Three Essays Analyzing the Behavior of Institutions of Higher Learning

by

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(Under the direction of David R. Kamerschen)

Abstract

The first essay examines whether the tuition differentiation used by public institutions is third-degree price discrimination. Public institutions discriminate "in reverse" in that they charge a higher price to the more elastic demanders. While this is contrary to standard economic theory, the reasons for discriminating in this way are rational. I find that the governing structure of a state's higher education industry is an explanatory factor to pricing behavior and market structure.

The second essay employs two methods of Data Envelopment Analysis to compare relative efficiencies of institutions of higher learning (IHLs). The first method constructs a single frontier and then groups the institutions afterwards for comparison. In addition to comparing private and public IHLs, I introduce a new way to group institutions. I separate IHLs by the percent of unrestricted revenue. The second method uses the Charnes, Cooper, and Rhodes (CCR) ratio form. The institutions are grouped together to generate separate frontiers and then projected on to their frontier by the CCR ratio. They are subsequently added together to construct a single frontier to make comparisons.

The third essay focuses on teaching and research components and proposes a model that addresses the reallocation of revenues within an institution. I find that public, doctoral-granting institutions are more likely to cross-subsidize from teaching revenues into research expenditures. Conversely, private, doctoral-granting institutions are more likely to cross-subsidize from research revenues into teaching expenditures. I postulate the percent of unrestricted revenue and indirect cost rates for on-campus research are explanatory variables for this behavior. I use a model of utility maximization in which teaching and research are produced subject to a zero profit constraint.

Index words: higher education, price discrimination, data envelopment analysis, cross-subsidization

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Chapter 1

The Impact of Governing Structure on the Pricing Behavior and Market Structure of Public Institutions of Higher Learning

1.1 Introduction

Public institutions of higher learning (IHLs) have long been known to charge different tuition to different students; in-state students pay lower tuition than their out-of-state classmates. The advertised "sticker" price is differentiated between these two groups of students, while need-based and merit-based financial aid are applied to that price to reduce the cost to each student. The reasons for this differential are straightforward. The state has an incentive to subsidize higher education to produce a higher-earning workforce that will pay higher taxes. An individual institution has an incentive to attract more in-state students because college students who graduate in a particular state are more likely to reside in that state after graduation. Alumni living near their *alma mater* are more likely to provide donations more through return trips to campus and to respond more favorably and generously to fundraising campaigns.

While these reasons are intuitively appealing and well addressed in the literature, I have found another determinant to this pricing differentiation that provides some additional insights into the pricing behavior and market structure of public IHLs. The governing structure of the institution plays an important role in pricing, horizontal differentiation, and vertical differentiation of the state's higher education industry.

I define governing structure as the approach the state has taken to organize its higher education system and the relationship between an individual institution and the state. I have found two types of structures. The first I call a state system. It is centralized with a high degree of state authority over all public IHLs. The centralized agency, usually called a board of regents or board of governors, has legal control and management over the institutions in its domain. The agency controls planning, mission definition, and budgets. Usually, state appropriations are provided to this agency and the agency is assigned with distribution to the individual institutions. For example, North Carolina has a Board of Governors for all sixteen of its four-year institutions and a Community College System for all fifty-nine of its two-year institutions. Georgia has a Board of Regents for its thirty-four four-year and two-year institutions and a Department of Technical and Adult Education for its thirty-eight technical and community colleges.

The second type I call a non-state system, which is decentralized with a higher degree of institutional autonomy. Some states have a specific agency that acts as a coordinating body between the IHLs, but this agency usually has limited authority over planning, mission, and budget review. In some states this agency is called a board of regents while in other states it is called a coordinating board. Usually, state appropriations are provided directly to the institutions. For example, Arizona has a Board of Regents with authority over three four-year universities, but no authority over the other two four-year institutions and the remaining twenty two-year institutions. Appendix A contains a listing of states and governing structures.

The flexibility, strategic interaction, and ability of an individual IHL to adapt to its environment will be different between these types of governing structures. As a result, the market structure of the higher education industry will vary between states with the two different types of governing structure. The centralized agency in a state system will consider the needs not only of a specific IHL but also of all IHLs

within its authority. IHLs that operate in a non-state system have more flexibility to set prices and make program changes and do not necessarily consider the needs of other institutions in the state.

The issue of governance is not well addressed in the literature. The two most relevant articles address governance at the individual institution level, not at a state level. McCormick and Meiners (1988) use a property rights perspective to address university governance. They conclude that increasing the role of faculty will lead to lower research output. Brown (1997) also uses a property rights perspective to address academic tenure. He concludes that tenure is necessary for faculty to be willing to assume ownership-type roles within the institution.

This essay unfolds as follows. Section 1.2 establishes that the pricing differentiation between in-state and out-of-state students is price discrimination. Section 1.3 addresses reasons for price discrimination and Section 1.4 develops pricing behavior and market structure of public IHLs operating in the two governing structures. Section 1.5 constructs the theoretical model for nonprofit, public institutions. Section 1.6 introduces the econometric model and data to test, explain, and analyze pricing behavior and market structure. Section 1.7 provides the results and Section 1.8 concludes.

1.2 Price Differentiation Is Third-Degree Price Discrimination

"Price discrimination occurs when different units of a homogeneous product are sold at different delivered prices in the same time period, for reasons not associated with differences in the manufacture, sale, or delivery costs, with due allowance for risk and uncertainty. Of course, the usual reason for engaging in price discrimination, when feasible, is the desire to enhance profits. Price discrimination may also refer to situations in which two similar goods, say the i^{th} and j^{th} commodities, have the

following relationship: $P_i/MC_i \neq P_j/MC_j$. That is, price discrimination is said to exist if two or more similar goods are sold at prices which are either in different ratios to marginal cost or not accounted for by the difference in marginal cost. Thus, price differentiation may not involve price discrimination and price discrimination may not involve price differentiation"(Kamerschen and Valentine, 1981, pp. 403-404).

Clarkson and Miller (1982) state four necessary conditions for the existence of price discrimination.

1. The firm must face a downward-sloping demand curve.

2. The two or more identifiable classes of buyers must be separable at a cost that does not exceed the monetary gains from separating them.

3. The resale by those buyers who pay a low price to those who would be charged a higher price must be deterred.

4. The price elasticity of demand for the product of two or more classes of buyers must be different and must be known by the firm, at least in an ordinal sense necessary for third-degree price discrimination.

Does an IHL face a downward-sloping demand curve? Leslie and Brinkman (1987) answer yes without exception. Their survey article standardizes twenty-five empirical studies, and they find the same results in each study: enrollment declines when tuition prices are raised and increases when prices are lowered.

Can buyers be separated at low costs? Yes, residency status is very easy to identify, and the cost to implement a tuition differential is small.

Is resale deterred? Yes, a student must officially enroll to receive instruction and earn a degree. One student cannot resell his or her human capital to another student.

Is there a difference between price elasticities of demand of in-state and out-of-state students? I have been unable to find any studies that estimate elasticities separately for in-state and out-of-state students. However, I can reasonably infer that the elasticities are different by standard economic theory. Standard theory suggests several qualitative reasons that determine elasticity. One determinant is the degree of substitutability or the presence of alternatives. If the degree of substitutability is high or if many alternatives are available, then elasticity will be relatively large. Another determinant is the percentage of income spent on the good. If the percentage is high, then elasticity will be large. For in-state students who wish to attend college in their state, the degree of substitutability is relatively low. Therefore, their demand curves will be more inelastic than demand curves for out-of-state students. *Ceteris paribus*, in-state students will spend a smaller percentage of income on tuition than out-of-state students because the price is lower. Therefore, in-state students will have more inelastic demand curves.

In the pure economic context as described previously, I contend that public institutions engage in price discrimination and the price difference is not simply price differentiation. The marginal cost of educating an in-state student and an out-of-state student is the same. Residency status does not dictate costs of instruction because instruction expenditures are mostly determined by the physical plant of the institution and faculty salaries. By meeting the previous necessary conditions, public IHLs engage in a clearly defined case of third-degree price discrimination.

