
Total operating revenues$_b$	TREV*	-0.00011	-3.13	0.0032	1.03
Research university$_c$	RES**	0.47831	2.07	0.0443	1.50

Student Selectivity[b]	SS*	-0.02261	-4.13	0.0002	2.34
Enrollment[c]	ENROLL	0.00001	1.13	0.2663	3.44
Appropriations[b]	APPROP**	-0.00205	-2.58	0.0136	2.76
Institution type[b]	GOV	0.66783	1.67	0.1016	5.68
Research expenditures[c]	RESEARCH	5.136E-7	1.58	0.1217	1.71
	Intercept	14.88306	65.53	0.0000	0.00
	N	50	F-Value	9.27	
	dF	42	Adjusted R^2	0.5415	
	R^2	0.6070			

Sources of Data

a) NCSE

b) IPEDS Data Source

c) WebCASPAR Data Source

Table 3:

Durbin-Watson Results

Durbin-Watson Test Statistic	2.251
Upper Bound ($d_{U,.05}$)	1.875
Lower Bound ($d_{L,.05}$)	1.246

Test for Positive Autocorrelation

$2.251 > d_{U,.05}$

Decision: There is statistical evidence that the error terms are not positively autocorrelated.

Test for Negative Autocorrelation

$(4-2.251)=1.749$

$d_{L,.05} < 1.749 < d_{U,.05}$

Decision: The test is inconclusive.

Table 4

Correlation Matrix

	TREV	*RES*	*SS*	*ENROLL*	*APPROP*	*GOV*	*RESEARCH*
TREV	1.0000						
RES	0.1081	1.0000					
SS	-0.0917	0.1029	1.0000				
ENROLL	0.0093	-0.2819	-0.2237	1.0000			
APPROP	-0.0490	-0.1093	-0.0304	0.3258	1.0000		
GOV	0.0467	0.1445	-0.3538	-0.5849	-0.6550	1.0000	
RESEARCH	-0.1103	-0.3419	0.2046	-0.3250	-0.2582	0.1107	1.0000

Table 5

Analysis of Covariance

Information Drawn from Regression Results				
	Original Model	Parallel Model	Separate Models	
			Sports=0	Sports=1
Sum of Squares Error	12.79052	12.05335346	3.39385354	6.68923585
Degrees of Freedom	42	41	17	17
Mean Square Error	0.30454	.2939842	0.19963844	0.39348446

Hypothesis Tests

Test 1

H_0: Original Model

H_A: Parallel Model

T.S.: $\frac{(12.79052-12.05335)/(42-41)}{12.05335/41} = 2.5075$

CV= $F_{.05,1,41}$=4.078546

TS<CV

Decision: Fail to Reject H_0: Original Model is Preferred

Test 2

H_0: Original Model

H_A: Separate Model

T.S.: $\frac{(12.79052-(3.39385354+6.68923585))/(42-(17+17))}{(3.3938535+6.68923585)/(17+17)} = 1.141176$

