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AUTHOR Huffman, John P., Jr.; Schneiderman, Stuart
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ABSTRACT

This study examined the effect of institutional size on the six year institutional graduation rate for undergraduates, controlling for five variables known to affect graduation rate: (1) student academic preparation; (2) enrollment to dormitory capacity ratio; (3) percentage of part-time students; (4) expenditure per student; and (5) student to faculty ratio. Institution size was defined as the number of headcount students enrolled in the Fall semester of 1993. Data were gathered for 800 four-year postsecondary institutions from a variety of sources including the Integrated Postsecondary Education Survey (for headcount data) and several published national surveys of postsecondary institutions (for graduation rates, Scholastic Assessment Test scores, student-faculty ratios, and educational expense per student). Statistical analysis indicated that institutional size has a significant and negative influence on graduation rates. The state with three 10,000-student institutions can be expected to graduate 3 percent more students than the state having one 30,000-student institution. Application to the state plans of Florida and Pennsylvania suggest that nearly 1,000 fewer degrees can be expected in Florida than in Pennsylvania with $60 million of a $2 billion budget spent unproductively. Results have implications for the long range planning of state systems of higher education. (Contains 18 references.) (BF)

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Size Matters: The Effect of Institutional Size on Graduation Rates

John P. Huffman, Jr.
Florida Postsecondary Education Planning Commission
325 West Gaines Street, 224 Collins
Tallahassee, FL 32399-0400
(904) 487-0032
fax (904) 922-5388
e-mail huffmaj@mail.doe.state.fl.us

Stuart Schneiderman
Florida State University
Bellamy Building
Department of Political Science
Tallahassee, FL 32306-2049
(904) 644-5727

SUMMARY

Research and policy initiatives on the effect of size and academic achievement is focused primarily on K-12 classes and schools. There is little discussion on the possible deleterious effects of increased size on postsecondary institutions. The findings in this paper are that, on average, larger postsecondary institutions are less effective in delivering educational outcomes, when controlling for other factors. Educational outcomes are defined as the institutional graduation rate.

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This paper was presented at the Thirty-Seventh Annual Forum of the Association for Institutional Research held in Orlando, Florida, May 18-21, 1997. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum Papers.

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INTRODUCTION

Over the next ten years, many states will experience tremendous growth in the number of high school graduates. Nationally, there will be an estimated 14% increase in high school graduates and, likewise, an increase of 14% in college enrollment (US Education Secretary R. Riley, 1996). California and Florida, for instance, will have as many as 50% more high school graduates in 2006-07 than they did in 1993-94 (Chronicle of Higher Education Sept. 2, 1996). If national enrollment trends continue, then California and Florida should expect an increase of at least 50% in college enrollment. But is there room on the campuses of existing institutions to accommodate these traditional students? The average size of a public four-year postsecondary institution in the US is 9,268 students (Fall 1993), while in California and Florida the average size is 16,226 and 20,287 students, respectively.

Will this increase in enrollment, and subsequent increase in campus size cause negative effects? If so, how can planners and institutional researchers measure them? Can they be ameliorated? Failure to identify or consider these effects can result in ineffective and inefficient educational and economic outcomes. But are educational planners concerned with the size of their institutions? As Patrick Callan, the former Executive Director of the California Higher Education Policy Center, has described his state's planning preparation, "California does not have a bad plan for the future of higher education: it has no plan at all" (Callan 1996).

The purpose of this paper is to investigate some of the potential "negative effects" of increasing the size of an institution. The central research question is to determine if larger postsecondary institutions, on average, are less able to deliver positive education outcomes, when controlling for other relevant factors. Educational outcomes will be defined as the six-year graduation rate for first time in college students (Mortenson April 1997).

BACKGROUND

Over the last two decades there has been tremendous concern over the negative effects of school and class size on student performance (e.g., Powell, Farrar, and Cohen

1985; Bryk, Lee and Smith 1990). Indeed there are volumes of research, arguments, remedies, and public policy proposals concerning the negative effects of size on student achievement. However, nearly all of this research is concerned with primary and secondary institutions.