1.3 Reasons for Price Discrimination

Two basic reasons for price discrimination exist: subsidizing higher education to increase future tax payments and increasing future donations by alumni. A critical factor common to both reasons is migration of students after graduation.

Groen and White (2001, p. 15) find "not surprisingly, students' probabilities of locating in a state are highest if they are both from the state and attended college there and successively lower if they are from the state but did not attend college there, if they only attended college there, and if they did neither." For public university students, they find the probability of in-state students residing in their home states after graduating from college in their home state is 0.55, and the probability of residing in their home states if they graduate from outside their home state falls to 0.32. For out-of-state students, the probability of residing in the state where they graduated is 0.15, and the probability of residing in a state if they neither are from there nor graduated there is 0.01.

Mixon and Hsing (1994, p. 330) highlight the importance of this issue: "College administrators and government officials are concerned about the economics of college student migration. First, each additional in-migrating student represents an additional source of revenue. Conversely, each out-migrating student represents a potential loss of revenue to some state colleges and universities. Second, the presence of out-of-state students represents a diversified social and cultural environment that may provide resident students with an opportunity to exchange views, thus enhancing investment in human capital through the migration process."

Groen and White model the two reasons outlined previously in the context of admissions policy. They establish an "equal additional tax payments rule" which considers the state's interests. Because tax revenues are roughly proportional to income, high-ability students will eventually pay more taxes because their income is higher. The state therefore has an incentive to keep high-ability, in-state students and attract high-ability, out-of-state students. The state prefers the IHL to maximize the increase in expected future tax payments subject to a capacity constraint. They then establish an "equal marginal revenue rule" which considers the IHL's interest of student ability and total revenues. Expected revenue comes from donations and

tuition. IHLs wish to set cutoff admissions levels to maximize expected revenue subject to a capacity constraint. They suggest that in-state students are more likely to locate near the school as adults, and this may cause them to donate more on average than out-of-state students having the same ability levels.

1.4 Pricing Behavior and Market Structure

There is a difference in the pricing behavior and market structure between IHLs that operate in each type of governing structure. I synthesize the thoughts and theories of several authors and apply them to differences in governance.

In a traditional context of market goods, Wolinsky (1987) discusses and models the practice of price discrimination using labeled and unlabeled products. In one model he considers a market for a differentiated product where the buyers differ in the intensity of their preferences. Sellers market some of their product with an identifying label and some without it, while buyers who strongly prefer a particular brand may be willing to pay a higher price for a labeled brand. In another model he considers a model of horizontal differentiation where different consumers have different rankings of the available brands.

Rothschild and White (1993, p. 24) state, "Individual universities have perceived quality differences and 'brand-name' reputations that surely influence student choice. Competition among universities appears to have both geographic-space and product-space dimensions."

Hoxby (1997, p. 2) points out, "As a result [of a geographically integrated market] each college has a student body that is increasingly homogeneous; within-college heterogeneity falls. Between-college heterogeneity, however, rises as colleges produce increasingly differentiated products. The increasing differentiation between colleges shows up not only in students' college choices but also in tuitions and subsidies,

which are predicted to grow more variable." She also predicts that colleges may horizontally differentiate by finding market niches.

While Hoxby's statements are true when all public IHLs are evaluated as one group, when they are segregated according to the governing structure, a different dynamic emerges. State system IHLs will exhibit the heterogeneity discussed previously and a greater degree of horizontal and vertical differentiation, but non-state system IHLs will exhibit a greater degree of homogeneity and less differentiation. State system IHLs will be positioned such that they meet the needs of their students and the general needs of the students in that state. The governing body will have an incentive to vertically and horizontally differentiate the institutions and will use its authority to brand the institutions. Conversely, non-state system IHLs will be competing against each other in a more direct way. As they seek to fill their seats and gain prestige, marketing power, and excellence, they will become more similar and attempt to position themselves at the top of the industry.

I use the University System of Georgia as an example to illustrate my points and explain behavior. All of the state's four-year and two-year public institutions are governed by a centralized Board of Regents. The Board groups the schools into one of five categories: research universities, regional universities, state universities, state colleges, and two-year colleges. There are four research universities and two regional universities. The two regional universities have many incentives to elevate to research status. However, the Board has an incentive to keep them at their current status because it is in the best interest of the state for them to stay there. Each institution in a category charges the same tuition, and the tuition varies considerably from the highest category to the lowest. The Board "brands" the IHLs by putting them in a particular category and markets them as such. Within a category, the IHLs are more homogeneous, and there is little horizontal differentiation.

If one were to keep the thirty-four IHLs in Georgia, take away the Board, and allow a non-state system of governance to develop, I predict a "rush to the top" as all IHLs would want to climb to a higher status. Two-year colleges would want to become state colleges, state colleges would want to become state universities, and so forth. Vertical and horizontal differentiation would decrease as the institutions in the market become more homogeneous. Between-college heterogeneity would fall as institutions produced less differentiated products.

The governing structure could also be a determinant in attracting students. A logical extension of the differences in institutions described previously is the ability to fill seats. Since a centralized governing agency will consider the general needs of the state when making decisions, I expect IHLs that operate in a state system of governance to have a higher percentage of their students come from their state.

1.5 Theoretical Model and Hypotheses

A profit-maximizing, price-discriminating firm will segment its market into at least two segments and charge a higher price in the market with the less elastic demand curve. My result is in direct conflict with standard economic theory. Public IHLs price in the opposite way: they charge a higher price in the market with the more elastic demand curve (i.e. tuition is higher for out-of-state students). What is the cause of this contradiction to standard theory? Rothschild and White (1993, p. 21) state, "The standard paradigm of profit-maximizing behavior as a motive for pricing, output, and/or entry decisions has only limited explanatory power." Standard economic theory relies on the profit-maximizing assumption. Public IHLs, by definition, are nonprofit organizations and the theory of profit maximization is not applicable. Nonprofit organizations are modelled in a variety of ways; utility, budget, and output

maximization assumptions are common forms. I use the model proposed by James (1978).

A multiproduct, nonprofit IHL produces Q_i, i = 1,...,n, at costs C_i and parametric prices P_i in order to maximize a utility function U$[Q_i, (Q_i/C_i)]$ subject to a zero-profit constraint $\sum C_i - \sum P_i Q_i$ - FR = 0, where $\partial U/\partial Q_i \gtreqless 0, \partial U/\partial(Q_i/C_i) < 0$, and FR = fixed revenue (donations or income from endowments) which are independent of current decisions about Q_i or C_i. Larger amounts of Q_i do not necessarily imply higher dollar costs, but if Q_i increases while C_i is constant, then this implies a technological (or quality) deterioration which will result in a decrease in utility. Output and costs are determined simultaneously such that

$$\partial U/\partial Q_i + [\partial U/\partial(Q_i/C_i)](1/C_i) + \lambda P_i = 0 \tag{1.1}$$

$$[\partial U/\partial(Q_i/C_i)][-(Q_i/C_i^2] - \lambda = 0 \tag{1.2}$$

Rearranging (1.1) results in the following:

$$\partial U/\partial Q_i + \lambda P_i = -[\partial U/\partial(Q_i/C_i)](1/C_i) \tag{1.3}$$

On the left-hand side of equation (1.3) are the positive effects of increasing Q_i – more direct utility as well as revenue. On the right-hand side are the negative effects – the decline in average cost and in utility as output rises. Production increases so long as the positive effects outweigh the negative, with the equilibrium output mix implying that relative (dis)utilities equal relative prices:

$$\{\partial U/\partial Q_i + [\partial U/\partial(Q_i C_i)](1/C_i)\} \tag{1.4}$$
$$\div\{\partial U/\partial Q_j + [\partial U/\partial(Q_j C_j)](1/C_j)\} = P_i/P_j$$

relative utilities equal relative net costs:

$$(\partial U/\partial Q_i)/(\partial U/\partial Q_j) = [(C_i/Q_i) - P_i]/[(C_j/Q_j) - P_j] \tag{1.5}$$

and with total revenues allocated such that the gain from marginal expenditures have been equalized across goods:

$$\{[\partial U/\partial(Q_i/C_i)][-(Q_i/C_i^2)]\} \div \{[\partial U/\partial(Q_j/C_j)][-(Q_j/C_j^2)]\} = 1 \qquad (1.6)$$

This theory of pricing behavior and market structure yields several testable hypotheses that I formally examine in the next section. Because a state system will cause more market heterogeneity and vertical differentiation, I expect the

1. governing structure to cause the tuition ratio, defined as out-of-state tuition divided by in-state tuition, to be larger in a state system than in a non-state system,
2. average tuition ratio to be higher in the state system,
3. variance of the tuition ratio to be greater in the state system,
4. percentage of in-state students to be greater in the state system, and
5. variance of the percentage of in-state students to be less in the state system.

