Private Universities and their Research Expenditure

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Overview of the Topic

The role of the universities is twofold: universities should help in the dissemination of knowledge through teaching, and they should also foster the creation of knowledge through research (Peters, 2003). In the late 1950s, the Ford and Carnegie Foundations published several reports pointing to the need of schools to develop doctoral scholars capable of great analytical rigor (Association to Advance Collegiate Schools of Business, 2013). The increase of doctoral programs is important for economic development; research shows a strong association between research created by universities and a strong local economy. The positive role of the university in regional economic performance is evident, particularly for research oriented universities (Lendl, 2010).

Twenty five percent of the higher institutions in United States are private institutions. Traditionally these institutions have been more focused towards the dissemination of knowledge. Lately due to the evidence of the benefits of research, and due to accreditation purposes more and more institutions are incorporating research components throughout their curriculum. However, among private universities, the for-profit sector is particularly limited in research outcomes. Enrollment at for-profit institutions has increased 225 percent, and these institutions currently hold 12% of the higher education students (National Conference of State Legislatures, 2013). As these institutions continue to grow, they attract more attention towards the need to have higher education institutions fulfill their mission of fostering the dissemination and creation of knowledge. Policy makers are particularly interested in forcing for-profit institutions into assigning more resources into research and in the creation of more rigorous academic degrees (Hanford, 2015). The end goal of these initiatives are to transform 4-year private institutions into important contributors of the local economy.

This topic made me inquire about the differences in research expenditure in 4-year public universities and 4-year private universities, as well as how could a private university, interested in fostering research and the development of doctoral scholars, forecast the impact of research expenditure in doctoral degrees.

Research Questions

1. To what extent does the CATEGORY of for PUBLIC 4-YEAR institutions and PRIVATE 4-YEAR institutions, affect the mean difference in RESEARCH EXPENSE PER STUDENT?
2. Is there a linear correlation between RESEARCH EXPENSE PER STUDENT and NUMBER OF DOCTORAL DEGREES in PRIVATE NOT-FOR-PROFIT, 4-YEAR RESEARCH INSTITUTIONS?
3. To what extent can we predict the NUMBER OF DOCTORAL DEGREES GRANTED AT 4-YEAR, PRIVATE NOT-FOR-PROFIT RESEARCH INSTITUTIONS based on the amount RESEARCH EXPENSE PER STUDENT?

Participants and Sampling

The population of this study is the institutions of higher education of the United States. The sample of the population includes 6,352 higher education institutions from the Delta Cost Project Integrated Postsecondary Education Data System (IPEDS) database. The Delta Cost Project IPEDS database is a longitudinal study from 1986 through 2009 which includes 202,800 observations of public domain data, related to postsecondary education costs, productivity and accountability (Delta Cost Project, 2011).

This specific study used institutions that are categorized as either: public, 4-year institutions; private, not-for-profit 4-year institutions; and private nonprofit research institutions.

For the first research question, only public 4-year and private not-for-profit 4-year institutions were used, for a total of 10,032 observations. For the second and third questions, the data used included only private not-for-profit 4-year institutions that are also considered private, not-for-profit, research institutions by the Carnegie selection, for a total of 843 observations.

Instruments and Measures

The Delta Cost Project obtains its data from three main sources: IPEDS surveys, the Financial Institution Shared Assessment Program (FISAP) database, and the Bureau of Labor Statistics (BLS). The IPEDS surveys provides the majority of data to the Delta Cost Project; nine surveys contribute to the database with data about institutional characteristics, enrollment, student financial aid, graduation rates, staffing and salaries. The FISAP database provides information on student financial aid; and the Bureau of Labor Statistics provides information on the inflation indices included in the Delta database (Delta Cost Project, 2011).