The research on postsecondary institutions is inconsistent and fails to clearly answer the central research question of whether or not larger institutions have a positive or negative impact on educational achievement. For instance, when using controls for academic ability and student socio-economic status, mixed results are found between the size of an institution and baccalaureate attainment rates (or drop-out rates). Stoecker, Pascarella and Wolfle (1988) were unable to find a statistical relationship, while Astin and Panos (1969) found a negative relationship and Kamens (1971) detected a positive relationship. This paper will begin to resolve the inconsistent and conflicting empirical findings of previous research.

We begin by analyzing the characteristics of students and institutions that have a major contributing influence on degree completion. Our first variable of interest is the academic preparation of the student body. We expect that better prepared students, on average, will have higher rates of degree completion. Likewise, institutions that have better prepared student bodies, on average, will have higher graduation rates, when controlling for other relevant variables. Now, the trick is finding and measuring the "other relevant variables."

Mainstream educational attainment research suggests that non-traditional, non-residential campuses will have lower rates of persistence and degree completion (Astin, 1975; Astin, 1977; Velez 1985; and Pascarella and Terenzini, 1991; among numerous others). Theoretically, the argument is that a student will have a better chance of graduating at an institution that has a more "close-knit" or student centered environment. In other words, because a student lives on campus she is more likely to participate in student activities and will be more involved in the academic environment. The evidence supporting this theory is consistent and overwhelming (see Pascarella and Terenzini 1991 for an excellent review). Most recently, Mortenson completed an analysis of institutional graduation rates (IGR) where he regressed IGR on SAT scores, percent of the student

body attending part-time and the percent of the student body living on campus (n=1,100; April 1997). He found that as the academic preparation of the student body and the number of students living on campus increased, so did the institutional graduation rate. However, he also found, that when the percentage of the student body who attended part-time increased, then graduation rate decreased. At a minimum, we should include at least one variable that measures campus environment.

Next, we turn to the issue of expenditures. Since one of the most distinguishing differences between educational institutions is the amount of funds that can be spent and the mechanisms that can be used to raise revenue, we may need to include some sort of control for educational expense. Also, one does not have to look far to find an education administrator or chief executive that claims that they could do a better job of educating students if they only had more money. Therefore, we would expect that when everything else is equal, then institutions that spend more per student, should have higher graduation rates.

Finally, we turn to our variable of central concern, size. Conceptually, larger institutions can offer a wider variety of degree programs, student activities and other experiences. Yet, at the same time, there is more competition for them. For instance, there can be only one student body president, one newspaper editor (of course there can be more than one paper, or assistant editors), one fraternity president (but perhaps more fraternities), etc. Larger institutions will also have several different, and sometimes conflicting missions. For instance, many operate health care facilities, extensive athletic programs, business development centers, and dedicate a significant amount of time, energy and resources towards scientific research. Each of these activities may detract from the goal of educating undergraduate students. The theoretical perspective is that on average, a small, focused institution can function more effectively than a larger, diverse one, *ceteris parabus*.

MODEL

The models that test our research question concerning institutional size must take into account those factors that influence graduation rates. While we cannot measure every

factor related to educational attainment, we can measure those variables that are most likely to have significant and direct effects on the dependent variable.

The dependent variable will be the six-year institutional graduation rate for undergraduates pursuing a baccalaureate degree (GRADRT). There will be several independent variables, some of which may measure portions of the same concept, and others which are theoretically and empirically distinct.

The academic preparation of the student body will be used as a control (independent) variable. This variable will be the average recentered SAT score for the Freshman class (SAT) . In some cases it was necessary to convert ACT scores to the SAT metric, this was done with a concordance table provided by the Florida Department of Education.

The next control variable is the degree to which the institution is a residential or commuter campus. This variable is measured by dividing the total number of students enrolled at the institution by the dormitory capacity of the campus (DORMPERS). The third control variable is the percentage of students who are enrolled part-time (PERPT). This variable is inversely related to DORMPERS. Students who live on campus are generally full-time students, thus, when the percentage of students attending part-time increases, the percentage of students living on campus decreases. These two variables must be interpreted with care if they are included in the same equation.