1.6 Econometric Model and Data

To formally test hypothesis 1, I use the following OLS model using cross-section data.

$$\begin{aligned} TuitionRatio &= \alpha + \beta_1 GOVERN + \beta_2 INSTENROLL + \\ &\quad \beta_3 OUTSTENROLL + \beta_4 STINCSHARE + \\ &\quad \beta_5 PCNTSTAY + \beta_6 PCTAX + \epsilon \end{aligned} \qquad (1.7)$$

The variables are defined and calculations are explained as follows. Unless indicated otherwise, the data come from the National Center for Education Statistics

(NCES) and the Integrated Postsecondary Education Data System (IPEDS) for academic year 1997-98. *TuitionRatio* is out-of-state tuition divided by in-state tuition. GOVERN is a dummy variable; 1 if a state system institution, 0 if a non-state system institution. INSTENROLL is the number of in-state undergraduate students enrolled in a twelve-month period, and OUTSTENROLL is the number of out-of-state undergraduate students enrolled. Every other year, IPEDS collects residency information for freshmen in the fall enrollment counts. I used the 1996-97 fall enrollment data file to calculate 1997-98 in-state and out-of-state enrollment. I calculated the percentage of freshmen who were in-state students and applied this percentage to the total undergraduate enrollment. Measurement error in these two variables is possible on two levels, but I am not concerned about this potential error. I invite the reader to Appendix B for a further discussion of calculations and other model specifications. STINCSHARE is state personal income divided by U.S. personal income, and the data are obtained from the Bureau of Economic Analysis. STINCSHARE is included to capture the wealth of a state because, as Goldin and Katz (1998) point out, "New states, with a high share of well-to-do families and scant presence of private universities in 1900, became the leaders in public higher education by 1929 and remain so today." PCNTSTAY is the state average for the percentage of students who remained in-state. Using the fall enrollment data file for 1996-97, I calculate PCNTSTAY as the total number of students that reside in-state and attended college in-state divided by the total number of students who went to college from that state. For example, in 1996-97, 26,680 students resided in Alabama and went to college in Alabama while 28,018 total students from Alabama went to college somewhere. PCTNTSTAY captures the migration of students and is calculated for the IHLs in the sample. PCTAX is per capita tax for each state, and the data are obtained from *The Book of the States, 2000*.

I do not include state appropriations as an explanatory variable because to do so would generate endogeneity problems. Paulsen (1991, p. 355) concluded that "when appropriations income decreases, public institutions tend to raise tuition to balance budgets," while Rusk and Leslie (1978, p. 540) concluded that "as state financial effort for higher education slackens, tuitions are raised to make up the difference." Strathman (1994, p. 915) states the problem concisely: "Evidence of these trade-offs is provided in the tuition and appropriations studies: state appropriations are commonly treated as a determinant of tuition, while tuition is often included among the determinants of state appropriations." To avoid endogeneity problems but capture the tax effects, I include PCTAX.

I perform Equation (1.7) on three subsamples of the data: all public IHLs, four-year public IHLs, and two-year public IHLs. Upon completion, I calculate a Chow statistic to determine if the equations are statistically different from each other. The results of the Chow calculation aid in discussing the differences between four-year and two-year IHLs and provide some insight into the behavior of the governing agencies of the state systems.

To test hypotheses 2 and 4, I calculate Welch's v statistic to compare two sample means when their variance is different (Welch, 1938). Welch's statistic is appealing because no distributional assumptions are imposed. To test hypotheses 3 and 5, I calculate an F statistic to determine if the variance of *TuitionRatio* and the percentage of in-state students (PCNTINST) are different between the two types of governing structures. The test statistic used is defined as follows:

$$\frac{s^2_{GOVERN=1}}{s^2_{GOVERN=0}} = F \tag{1.8}$$

I calculate the F statistics for two subsamples: four-year and two-year IHLs.

1.7 Results

The Chow test statistic for Equation (1.7) is 127.37 and the critical value at the 1% significance level is 3.00. I therefore reject the null hypothesis that the two equations are the same and conclude the four-year and two-year equations are different.

The results for four-year institutions are presented in Table One.

Table One		
TuitionRatio for All Public Four-Year IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-2.707 (0.665)	0.000
GOVERN	0.465 (0.074)	0.000
INSTENROLL	0.000 (0.000)	0.048
OUTSTENROLL	0.000 (0.00)	0.001
STINCSHARE	4.235 (1.295)	0.001
PCNTSTAY	5.487 (0.659)	0.000
PCTAX	-0.000 (0.000)	0.501
N = 579		
R^2 = 0.268		

For Equation (1.7), the coefficient for GOVERN is 0.465 and significant. Since GOVERN is a dummy variable, a state system governing structure causes *TuitionRatio* to rise by 0.465. This is a large increase since the mean of *TuitionRatio* in the sample is 2.79.

The results for two-year institutions are presented in Table Two.

Table Two		
TuitionRatio for All Public Two-Year IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-15.960 (1.374)	0.000
GOVERN	1.30 (0.132)	0.000
INSTENROLL	0.000 (0.000)	0.528
OUTSTENROLL	0.000 (0.00)	0.566
STINCSHARE	25.327 (2.221)	0.000
PCNTSTAY	15.289 (1.389)	0.000
PCTAX	0.002 (0.000)	0.000
N = 1077		
$R^2 = 0.425$		

For Equation (1.7), the coefficient for GOVERN is 1.30 and significant. Therefore, a state system governing structure causes *TuitionRatio* to rise by 1.3. This is a very large increase since the mean of *TuitionRatio* in the sample is 3.28.

These results support hypothesis 1. A state system governing structure causes the tuition ratio to be larger than that of a non-state system for both four-year and two-year IHLs.

For four-year IHLs, the average tuition ratio is 2.91 for state system schools and 2.47 for non-state system schools. Welch's test statistic is 6.53, which is greater than the critical value of 1.96 at the 5% significance level. I therefore reject the null hypothesis that the means are the same and conclude the state system IHLs have a higher average tuition ratio.

For two-year IHLs, the average tuition ratio is 4.06 for state system schools and 2.16 for non-state system schools. Welch's test statistic is 15.53, which is greater

than the critical value of 1.96 at the 5% significance level. I therefore reject the null hypothesis that the means are the same and conclude the state system IHLs have a higher average tuition ratio.

These results support hypothesis 2. A state system governing structure causes the average tuition ratio to be greater than that of a non-state system for both four-year and two-year IHLs.

For four-year IHLs, the variance of *TuitionRatio* is 1.01 for state system schools and 0.59 for non-state system schools. The F statistic is 1.71, which is greater than the critical value of 1.00 at the 1% significance level. I therefore reject the null hypothesis that the variances are the same and conclude the state system IHLs have a greater variance in tuition ratios.

For two-year IHLs, the variance of *TuitionRatio* is 8.73 for state system schools and 1.05 for non-state system schools. The F statistic is 8.31, which is greater than the critical value of 1.00 at the 1% significance level. I therefore reject the null hypothesis that the variances are the same and conclude the state system IHLs have a greater variance in tuition ratios.