This study used four variables from the Delta Cost Project, and it constructed one variable from the available data. These variables were: sector, total enrollment, research expenditure, number of doctoral degrees granted, and research expense per student (RPS). Sector refers to the institutional category of public, 4-year institution and private, 4-year institution. Total enrollment refers to the number of students enrolled during the fall period at the institutions. Research Expenditure refers to the amount of expenses specifically organized to produce research. Number of doctoral degrees awarded refers to all doctoral degrees awarded by the institution. Finally, research per student (RPS) is the constructed variable, and it refers to the amount of research spent on every student per year; it was obtained by dividing research expenditure by total enrollment. The objective of this constructed variable was to make comparison feasible even among different size institutions.

Data Collection Procedures

The Delta Cost Project collects its information from IPEDS surveys, Financial Institution Shared Assessment Program (FISAP) database, and the Bureau of Labor Statistics (BLS). The database is hosted since 2012, by the National Center for Education Statistics (NCES), and may downloaded from that site (http://nces.ed.gov/ipeds/deltacostproject/) into SPSS.

Analysis

This study is quantitative in nature, it uses descriptive and inferential statistics to address the research questions. The data was downloaded and cleaned to suit the needs of the study using SPSS Version 22 and Microsoft Excel.

Research Question #1

To what extent does the CATEGORY of for PUBLIC 4-YEAR institutions and PRIVATE 4-YEAR institutions, affect the mean difference in RESEARCH EXPENSE PER STUDENT?

Independent Samples t-test. The first research question was answered using an independent samples t-test. The independent samples t-test is used for comparing the same variable (Research Expense per Student, RPS) for two different groups which are independent of one another (public 4-year institutions and private 4-year, not-for-profit institutions). In this case, the null hypothesis states that the mean research expense per student will not differ based on the institution category of public 4-year or private not-for-profit 4-year. The alternative hypothesis states that the mean research expense per student will differ based on the institution category of public 4-year or private not-for-profit 4-year.

H_0: $\mu_{pu} = \mu_{pr}$

H_a: $\mu_{pu} \neq \mu_{pr}$

Research Question #2

Is there a linear correlation between RESEARCH EXPENSE PER STUDENT and NUMBER OF DOCTORAL DEGREES in PRIVATE NOT-FOR-PROFIT, 4-YEAR RESEARCH INSTITUTIONS?

Correlation. Correlation measures the relation between two or more variables. The correlation coefficients may range from 1 to -1, where 1 represents a perfect positive correlation; -1 represents a perfect negative correlation; and 0 represents no correlation (StatSoft, 2013). The study used the *Pearson r* correlation coefficient, which expresses the correlation as a linear relationship (Creswell, 2008). Specifically, the study researched the correlation between research expense per student and number of doctoral degrees granted at private, not-for-profit, 4-year institutions.

Research Question #3

If there is a linear correlation, to what extent can we predict the NUMBER OF DOCTORAL DEGREES GRANTED AT 4-YEAR PRIVATE NOT-FOR-PROFIT RESEARCH INSTITUTIONS based on the amount RESEARCH EXPENSE PER STUDENT?

Linear Regression. Using the concept of correlation and its expression as a linear relationship, the study used linear regression to predict the behavior of one variable (Y), based on the knowledge of another variable (X) (Hinkle, Wiersma & Jurs, 2003). The equation for a linear regression is $\hat{y} = bx + a$, where $\hat{y}$ is the predicted value, "b" is the slope, and "a" is the y-intercept. The best regression line is determined by the least squares method. The independent variable in this study is research expense per student, and the dependent variable is number of doctoral degrees granted.

Coefficient of Determination. The correlation may be squared to obtain the strength of the relationship; this is called the coefficient of determination. It provides the proportion of variability in *Y* that can be explained by *X* (Cohen, 2011). The coefficient of determination was calculated to identify the proportion of the variability in the number of doctoral degrees granted that could be explained by the amount of research expense per student.

Results

Research Question #1

To what extent does the CATEGORY of for PUBLIC 4-YEAR institutions and PRIVATE 4-YEAR institutions, affect the mean difference in RESEARCH EXPENSE PER STUDENT?