The next independent variable is the educational expense per student (EDEXP). This variable measures the number of dollars that is spent on each full-time equivalent undergraduate student, regardless of the source of the money (i.e., tuition, state appropriation, federal grants and loans, endowment, etc.).

The final control variable is the student to faculty ratio (SFRATIO). This variable simply divides the number of undergraduate students by the number of instructional faculty. This variable may prove to be troublesome in a multivariate equation when EDEXP is included with SFRATIO. Conceptually, institutions that have more fiscal resources at their disposal can simply hire more faculty, thus as EDEXP increases, SFRATIO decreases.

The test variable of interest is the size of the institution (ENROLMNT). Size will be defined as the number of headcount students enrolled in the Fall semester of 1993. This includes undergraduate, graduate and professional students. We must use a great deal of caution when estimating models that include ENROLMNT and any other variable that uses some measure of enrollment in it's calculation, such as PERPT or DORMPERS. If these three variables are included together in a multivariate equation we should expect the results to exhibit some multicollinearity and it may be unclear as to which dimension is being measured. In a bi-variate sense we should expect DORMPERS to be negatively related to ENROLMNT and PERPT, and ENROLMNT to be positively related to PERPT.

DATA AND STATISTICAL METHODS

The data were collected for 800 four-year postsecondary institutions from a variety of sources. The National Center for Education Statistics' Integrated Postsecondary Education Survey (NCES) provided data for **ENROLMNT** (Fall headcount enrollment), **DORMPERS**, and **PERPT**. Several national surveys of postsecondary institutions were used to measure graduation rates, recentered SAT scores, student-faculty ratios and educational expense per student (e.g. NCAA, Money Magazine, and U.S. News & World Report). The data gathered from these publications were compared to determine reliability, and was found to be highly correlated (i.e., reported 6 year baccalaureate degree graduation rates is correlated at .99).

The U.S. News data has been used extensively by "The Mortenson Research Seminar on Public Policy Analysis of Opportunity for Postsecondary Education" to examine graduation rates by income level and admissions selectivity (Mortenson, March 1997; April 1997). The U.S. News data, while not perfect, is reliable and was used as the source for **GRADRT, SAT, SFRATIO** and **EDEXP**.

The research design and intent of this paper is to use the most parsimonious method to answer the central question. To test the degree to which any two variables are related we used the SPSS bi-variate correlation function. In order to test more than one

Model 3 drops ENROLMNT from the equation and tests the influence of SAT and EDEXP on institutional graduation rates. SAT remains significant at the .01 level, while EDEXP fails to achieve this level of significance. It does not appear as if including expenditure data has added a great deal to our understanding of graduation rates and, substantively, means that institutions should not be too quick to blame inadequate funding for low graduation rates.

Models 4, 5, and 6 include the surrogate or indirect measure of size in place of ENROLMNT. In all three models DORMPERS, PERPT, and SFRATIO attained the .01 level of significance and each explained at least 64% of the variance. Substantively, as the percentage of students living on campus increases, on average, the percentage of students who graduate increases, controlling for academic ability (Model 4). Conversely, as the percent of students who attend part-time increases and as the student-faculty ratio increases, on average, the percentage of students who graduate decreases, controlling for academic ability (Models 5 and 6, respectively).

The results of Models 4, 5 and 6 strongly reinforces the theory that DORMPERS, PERPT and SFRATIO are indirect measures of size. In fact, the statistical results indicate that they may be better explanatory variables than size alone. Unfortunately, because they all measure portions of the same thing, when they are included in the same equation one or more of the variables fail to achieve statistical significance or the direction of the sign changes. Thus, when they are included in the same equation, it is statistically unclear which dimension of each variable is actually being measured. Subsequently, the equation fails to perform adequately.

Before moving to the next section we should explain why public, private, state-related, and quasi-public institutions have been included in the data set. First, it is increasingly difficult to describe the difference between some public and private institutions. Second, with the increase in sponsored research, financial aid, tuition voucher and contract programs, and types of governance structures it is almost impossible to precisely define these differences. For instance, is the University of Pittsburgh public or private? Cornell? Michigan? Third, public and private, as well as doctoral and non-doctoral granting institutions are all in competition for many of the same resources, such

variable at a time, we have chosen linear multiple regression using ordinary least squares estimators (Gujarati 1992).