Therefore, a state system governing structure causes the variance in *TuitionRatio* to be greater than a non-state system for both four-year and two-year IHLs. The data support hypothesis 3.

For four-year IHLs, the average percentage of in-state students, hereinafter labelled PCNTINST, is 85.6 for state system schools and 83.8 for non-state system schools. Welch's test statistic is 1.46, which is less than the critical value of 1.96 at the 5% significance level. I therefore fail to reject the null hypothesis that the means are the same.

For two-year IHLs, the average PCNTINST is 94.3 for state system schools and 93.7 for non-state system schools. Welch's test statistic is 1.02, which is less than

the critical value of 1.96 at the 5% significance level. I therefore fail to reject the null hypothesis that the means are the same.

A state system governing structure does not cause the average percentage of in-state students to be greater than a non-state system. The percentage of in-state students must be caused by other factors. The quality of the institutions in that state and other migration factors are potential explanations. Hypothesis 4 is therefore not supported by the data.

For four-year IHLs, the variance of PCNTINST is 0.018 for state system schools and 0.02 for non-state system schools. Here, I respecify the F statistic such that my new test statistic is F^{-1}. The F statistic is 1.13, which is greater than the critical value of 1.00 at the 1% significance level. I therefore reject the null hypothesis that the variances are the same and conclude the non-state system IHLs have a greater variance in PCNTINST.

For two-year IHLs, the variance of PCNTINST is 0.007 for state system schools and 0.01 for non-state system schools. Again, I respecify the F statistic such that my new test statistic is F^{-1}. The F statistic is 1.47, which is greater than the critical value of 1.00 at the 1% significance level. I therefore reject the null hypothesis that the variances are the same and conclude the non-state system IHLs have a greater variance in PCNTINST.

These results support hypothesis 5. A state system governing structure causes the variance in the percentage of in-state students to be less than a non-state system for both four-year and two-year IHLs.

1.8 Conclusion

The price differentiation observed at most public institutions of higher learning is the practice of charging out-of-state students higher tuition than in-state students.

This pricing behavior is third-degree price discrimination, however public institutions discriminate in the opposite direction that standard economic theory predicts. Lower tuition is charged to consumers with the less elastic demand curve (i.e. in-state students). Two reasons for this pricing strategy exist. First, states subsidize public higher education as an investment. Their goal is to produce a better-educated, higher-earning workforce that will pay higher taxes. Second, institutions wish to attract students who will locate near the school after graduation. Alumni living close by are more likely to donate more than alumni living far away. As Groen and White (2001) estimate, those students who are both from a state and graduate college from that state have the highest probability of residing in that state after graduation. Those students are also more likely to produce the highest donations.

In this essay I apply cross-section data to an OLS model to investigate the impact of governing structure on the pricing behavior and market structure of public IHLs. A governing structure dummy variable, either a state or non-state system, has statistically significant explanatory power of the tuition ratio of an IHL. Tuition ratio is defined as out-of-state tuition divided by in-state tuition. I find IHLs operating under a state system to have higher tuition ratios and greater variance in tuition ratios than IHLs operating under a non-state system. The market structure in a state system exhibits a greater degree of between-college heterogeneity and more vertical and horizontal differentiation. The market structure in a non-state system exhibits less heterogeneity because IHLs compete more directly with each other in quality and program offerings.

1.9 References

Brown, William O., Jr. (1997), "University Governance and Academic Tenure: A Property Rights Explanation," *Journal of Institutional and Theoretical*

Economics, Volume 153, pp. 441-461.

Bureau of Economic Analysis, http://www.bea.gov/bea/regional/spi, Regional Accounts Data, Table SA 1-3, 1997.

Clarkson, Kenneth W. and Roger LeRoy Miller (1982), *Industrial Organization: Theory, Evidence and Public Policy.* New York: McGraw Hill Book Company.

Council of State Governments (2001), *The Book of the States, 2000-2001 edition* (volume 33). Lexington, KY.

Goldin, Claudia and Lawrence F. Katz (1998), "The Origins of State-Level Differences in the Public Provision of Higher Education: 1890-1940," *The American Economic Review*, Volume 88, Issue 2, Papers and Proceedings of the Hundred and Tenth Annual Meeting of the American Economic Association, pp. 303-308.

Groen, Jeffrey A. and Michelle J. White (2001), "In-State versus Out-of-State Students: The Divergence of Interest between Public Universities and State Governments," working paper, University of California, San Diego.

Hoxby, Caroline M. (1997), "How the Changing Market Structure of U.S. Higher Education Explains College Tuition," NBER working paper no. 6323.

James, Estelle (1978), "Product Mix and Cost Disaggregation: A Reinterpretation of the Economics of Higher Education," *The Journal of Human Resources*, Volume 13, Issue 2, pp. 157-186.

Kamerschen, David R. and Lloyd M. Valentine (1981), *Intermediate Microeconomic Theory, 2nd edition.* Cincinnati: South-Western Publishing Co.

Leslie, Larry L. and Paul T. Brinkman (1987), "Student Price Response in Higher Education: The Student Demand Studies," *Journal of Higher Education*, Volume 58, Issue 2, pp. 181-204.

McCormick, Robert E. and Roger E. Meiners (1988), "University Governance: A Property Rights Perspective," *Journal of Law & Economics*, Volume XXXI, pp. 423-442.

Mixon, Franklin G., Jr. and Yu Hsing (1994), "The Determinants of Out-of-State Enrollments in Higher Education: A Tobit Analysis," *Economics of Education Review*, Volume 13, Number 4, pp. 329-335.

Paulsen, Michael B. (1991), "College Tuition: Demand and Supply Determinants from 1960 to 1986," *The Review of Higher Education*, Volume 14, pp. 339-358.

Rothschild, Michael and Lawrence J. White (1993), "The University in the Marketplace: Some Insights and Some Puzzles," in Clotfelter, Charles T. and Michael Rothschild, eds. *Studies of Supply and Demand in Higher Education.* Chicago: University of Chicago Press for the NBER, pp. 11-37.

Rusk, James J. and Leslie, Larry L. (1978), "The Setting of Tuition in Public Higher Education," *Journal of Higher Education*, Volume 49, pp. 531-547.

Strathman, James G. (1994), "Migration, Benefit Spillovers and State Support of Higher Education," *Urban Studies*, Volume 31, Number 6, pp. 913-920.

Welch, B.L. (1938), "The Significance of the Difference Between Two Means when the Population Variances are Unequal," *Biometrika*, Volume 29, Issue 3/4, pp. 350-362.

Wolinsky, Asher (1987), "Brand Names and Price Discrimination," *Journal of Industrial Economics*, Volume 35, Issue 3, pp. 255-268.

Chapter 2

Data Envelopment Analysis of Relative Efficiencies of Institutions of Higher Learning

2.1 Introduction

Created by Charnes, Cooper, and Rhodes (1978) Data Envelopment Analysis (DEA) was developed for application to nonprofit entities as a means to identify inefficiencies of inputs and outputs. The first application of DEA was to public schools in the evaluation of Program Follow Through (Charnes, Cooper, and Rhodes, 1981). Since then, DEA has been greatly extended and advanced in its methods and sophistication. DEA has been applied to a variety of other nonprofit entities including police departments, water agencies, elementary and secondary education, and higher education. For an extensive bibliography, see Ali Emrouznejad's web site, www.deazone.com, or his printed version (Emrouznejad and Thanassoulis, 1996).

This essay applies DEA to institutions of higher learning (IHLs) which include bachelor's, master's, and doctoral-granting four-year colleges and universities. Data obtained from the National Center of Education Statistics for academic year 1995-96 are used to calculate efficiency scores and make comparisons.

Two distinguishing characteristics of this essay are the comprehensive nature of the data and the new way of separating institutions. Previous papers with applications to U.S. higher education have used a relatively small sample of institutions. This paper uses the largest sample to date which includes 1,323 institutions. Additionally, I propose a new way to separate the institutions. I separate IHLs by

the percent of unrestricted revenue; those with unrestricted revenue above a certain threshold are grouped together and those with unrestricted revenue below that threshold are grouped together.