Independent Samples t-test. The independent samples t-test was conducted in two parts. Initially, I tested for the homogeneity of variances using the Levene's test. The null hypothesis stated that the variance of the research expense per student does not differ from the variance of the number of doctoral degrees awarded. The alternative hypothesis stated that the variance of the research expense per student differs from the variance of the number of doctoral degrees awarded.

H_0: $V_{rps} = V_{dd}$

H_a: $V_{rps} \neq V_{dd}$

The Levene's Test for Equality of Variance obtained a p value = 0.140 with a significance value of 0.05; therefore, we accepted the null hypothesis, assumed that there was homogeneity of variance, and proceeded to check the correlation factor.

The p-value of 0.358 is more than the alpha level of 0.05, thus we ACCEPT the null hypothesis claim of equal mean research expense per student for public 4-year institutions and

private not-for-profit 4-year institutions. There was sufficient evidence to support the claim that there is no difference in the means. The mean research per student was $8,551 for public 4-year institutions and $6,335 for private nonprofit 4-year institutions. The results of the test are depicted in Table 1.

Table 1

Independent T-Test Analysis of Research per Student Means Based on Category of 4 year Institutions (n=10,034)

Institution Category	n	Mean	Std. Deviation	t	df	p
Public, 4-Year	5186	8,550.94	164,496.68	.358	10,032	.358
Private, 4-Year	4848	6,335.09	33,896.03			

Note: p>alpha level of .05

Research Question #2

Is there a linear correlation between RESEARCH EXPENSE PER STUDENT and NUMBER OF DOCTORAL DEGREES in PRIVATE NOT-FOR-PROFIT, 4-YEAR RESEARCH INSTITUTIONS?

Correlation. The bivariate data was graphed; since the two variable used two different scales, the variables were standardized to make them more comparable. A second scatter plot graph was created. This graph suggested that it may be necessary to remove outliers, so that data could be properly interpreted. The data values that were more than two standard deviations from the mean were considered outliers, and therefore, were removed. A scatter plot graph was ran for a third time, and finally the correlation analysis was performed. Figure 1 depicts the two scatter plots, with the presence of outliers and without the presence of outliers. The correlation

excluded cases pairwise. The Pearson correlation value was 0.52, and the p-value is 0.001, therefore it was considered statistically significant: There is a positive correlation between the amount of research expense per student and number of doctoral degrees. The results of the correlation test are depicted in Table 2.

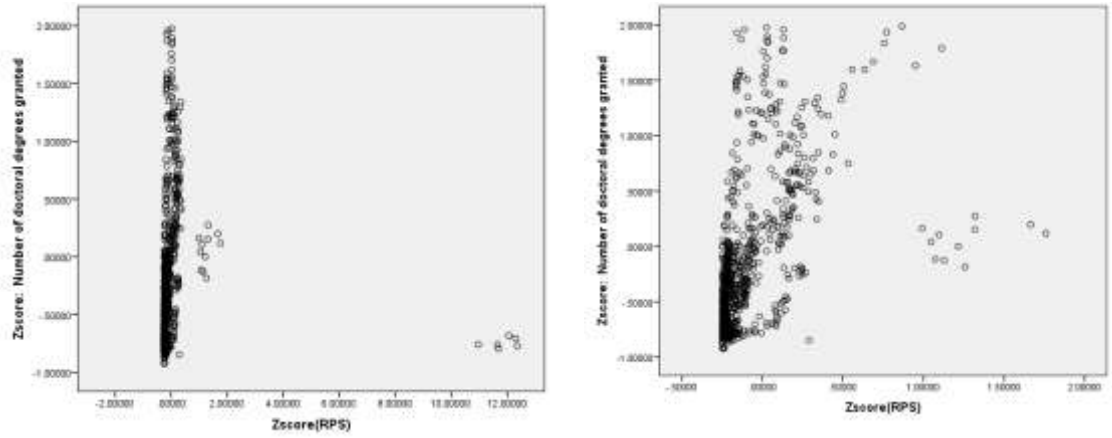

Figure 1. Scatterplots of number of doctoral degrees granted to research expense per student at Private Non-Profit Research Carnegie Classification including outliers (left) and excluding outliers (right).