RESULTS

For those who do not wish to wade through the technical statistical discussion, feel free to skip ahead to the **SUMMARY AND SUBSTANTIVE INTERPRETATION** section. The results of the bi-variate correlations are all in the expected direction and are reported in TABLE 1. GRADRT was positively correlated with DORMPERS, EDEXP, and SAT, and negatively correlated with ENROLMNT, PERPT, and SFRATIO. The correlations of ENROLMNT and PERPT, SFRATIO, and DORMPERS were also in the expected direction. This later finding lends credence to the notion that the percent of the student body attending part-time, the student-faculty ratio and the percentage of the student body living on campus are surrogate or indirect measures of size.

[TABLE 1 About Here]

The multivariate results are also very encouraging and are reported in TABLE 2. The statistical findings indicate that when controlling for academic ability of the student body (SAT scores) larger institutions, on average, have significantly lower six year graduation rates. TABLE 2 reports the findings for six of the models and all six are consistent and support the thesis that larger institutions are less effective at delivering educational outcomes. Model 1 reports a negative and highly significant coefficient for institutional size, when controlling for the academic preparation of the student body and the independent variables explain 63% of the variance (adjusted r-squared).

[TABLE 2 About Here]

Model 2 is identical to Model 1 except that the educational expense per full-time undergraduate student is added to the equation. All three independent variables (SAT, ENROLMNT, and EDEXP) are significant, but the adjusted r-squared remained at .63.

columns **SAT** and **EdEXP** in Table 3). The final column, "*# of Students who Fail to Graduate per 10,000*," indicates a difference of 328 students per 10,000. Thus, for every 30,000 students, Pennsylvania will grant nearly 1,000 more degrees than Florida, a difference of a modest 3%.

In terms of dollars and cents, Florida spends nearly $2 billion dollars a year on its public four-year institutions (State University System), not counting capital costs or sponsored research. When we realize that 3% of $2 Billion is $60 million, we begin to see that modest differences can have large consequences. The annual loss of $60 million and 1,000 fewer degrees represents a real, tangible negative effect of a policy choice.

Another tangible and measurable negative effect concerns the ability of a state to educate it's citizenry. Florida currently ranks 45th nationally in the number of baccalaureate degrees granted per 18-44 year old population (coincidentally, Pennsylvania ranks 12th). A portion of Florida's low ranking can clearly be attributed to the state's intentional decision to create large institutions.

Some intangible effects are that unnecessarily low graduation rates means that students do not graduate that ordinarily would graduate. This directly translates into lower educational attainment levels of the citizenry, and in turn, lower wages and standards of living. These effects have led Dennis Ross, a member of Florida's Board Regents to comment that baccalaureate education is "the single most important determinant for economic development" (Ross 1995). Likewise, when economic development is stunted and wages are low, tax revenues become more scarce. Thus, the state has less resources available to address its current or future problems, such as rapidly increasing enrollments.

The Florida Department of Education is projecting an increase of 50,000 in annual high school graduates ~~over the same period~~ from 1990 to 2010 (a 45% increase) and preliminary projections by the Florida Postsecondary Education Planning Commission (PEPC) indicate that by 2010 there will be an additional 250,000 college credit students enrolled in the state's institutions of higher education. This translates into an additional 15,000 college students per year for the next 15 years.

as students, grants, state tax dollars, private donations, athletes, and faculty. Fourth, these institutions are included in the analysis because we have controlled for the key differences between public and private colleges (i.e., admissions selectivity and expenditure per student). An examination of the plots of the residuals indicated that public and private institutions were fairly evenly distributed. Likewise, doctoral and non-doctoral granting institutions were also distributed in a random manner. Given the control and test variables of this research design, the inclusion of these types of institutions in the same equation does not bias the results and is a valid approach.