I develop two models; one with disaggregated inputs and outputs and one with aggregated inputs and outputs. I obtain results for these two models employing two different DEA methods. The first method generates a single frontier for each subsample and then separates institutions for comparisons. This allows program and managerial inefficiencies to exist. For example, a single frontier is generated using all doctoral-granting institutions and each institution is assigned an efficiency score. The institutions are then separated into public and private groups and mean efficiency scores are calculated. The mean scores are used to determine which group is relatively more efficient.

The second method generates separate frontiers (i.e. first-stage frontiers) by initially separating the institutions. I then use the Charnes, Cooper, and Rhodes (CCR) (1978) ratio to project each institution onto its frontier. I then rerun DEA with a single frontier (i.e. second-stage frontier) to make comparisons. This method eliminates managerial inefficiencies. For example, separate (first-stage) frontiers are generated for public, master's-granting institutions and private, master's-granting institutions. The CCR ratio then projects each IHL onto its respective frontier. The institutions are then combined to generate a single (second-stage) frontier. Then comparisons between public and private are made.

To anticipate the results, when program and managerial inefficiencies exist and a disaggregated model is used I find that private, doctoral-granting IHLs are more efficient than public and public, master's-granting IHLs are more efficient than private. I also find that master's and bachelor's-granting IHLs with unrestricted revenue less than 85% are more efficient than those with greater than 85%. When the aggregated model is used, I find bachelor's and master's-granting IHLs with unrestricted revenue

less than 85% are more efficient than those with greater than 85%. When managerial inefficiencies are eliminated, I find all private IHLs are more efficient than public. Master's and bachelor's-granting IHLs with unrestricted revenue greater than 85% are more efficient than those with less than 85%.

This essay progresses as follows. Section 2.2 provides background on DEA applications to higher education. Section 2.3 describes the data while Section 2.4 describes the two methods and models. Section 2.5 discusses and justifies the variable selection. Section 2.6 explains the manner in which efficiency comparisons are made. Sections 2.7 and 2.8 provide the results while Section 2.9 concludes.

2.2 Background on DEA Applications to Higher Education

The two seminal papers using DEA as a tool to analyze IHLs are Rhodes and Southwick (1986) and Ahn, Charnes, and Cooper (1988). Each of these papers focused on the differences between public and private IHLs.

Rhodes and Southwick compiled data from 1979-80 for 96 public and 54 private institutions to perform their analysis. For inputs, they used the number of full professors, number of associate professors, number of assistant professors, dollars spent on maintenance, and dollars spent on libraries. For outputs, they used undergraduate enrollment, graduate enrollment, bachelor degrees, master degrees, doctoral degrees, and research funds. Their DEA results indicate that public IHLs are less efficient than private IHLs. They postulate that since public IHLs rely on tax dollars for a majority of their funding, they have less incentive to be efficient with their inputs and hence have inherent behavioral differences from their private counterparts.

Ahn, Charnes, and Cooper performed their analysis on 161 doctoral granting institutions using 1984-85 data. For inputs, they used dollars of instruction expenditures, physical investments, and dollars spent on overhead. For outputs, they used

undergraduate full-time equivalent students, graduate full-time equivalent students, and federal grants and contracts. Their DEA results indicate that public IHLs are more efficient than private IHLs.

Other studies include Carlson (1972), Ahn (1987), Ahn, Arnold, Charnes, and Cooper (1989), Ahn and Seiford (1993), Breu and Raab (1994), Beasley (1995), Coelli, Rao, and Battese (1998), and Avkiran (2001). The study by Carlson utilizes mathematical programming and, in retrospect, can be viewed as a DEA paper even though the term was not used. Carlson used a cross-section dataset of four-year institutions in the U.S. The first two papers by Ahn analyzed public IHLs in Texas. Faculty salaries, state research funds, administrative overheads, and total investment in physical plants were used as inputs. Outputs included number of undergraduate enrollments, number of graduate enrollments, total semester credit hours, and federal and private research funds. The focus of the papers was to identify efficient and inefficient institutions in Texas as part of a legislative study.

Ahn and Seiford (1993) developed four DEA and performance models and used 153 private and public doctoral-granting IHLs across the U.S. to test the sensitivity between the models. Inputs common to all models included faculty salaries, physical investment, and overhead investments. Other inputs included undergraduate full-time equivalent (FTE) students, graduate FTEs, and total enrollment. Outputs varied by model and used undergraduate FTEs, graduate FTEs, total FTEs, undergraduate degrees, graduate degrees, total degrees, and grants. They inferred that relative efficiency results were consistent across the DEA models. They found lower efficiency scores when the outputs were aggregated. When enrollments were used as outputs, public IHLs were more efficient than private.

Breu and Raab (1994) studied the top 25 national universities and national liberal arts colleges (as ranked by *US News and World Report*). They found that universities with high prestige and reputation did not necessarily produce higher student

satisfaction. They also selected one inefficient university and provided recommendations to increase its efficiency. Five inputs and two outputs were selected. For inputs, they used SAT average or midpoints scores, percentage of faculty with doctorates, faculty to student ratio, and educational and general expenditures per student. For outputs, they used graduation and freshman retention rates.

A study at the department, not institution level, is provided in Beasley (1995). His concern was over departmental efficiencies when resources are shared between different activities. He used three inputs and eight outputs and applied them to chemistry and physics departments in the United Kingdom.

Administration issues were the focus of the Coelli, Rao, and Battese (1998) study. For inputs, they used administrative staff expenditures and other administration costs while for outputs they used total number of students and total staff. They calculated efficiency scores for 36 universities in Australia.

Avkiran (2001) developed three DEA models: one to measure overall performance, one to measure performance on delivery of educational services, and one to measure performance on fee-paying enrollments. In the first model, he used FTE academic staff and FTE non-academic staff for inputs and undergraduate enrollments, postgraduate enrollments, and research quantum for outputs. In the second model, he used FTE academic staff and FTE non-academic staff for inputs and student retention rate, student progress rate, and graduate full-time employment rate for outputs. In the third model, he used FTE academic staff and FTE non-academic staff for inputs and overseas fee-paying enrollments and non-overseas fee-paying postgraduate enrollments as outputs. His results indicate that Australian universities were performing well on technical and scale efficiency but there was room for improving performance on fee-paying enrollments.

2.3 Data

The National Center for Education Statistics (NCES) conducts an annual survey of all institutions of higher education. NCES then stores and maintains the results in the Integrated Postsecondary Education Data System (IPEDS). IPEDS contains multiple component files and I use the Finance, Full-time Faculty, Fall Enrollment, and Completions data files for the 1995-96 academic year. I include all institutions with Carnegie Classification codes 11 through 32 which include Baccalaureate Colleges through Research I Universities. Appendix C contains details on the Carnegie classification system.

The sample included in this study is comprised of 1,323 institutions with the following subsamples: 222 research and doctoral universities, 507 master's-granting universities and colleges, and 594 bachelor's-granting colleges.

2.4 Two DEA Methods and Models

Data Envelopment Analysis is a mathematical programming approach used to construct a frontier or production possibilities curve for a set of decision-making units (DMUs). DMU was first coined by Charnes, Cooper, and Rhodes (1978) as an alternative to "firms" or "plants" and is meant to be a more general description of the entity being analyzed.

DEA models generally take two forms; either input-oriented or output-oriented. Using an input-oriented model, a DMU is not efficient if it is possible to decrease any input without augmenting any other input and without decreasing any output. In other words, the question is "By how much can inputs be proportionally reduced without altering outputs?" Using an output-oriented model, a DMU is not efficient if it is possible to augment any output without increasing any input and without

decreasing any other output. In other words, the question is "By how much can outputs be proportionally increased without altering inputs?" I use an output-oriented model because I believe managers of IHLs have more control over output decisions than input decisions. Given the nature of their nonprofit organizations and the predominance of tenure in the faculty labor market, I assert that managers can more easily make changes in outputs than inputs.