Table 2
Correlation and Coefficient of Determination for Number of Doctoral Degrees Granted Based on Research Expense per Student (n=843)

		Zscore: Research Expense per Student	Zscore: Expenditure for Research
Zscore: Research Expense per Student	Pearson Correlation	1	.523
	Sig (2-tailed)		.000*
	n	843	843
Zscore: Number of Doctoral Degrees Granted	Pearson Correlation	.523	1
	Sig (2-tailed)	.000*	
	N	843	843

*p<.01 level (2-tailed)

Research Question #3

To what extent can we predict the NUMBER OF DOCTORAL DEGREES GRANTED AT 4-YEAR PRIVATE NOT-FOR-PROFIT RESEARCH INSTITUTIONS based on the amount RESEARCH EXPENSE PER STUDENT?

Linear Regression. A linear regression was generated to answer this question. The results of the linear regression are depicted in Table 3. The regression equation is as follows: $\hat{y} = bx + a$, where $\hat{y}$ is the number of doctoral degrees granted, "b" is the slope, and "a" is the y-intercept. Using the model, $\hat{y} = (.004)x + (91.86)$

Forecast. Using the linear regression equation, we calculated $\hat{y} = (.004)x + (91.86)$, which can be interpreted as: The number of doctoral degrees granted will increase by 4 for every $1000 in research expense per student. The model has a coefficient of determination (R^2) of 0.27, which means that 27% of the variance in number of doctoral degrees granted can be explained by the amount of research per student. We are 95% confident that the number of doctoral degrees in the study lies in the interval between 4 and 5.

Table 3

Regression Analysis for Number of Doctoral Degrees Granted and Research Expense per Student (n=843)

Variables	R	R^2	Unstandarized Coefficient		Standarized Coefficient	*t*	P (*Sig.*)	95% CI	
			β	Std. Error	β			Lower	Upper
Constant	--	--	91.86	3.97	--	23.14	.000	84.07	99.66
Research Expense per Student	.52	.27	.004	.000	.523	17.78	.000	.004	.005

Conclusion

Due to the importance of research conducted by universities impact the local economies, the purpose of this study was to better understand private universities and their research expenditures, by analyzing how the research expenditure in private not-for-profit institutions compared to the research expenditure of public, 4-year institutions. Also, the study aimed at identifying the relationship between the research expense per student in private, not-for-profit, 4-year institutions and the number of doctoral degrees granted.

The study found enough evidence to accept the claim that there is no difference in the mean research expense per student of the public, 4-year institutions and the private not-for-profit, 4-year institutions. In answering the question of whether there is a linear correlation between research expense per student and the number of doctoral degrees granted in private, 4-year, not-for-profit research institutions, the study found a positive correlation between these variables. Finally, since a correlation exists between research expense per student and the number of

doctoral degrees granted in private, 4-year, not-for-profit research institutions, the study wanted to answer to what extent we could predict the number of doctoral degrees granted at a private, 4-year, not-for-profit research institution based on the amount of research expense per student. The results show that the number of doctoral degrees granted would increase by 4, for every $1,000 of research expense per student; which supports the literature on how research and doctoral degrees are related.

As private universities, both not-for-profit and for-profit invest more resources into research, either because of their own social responsibility or due to policy makers, the local communities near these institutions may began to perceive some of the benefits that research brings to the local economies. At the same time, the money invested in research may eventually lead to the creation or strengthening of doctoral programs, which products also contributes importantly towards the academia and the wellbeing of communities.

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