SUMMARY AND SUBSTANTIVE INTERPRETATION

The statistical results indicate that institutional size has a significant and negative influence on graduation rates. As an institution grows in size, on average, the percentage of students who complete a baccalaureate degree in six-years decreases, when controlling for other factors. Table 3 provides a substantive depiction of the negative effect of institutional size.

[TABLE 3 About Here]

The inner box of Table 3 labeled **Substantive Interpretation** models seven institutions (A-G) of different size. At first glance it does not appear as if there is much difference in the graduation rate of institutions A, B, C, D, E, F, or G. However, when we compare institution C to institution E, and then place the graduation rates into context, we find some shocking results. Let's assume that two states have two different types of enrollment policies. One state, much like Florida, decides that it is more effective to have a few large institutions. While another, for instance, Pennsylvania relies on several smaller institutions.

Now consider that each state has the task of enrolling 30,000 students. Institution E, which has 30,000 students, represents Florida's policy choices, and Pennsylvania's choices are represented by three institution C's. Both states have 30,000 students of equal academic preparation and they spend the same amount per student (represented by

The State University System of Florida will open Florida Gulf Coast University (FGCU) in the Fall of 1997. Projected enrollment for FGCU in the Fall of 2003 is expected to be approximately 10,000 students. FGCU will be able to enroll 4% of the projected increase in college students. Given that Florida's public four-year institutions are twice the size of the national average (and also twice the size of the institutions in the data set used for this paper), we can see that in the future Florida may have some serious problems delivering a baccalaureate education.

CONCLUSION

This paper has used data from 800 four-year postsecondary institutions in the United States to demonstrate that larger institutions are not more effective at delivering positive educational outcomes. In fact, it seems that the opposite is true. That larger institutions are significantly less able than smaller institutions to graduate students with a baccalaureate degree.

A tangential research project will follow the decision-making process in Florida and measure the outcomes of current and future policies. Also, additional institutions and variables will be added to the data set to develop a more in-depth understanding of precisely which attributes of size are causing the deleterious effects on graduation rates.

The results of this research are encouraging. Future work will be done to try to determine if the relationships are non-linear. Preliminary analyses indicate that for extreme measures of SAT scores, educational expense and graduation rates, that a non-linear phenomena may be occurring. The non-linearity is not strong enough to significantly alter the statistical results or substantive interpretation. However, for those who would like to use the models presented here as point estimates or as predictive models, we would urge caution because any particular case may fall within the non-linear range (e.g., graduation rate above 90%, SAT score above 1300 or education expense above $25,000).

Finally, these findings have serious implications for institutional researchers and planners and we would urge state level officials to take into consideration the effect of adding more students to institutions that are already larger than average. From the

perspective of granting baccalaureate degrees and allowing students the opportunity to complete their education, smaller postsecondary institutions are preferred to larger institutions. It appears to be the case that adding students to large institutions is less effective and efficient than creating a new institution, at least in the long run.

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TABLE 1

Bi-Variate Correlations

	DORMPERS	EDEXP	ENROLMNT	GRADRT	PERPT	SAT	SFRATIO
DORMPERS	1.0000						
EDEXP	.2869**	1.0000					
ENROLMNT	-.4446**	-.0150	1.0000				
GRADRT	.4999**	.5835**	-.1018**	1.0000			
PERPT	-.6232**	-.2934**	.1102**	-.4900**	1.0000		
SAT	.4530**	.7017**	-.0351	.7940**	-.4693**	1.0000	
SFRATIO	-.3866**	-.4686**	.4164**	-.4333**	.1380**	-.4159**	1.0000

** = Significant at .01 Level

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TABLE 2

Multivariate OLS Regression Results

(Dependent Variable = Educational Expenditure Per Full-Time Undergraduate Student)

Variables (Coefficients and t-Ratios)