CV= $F_{.05,8,34}$=2.2253

TS < CV

Decision: Fail to Reject H_0: Original Model is Preferred

Figure 1

Observed vs. Predicted Plot

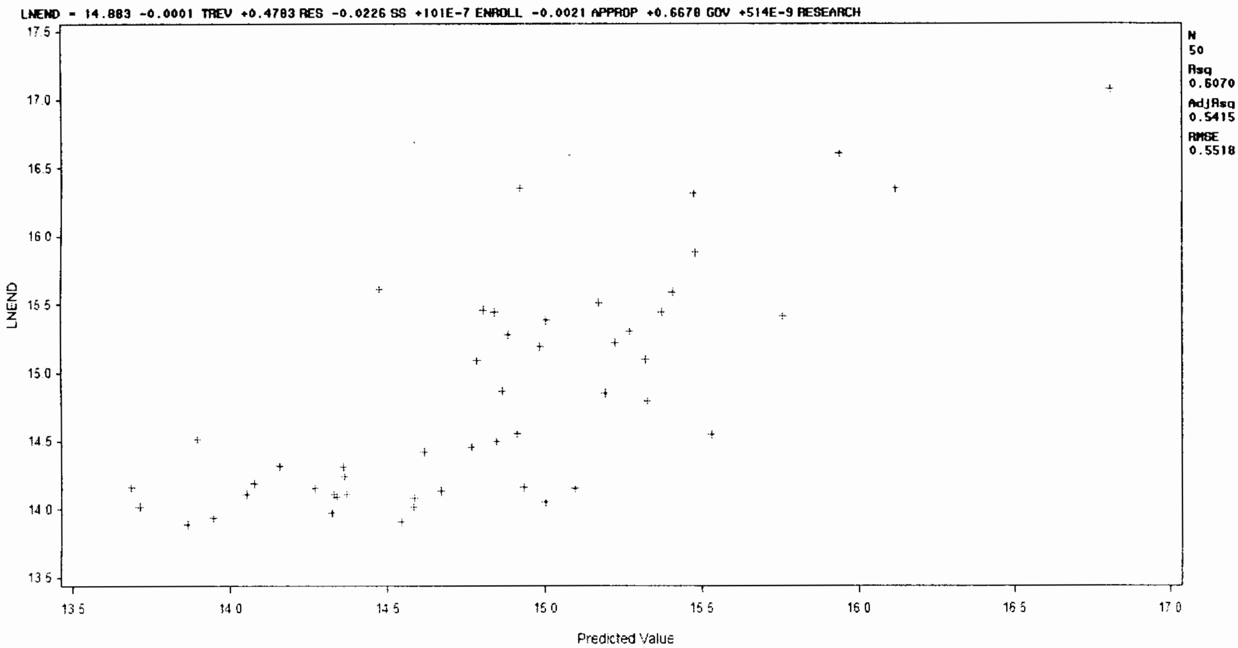


Figure 2

Residuals vs Predicted Plot

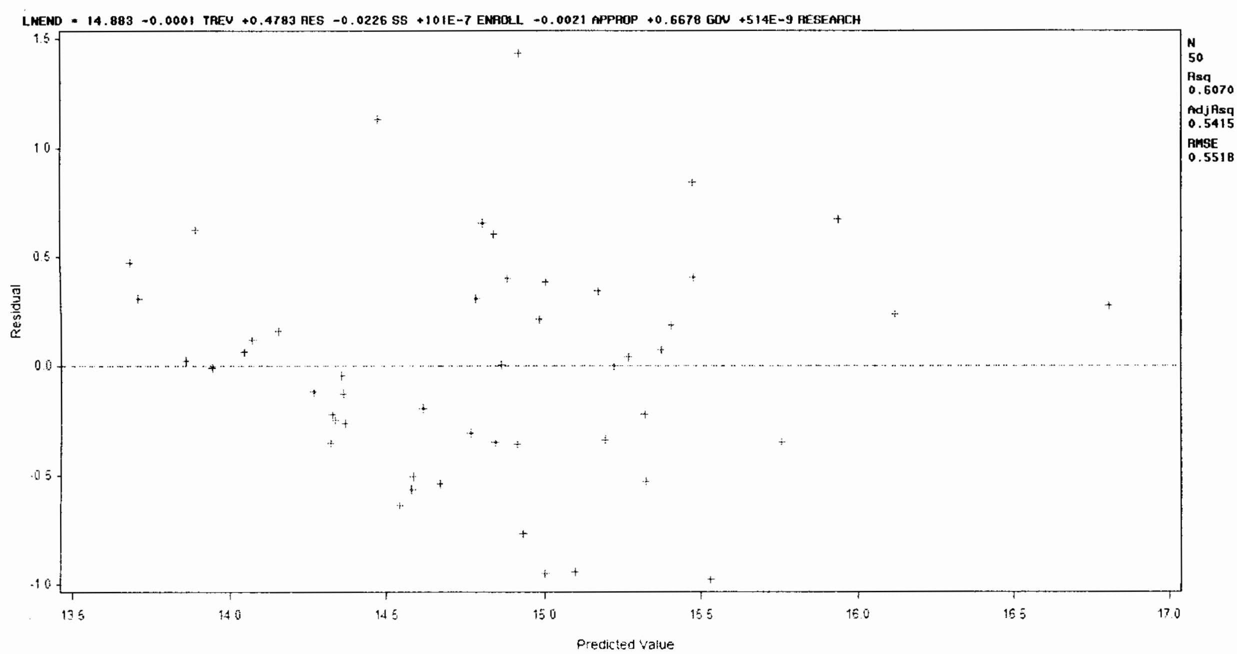
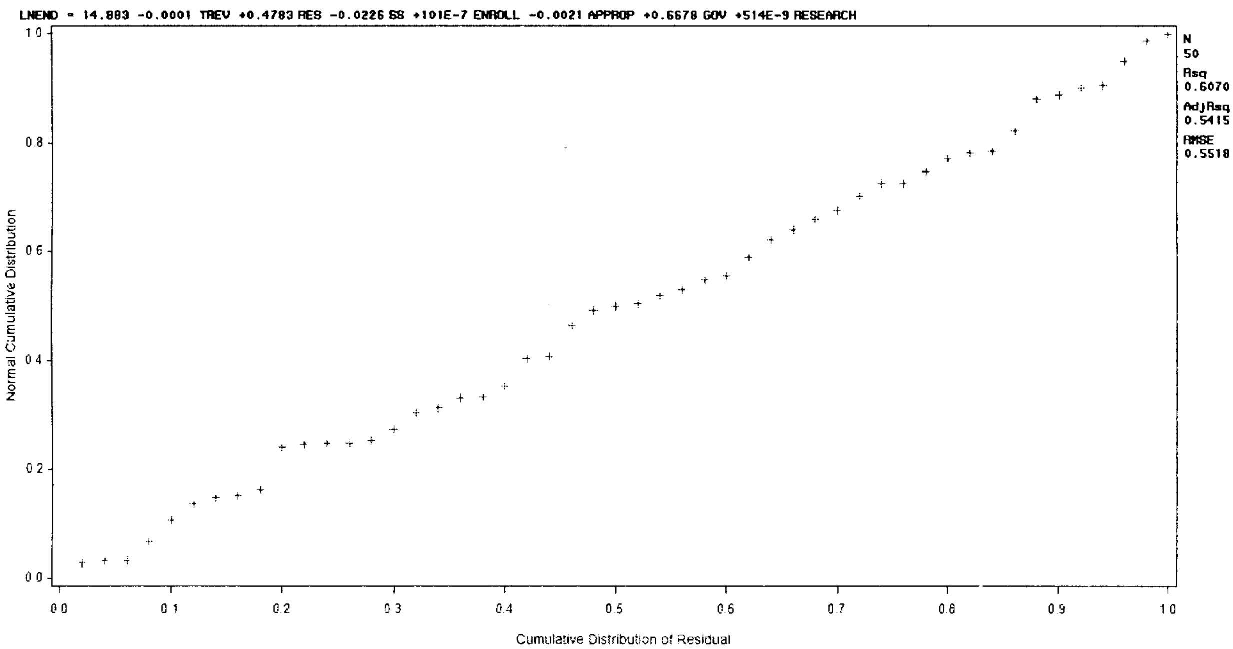


Figure 3

Normal Probability Plot



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