Another variation to a DEA model is the returns to scale (RTS) assumption. Constant, decreasing, increasing, and variable returns to scale assumptions may be employed. Constant RTS implies that doubling inputs will exactly double outputs. Decreasing RTS implies that doubling inputs will less-than-double outputs. Increasing RTS implies that doubling inputs will more-than-double outputs. Variable RTS allows for a combination of constant, increasing, and decreasing regions along the frontier. I use a variable returns to scale model because I do not wish to impose a specific RTS assumption.

More formally, the model is specified as follows:

$max_{\phi,\lambda}\ \phi$,

subject to

$-\phi y_i + Y\lambda \geq 0$,

$x_i - X\lambda \geq 0$,

$N1'\lambda = 1$,

$\lambda \geq 0$,

where ϕ is the efficiency score, $1 \leq \phi \leq \infty$, and $(\phi - 1)$ is the proportional increase in outputs that could be achieved by the i^{th} institution. y_i is a vector of outputs and x_i is a vector of inputs for the i^{th} institution. X represents a vector of inputs and Y represents a vector of outputs for all institutions in the group. λ is an N x 1 vector of constants. N1 is an N x 1 vector of ones. The convexity constraint $(N1'\lambda = 1)$, essentially ensures that an inefficient IHL is only related or benchmarked

against institutions of similar size. The efficiency score is calculated using a convex combination of observations.

As described in the Introduction, I employ two different DEA methods to calculate and compare relative efficiency scores. The first method generates a single frontier for each subsample (i.e. doctoral, master's, and bachelor's-granting IHLs) and then separates institutions for comparisons. This allows program and managerial inefficiencies to exist. The second method generates separate frontiers (i.e. first-stage frontiers) by initially separating the institutions. I then use the Charnes, Cooper, and Rhodes (CCR) (1978) ratio to project each institution onto its frontier. I then rerun DEA with a single frontier (i.e. second-stage frontier) to make comparisons. This method eliminates managerial inefficiencies.

The concepts of program and managerial inefficiencies were introduced by Charnes, Cooper, and Rhodes (1981) and I paraphrase their discussion here in the context of this essay. For simplicity, assume a single output is produced by a variety of inputs. The production function may be written as

$$y = f(x_1, ..., x_m) \tag{2.1}$$

where the value of y is a maximal value for the collection of input values. The function is defined by reference to a given technology (i.e. managerial and engineering knowledge) which includes the way the institution is or should be organized.

Because (2.1) is applicable to each of the j = 1,...n institutions, it may be used to evaluate the efficiency of any one institution as follows. Suppose for the j^{th} IHL, the input values are $x_{1j}, ..., x_{mj}$. Substituting into (2.1) yields

$$\hat{y}_j = f(x_{1j}, ..., x_{mj}) \tag{2.2}$$

as the maximal output obtainable from the input values. If the observed output value for this IHL is y_j, then

$$0 \leq y_j/\hat{y}_j \leq 1 \tag{2.3}$$

provides a measure of the efficiency achieved by this institution.

Under these circumstances, inefficiencies can be directly attributed to management. The possibility that some managers may be required to operate with different production functions arises. We could assign $\hat{y}_j^{\alpha}$ as the maximal output that is possible for each of $\alpha = 1, 2, ..., k$ different production functions and similarly index the input vectors as $x_j^{\alpha} = (x_{1j}^{\alpha}, x_{2j}^{\alpha}, ..., x_{mj}^{\alpha})$ in order to evaluate the efficiency of management under each of these k different sets of production possibilities.

Assuming that all managers are perfectly efficient, we might want to know which of the production functions is most efficient, and how this kind of efficiency might be identified and evaluated. This type of "functional efficiency," which involves a comparison between functions brings forth the concepts of program and managerial efficiency as analyzed in Charnes, Cooper, and Rhodes (1981) and this essay. Program efficiency is measured by reference to managerial behavior under its appropriate function. It can be thought of as "picking the right production function." Managerial efficiency involves an across-program comparison between different functions. It can be thought of as "producing efficiently given a production function."

I develop two DEA models; one with disaggregated inputs and outputs and one with aggregated inputs and outputs. I choose seven inputs and outputs provided as follows:

Disaggregated Model	
Inputs	Outputs
academic support expenditures	federal, state, local, and private grants and contracts
institutional support expenditures	public service expenditures
expenditures on plant	number of bachelors degrees
instruction expenditures	number of masters degrees
number of faculty	number of doctoral degrees
number of undergraduate students	number of first-professional degrees
number of graduate students	number of certificates

For the aggregated model, I choose four inputs and outputs provided as follows:

Aggregated Model	
Inputs	Outputs
total support expenditures	federal, state, local, and private grants and contracts
instruction expenditures	public service expenditures
number of faculty	number of awards
number of students	

For the aggregated model total support expenditures is the sum of academic support expenditures, institutional support expenditures, and expenditures on plant. Number of students adds undergraduate and graduate students into a single category. Number of awards is the sum of the number of bachelors degrees, masters degrees, doctoral degrees, first-professional degrees, and certificates. Appendix D contains details of the definitions of the input and output variables.

2.5 Variable Selection

By using these inputs and outputs, I attempt to model the core missions of institutions: teaching, research, and public service. This way, if an institution is generating

large amounts of revenue and uses it for activities not directly related to the core missions, the efficiency score falls.

As outlined in Section 2.2, previous authors have used a wide variety of input and output measures. The most important decision criteria when choosing variables is the focus of the research. Coelli, Rao, and Battese (1998) were researching administrative issues so they chose variables applicable to their investigation. Beasley (1995) was researching departmental issues so he chose variables that impacted department behaviors. Since I am modelling the three-dimensional mission of institutions, I select variables that influence institutional behavior. I draw upon the DEA and non-DEA literature for variable selection. At the outset, I admit that none of the variables either control for quality aspects or directly measure quality. While I do not intend to ignore or imply that quality issues will not influence efficiency, data on quality indicators are not readily available or are unreliable.

I begin with the non-DEA literature. Generally speaking, this literature views production and costs from the institutional level and is concerned with overall behavior. Sengupta (1975) used regression techniques to estimate production and cost functions for universities. He identified six inputs: senior teaching, junior teaching, graduate student teachers, professional staff, administrative staff, and capital. He identified four outputs: undergraduate FTE, graduate FTE, combined enrollment, and research contracts.

Hopkins and Massy (1981) are commonly cited for their listing of tangible and intangible inputs and outputs. Their tangible inputs include new students matriculating, faculty time and effort, student time and effort, staff time and effort, building and equipment, library holdings and acquisitions, and endowments. Their tangible outputs include student enrollment in courses, degrees awarded, research awards, articles, and citations, and services rendered to the general public. These lists include all activities pertaining to the three-dimensional mission.

These authors specifically identify students as an input and output of the higher education production process. Dolan, Jung, and Schmidt (1985), in the context of quality and self-selection issues of faculty and students, formally identify students as an input in an econometric study. Rothschild and White (1995, p. 574) formally discuss students as an input and output to the educational process. They state "colleges and universities provide human capital as outputs, and students - individually and collectively - are clearly inputs into the production process."

Turning to the DEA literature which has been discussed previously, I focus on the four studies that addressed efficiency at the institutional level and were more general in nature [Rhodes and Southwick (1986), Ahn, Charnes, and Cooper (1988), Avkiran (2001), and Ahn and Seiford (1993)]. The first three do not identify students as inputs but have some kind of student variable as an output (i.e. either enrollments or degrees). The last study contains four models, two with students as inputs and two without. One of the major conclusions that Ahn and Seiford found was consistency of relative efficiencies between their four model specifications. Common inputs to all of the studies listed above include some variable for faculty (either number or expenditure) and overhead or administration. Most of the models include some form of research variable as either an input or output.