MODEL (n)	Constant	SAT	ENROLMNT	EDEXP	DORMPERS	PERPT	SFRATIO	Adj. R Sq.
1	-77.8	0.124	-0.000152					0.632
774		(36.17)	(-3.39)					
2	-70.7	0.116	-0.000164	0.000189				0.632
748		(23.65)	(-3.65)	(1.95)				
3	-73.3	0.117		0.000158				0.629
758		(23.34)		(1.70)				
4	-70.4	0.112			12.46			0.651
774		(29.89)			(7.45)			
5	-65	0.114				-17.86		0.641
766		(29.3)				(6.24)		
6	-62.6	0.116					-.518	0.642
783		(31.5)					(-5.30)	

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TABLE 3

OLS Regression Results

(Dependent Variable = 6 Year Baccalaureate Graduation Rate)

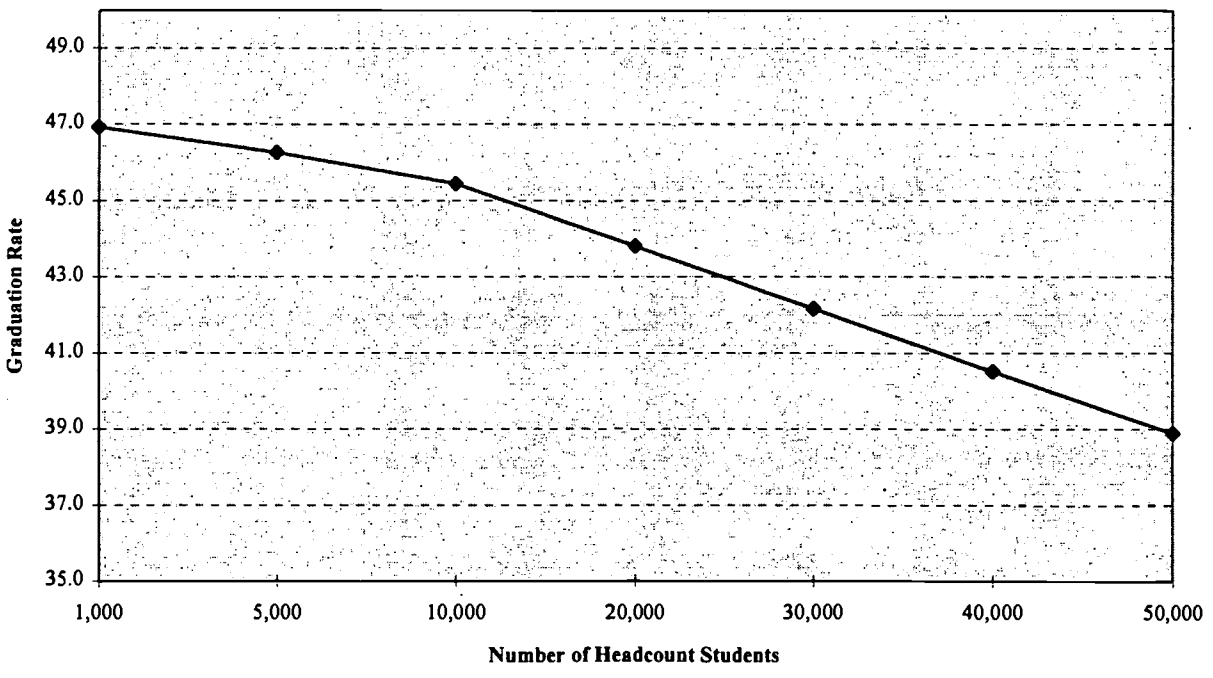
Variables	Coefficients	t-Ratio	Significance Level
SAT	0.116294	23.659	0.0000
EdExp	0.000189838	1.949	0.0517
Enrolmnt	-0.000164036	-3.654	0.0003
Intercept	-70.724956		

(n=748, Adjusted r-Square=.63)

Substantive Interpretation

Institution	SAT	EdEXP	Enrollment	GradRate	*#of Students who Fail to Graduate per 10,000*
A	1000	8,000	1,000	46.9	==
B	1000	8,000	5,000	46.3	66
C	1000	8,000	10,000	45.4	148
D	1000	8,000	20,000	43.8	312
E	1000	8,000	30,000	42.2	476
F	1000	8,000	40,000	40.5	640
G	1000	8,000	50,000	38.9	804

The Negative Effect of Institutional Size



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