Pastor, Ruiz, and Sirvent (2002) present a method to analyze the marginal role of a given variable with respect to efficiency measurement. Their "efficiency contribution measure (ECM)" calculates the change in efficiency score from adding or deleting an input or output variable to a DEA model. As the ECM approaches zero, the variable in question can be deleted because its impact on the efficiency score approaches zero. As the ECM increases in value, the variable in question should be retained because its impact increases. ECM is analogous to a t-statistic test in regression hypothesis testing. Instead of employing this method, I follow Breu and

Raab (1994) to more formally validate input and output variables by completing correlation and regression analysis.

For each of my three subsamples (doctoral, master's, and bachelor's-granting) I construct a correlation coefficient matrix of possible inputs and outputs. For inputs, I select seven potential variables: total support expenditures (SUPP), instruction expenditures (INSTR), tuition and fee revenue (TUIFEE), total faculty (TFAC), total number of students (TSTUD), student service expenditures (STSERV), and federal, state, and local appropriations (FSLAPP). For outputs, I select four potential variables: federal, state, local, and private grants and contracts (FSLPGC), public service expenditures (PSERV), total awards (TAWRD), and research expenditures (RESEARCH). For regression analysis, I regress each of the four potential output variables on total support expenditures, instruction expenditures, total faculty, total number of students, and student service expenditures. A high degree of multicollinearity exists since each of the potential input variables are highly interdependent. I only report the results for doctoral-granting institutions; the results are similar for the other two subsamples.

The following table reports the correlation coefficients, excluding tuition and fee revenue, federal, state, and local appropriations, and research expenditures. I will discuss these three variables later.

Table One								
Doctoral-Granting IHLs								
Correlation Coefficient Matrix								
	FSLPGC	PSERV	STSERV	INSTR	SUPP	TFAC	TSTUD	TAWRD
FSLPGC	1.00							
PSERV	0.44	1.00						
STSERV	0.61	0.15	1.00					
INSTR	0.84	0.35	0.70	1.00				
SUPP	0.85	0.28	0.79	0.87	1.00			
TFAC	0.64	0.54	0.56	0.76	0.67	1.00		
TSTUD	0.46	0.42	0.56	0.64	0.58	0.87	1.00	
TAWRD	0.58	0.40	0.64	0.75	0.68	0.91	0.95	1.00

The following tables report the results from the four regressions. The dependent variables are the potential output variables and the independent variables are potential input variables.

Table Two		
FSLPGC for Doctoral-Granting IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	0.000 (0.000)	0.106
SUPP	1.088 (0.127)	0.000
INSTR	0.334 (0.073)	0.000
STSERV	-1.473 (0.632)	0.021
TFAC	94934.1 (19734.2)	0.000
TSTUD	-4229.15 (742.39)	0.000
N = 222		
R^2 = 0.80		

Table Three		
RESEARCH for Doctoral-Granting IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	0.000 (0.000)	0.001
SUPP	0.795 (0.099)	0.000
INSTR	0.037 (0.057)	0.516
STSERV	-0.037 (0.490)	0.940
TFAC	54828.8 (15315.1)	0.000
TSTUD	-1473.05 (576.145)	0.011
N = 222		
$R^2 = 0.727$		

Table Four		
PSERV for Doctoral-Granting IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	0.000 (0.000)	0.238
SUPP	0.047 (0.063)	0.452
INSTR	-0.03 (0.036)	0.401
STSERV	-0.755 (0.311)	0.016
TFAC	60239.7 (9710.51)	0.000
TSTUD	-568.448 (365.304)	0.121
N = 222		
$R^2 = 0.342$		

Table Five		
TAWRD for Doctoral-Granting IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-342.985 (146.508)	0.020
SUPP	0.000 (0.000)	0.643
INSTR	0.000 (0.000)	0.000
STSERV	0.000 (0.000)	0.006
TFAC	2.06 (0.397)	0.000
TSTUD	0.291 (0.015)	0.000
N = 222		
R^2 = 0.947		

As expected, SUPP has a very high correlation with two output variables FSLPGC and TAWRD and a low correlation with another output variable PSERV. The coefficient on SUPP is also positive and significant for FSLPGC from the regression analysis. Therefore, SUPP is chosen as an input variable. INSTR has a very high correlation with FSLPGC and TWARD and is also positive and significant for FSLPGC so it is chosen as an input variable. TFAC is highly correlated with TAWRD and moderately correlated with FSLPGC and PSERV. The coefficient on TFAC is positive and significant for FSLPGC, PSERV, and TAWRD. Therefore, TFAC is chosen as an input variable. TSTUD is nearly perfectly correlated with TAWRD which is expected. The coefficient on TSTUD is also positive and significant for TAWRD so it is chosen as an input variable. Because of the relationships described here, FSLPGC, PSERV, and TAWRD are chosen as output variables.

I eliminate STSERV as an input variable because it has a high correlation with two other input variables, INSTR and SUPP. Its inclusion seems to be redundant.

In addition, the level of STSERV on any particular campus may be a factor for a student's decision to enroll, but probably has little to do with the actual production process of the institution. STSERV also has a relatively low correlation with all four potential output variables. The regression analysis indicates STSERV explains very little about the four potential output variables.

I now turn to the variables that are excluded from the results previously presented in the correlation: tuition and fee revenue, federal, state, and local appropriations, and research expenditures. TUIFEE and FSLAPP have a very small correlation coefficient, 0.07, for two reasons. First, private institutions are included in this subsample and receive very little, if any, appropriations. Second, these two are generally viewed as substitute revenue sources. TUIFEE has a high correlation to two other input variables, INSTR and SUPP. As potential inputs, TUIFEE and FSLAPP have low correlation to the four potential output variables for this subsample. For the remaining two subsamples, the correlation is even lower. I therefore eliminate TUIFEE and FSLAPP as input variables.

I debated about which output variable to use for research activity. Some previous authors used research expenditures while others used grant revenues and I have data available for each. The correlation coefficient between the two is 0.92 which suggests that I could choose either of them because they seem to be substitutes for a measure of research activity. I decide to eliminate RESEARCH and use FSLPGC because it has a higher correlation coefficient with the input variables than does RESEARCH. In addition, the regression analysis indicates the five potential input variables have larger (in absolute terms) values and are statistically more significant for FSLPGC than for RESEARCH.

2.6 Efficiency Comparisons

Many of the studies of IHLs have focused on differences between public and private and have either explicitly or implicitly stated that the two types of institutions behave differently. I offer a new way to differentiate IHLs that is more consistent with behavioral differences. However, since the public and private distinction is so prevalent I will also formally test the difference between their behavior.

In today's higher education industry, I argue that public and private institutions do not necessarily behave differently because of their revenue sources. Both types will have more behavioral similarities than differences. The only true significant difference in public and private institutions is the source of revenue. Private IHLs obtain most, but not all, of their revenue from "private" sources – non-government funds such as tuition, investment return, and other educational activities. Public IHLs obtain a greater share of their revenue from "public" sources – mostly from state funds. According to the U.S. Department of Education for academic year 1996-97, private IHLs obtain 9.8% of their revenue from government sources while public IHLs obtain 50.5% of their revenue from government sources.

Upon closer examination of the revenue sources, revenue is either received as unrestricted or restricted. Restricted funds are obtained with a specific destination attached while unrestricted funds can be used at the institution's discretion. An institution that operates with a higher percentage of unrestricted funds will have more flexibility in its use of funds.

The new way to differentiate the institutions is based upon the percent of unrestricted revenue received. I will begin with 90% as a threshold: those institutions with greater than 90% unrestricted funds will be grouped together while institutions with less than 90% unrestricted funds will be grouped together. As part of my sensitivity

analysis, I change the percentage to test the results. I change the percentage to 85% and 80%.

Choosing these thresholds is somewhat arbitrary but also based upon the data. For all IHLs in the sample, the average unrestricted revenue percent is about 85%. I run additional DEA results for a second set of groupings: those IHLs with greater than 90% versus those less than 85%, greater than 85% versus less than 80%, and greater than 80% versus less than 75%. IHLs just below the thresholds are thus eliminated from the calculations.

To compare a small, private liberal arts college to a major research university would be senseless. Their mission and goals are clearly different and their behavior would represent such differences. In order to create nearly homogeneous groups of IHLs, I employ the 1994 Carnegie Classification Codes to create three subsamples from the total number of institutions. Appendix C contains Carnegie Code definitions.

The first subsample comprises Carnegie Codes 11, 12, 13, and 14 which consist of all institutions that award degrees through the doctoral level. The second subsample comprises Carnegie Codes 21 and 22 which consist of all institutions that award degrees through the master's level. The third subsample comprises Carnegie Codes 31 and 32 which award bachelor's degrees. Two-year colleges, community colleges, and technical schools are not analyzed.

The calculated efficiency scores will range between 0 and 100; 100 implying perfect efficiency. For each subsample, the mean and variance of the efficiency scores are calculated to make comparisons. I employ Welch's v statistic (Welch, 1938) to test the hypothesis that the means are the same. Welch does not make any distributional assumptions for his statistic. I then change the efficiency scores into inefficiency scores to employ two test statistics of Banker (1993). Inefficiency scores are simply 100 minus the efficiency scores. Banker's tests compare the mean inefficiency scores

from two groups and assume either a half-normal or exponential distribution. Each test is a ratio of two chi-square variates under the null hypothesis of equal average scores. I then employ an F statistic to test the hypothesis that the variances are the same. Unless otherwise noted, all tests are performed at the 5% level. The F statistic is defined as follows.

$$\frac{s^2_{abovethreshold}}{s^2_{belowthreshold}} = F \tag{2.4}$$

and

$$\frac{s^2_{public}}{s^2_{private}} = F \tag{2.5}$$

I expect the IHLs below the threshold to be more efficient than those above. As institutions receive a higher percentage of their revenue as restricted, I argue they will become more efficient as they are forced to use the revenue for specific purposes. The nature of the revenue is a source of accountability and includes inherent efficiency incentives. I also expect those above the threshold to be more variable than those below. I have no a priori expectations regarding the private and public comparisons.

2.7 DEA When Program and Managerial Inefficiencies are Present

This method creates a single frontier for each subsample and then separates the IHLs according to the three ways previously described. This method maintains any program and managerial inefficiencies and allows both to influence the efficiency scores.

2.7.1 Disaggregated Model

As discussed in section 2.4, this model uses the disaggregated input and output variables to calculate efficiency scores. I use seven inputs: academic support expenditures, institutional support expenditures, expenditures on plant, instruction expendi-

tures, number of faculty, number of undergraduate students, and number of graduate students. I use seven outputs: federal, state, local, and private grants and contracts, public service expenditures, number of bachelors degrees, number of masters degrees, number of doctoral degrees, number of first-professional degrees, and number of certificates. For the master's-granting IHLs, I eliminate number of doctoral degrees, number of first-professional degrees, and number of certificates as outputs. For the bachelor's-granting IHLs, I eliminate number of graduate students as an input and number of masters degrees, number of doctoral degrees, number of first-professional degrees, and number of certificates as outputs.

DEA Results for Doctoral-Granting IHLs

The following two tables provide the results for doctoral-granting IHLs. N is the number of institutions and MES is the mean efficiency score for that group.

Table Six: Single Threshold								
Disaggregated Model: Doctoral-Granting IHLs								
When Program and Managerial Inefficiencies are Present								
Group	$> 90\%$	$< 90\%$	$> 85\%$	$< 85\%$	$> 80\%$	$< 80\%$	public	private
N	33	189	76	146	129	93	147	75
MES	96.3	94.7	93.8	95.6	94.7	95.4	94.4	96.7

Table Seven: 5% gaps in Threshold						
Disaggregated Model: Doctoral-Granting IHLs						
When Program and Managerial Inefficiencies are Present						
Group	$> 90\%$	$< 85\%$	$> 85\%$	$< 80\%$	$> 80\%$	$< 75\%$
N	33	146	76	93	129	54
MES	96.3	95.6	93.8	95.4	94.7	94.5

For each of the three unrestricted revenue thresholds, I find no statistical difference between the groups when employing Welch's statistic. All of the mean scores are above 90 and close to each other. Introducing a 5% gap in the thresholds does not change the inference. Private IHLs are more efficient than public and the difference

is statistically significant. Welch's v statistic is 2.12 which is larger than the critical value of 1.96. However, the difference between the two is only 2.3 points. I fail to reject both of Banker's test statistics. When an exponential distribution is assumed, the test statistic is 1.79 for the private versus public group and 0.70, 1.41, and 1.15, respectively, for the 90%, 85%, and 80% thresholds. All of these are less than the critical value of 1.83 so I cannot say the scores are different. When a half-normal distribution is assumed, the test statistic is 1.67 for the private versus public group and 0.55, 1.37, and 1.14, respectively, for the 90%, 85%, and 80% thresholds. All of these are less than the critical value of 1.83 so I cannot say the scores are different. There is no difference in the inference when 5% gaps are included in the thresholds.

DEA Results for Master's-Granting IHLs

The following two tables provide the results for master's-granting IHLs.

Table Eight: Single Threshold
Disaggregated Model: Master's-Granting IHLs
When Program and Managerial Inefficiencies are Present

Group	> 90%	< 90%	> 85%	< 85%	> 80%	< 80%	public	private
N	202	305	376	131	447	60	269	238
MES	75.3	76.6	74.5	80.6	75.1	83.1	77.7	74.3

Table Nine: 5% gaps in Threshold
Disaggregated Model: Master's-Granting IHLs
When Program and Managerial Inefficiencies are Present

Group	> 90%	< 85%	> 85%	< 80%	> 80%	< 75%
N	202	131	376	60	447	31
MES	75.3	80.6	74.5	83.1	75.1	87.6

At the 90% threshold, those IHLs below are more efficient but the difference is not statistically significant. At the 85% and 80% thresholds, those IHLs below are more efficient and the difference is significant. Welch's statistic is 3.39 and 3.27, respectively, which is greater than the critical value of 1.96. By changing the grouping to

include a 5% gap, I find significant difference for all three groups. The test statistics are 2.62 for the 90% threshold groups, 3.49 for the 85% threshold groups, and 4.29 for the 80% threshold groups. Public institutions are more efficient than private and the difference is significant. The test statistic is 2.21. It should be noted that the difference between the mean scores is only 3.4.

For the single threshold groupings, I fail to reject both of Banker's test statistics. When an exponential distribution is assumed, the test statistic is 0.87 for the public versus private group. When a half-normal distribution is assumed, the test statistic is 0.80 for the public versus private group. For the 85% threshold groups, the test statistic is 1.06 when an exponential distribution is assumed and the test statistic is 1.33 when a half-normal distribution is assumed. All of these are less than the critical value of 1.83.

However, for the second groupings when 5% gaps are included in the thresholds, I reject the null for both test statistics for the group above 80% versus below 75%. When an exponential distribution is assumed, the test statistic is 2.01 and when a half-normal distribution is assumed, the test statistic is 2.34. The critical value for each is 1.99. Therefore, those below 75% unrestricted revenue are more efficient than those above.

DEA Results for Bachelor's-Granting IHLs

The following two tables provide the results for bachelor's-granting IHLs.

Table Ten: Single Threshold								
Disaggregated Model: Bachelor's-Granting IHLs								
When Program and Managerial Inefficiencies are Present								
Group	> 90%	< 90%	> 85%	< 85%	> 80%	< 80%	public	private
N	177	417	351	243	480	114	74	520
MES	61.2	69.0	63.0	71.9	64.2	77.1	66.5	66.7

Table Eleven: 5% gaps in Threshold						
Disaggregated Model: Bachelor's-Granting IHLs						
When Program and Managerial Inefficiencies are Present						
Group	$> 90\%$	$< 85\%$	$> 85\%$	$< 80\%$	$> 80\%$	$< 75\%$
N	177	243	351	114	480	59
MES	61.2	71.9	63.0	77.1	64.2	82.8

For each of the three unrestricted revenue thresholds, the IHLs below the threshold have a mean efficiency score greater than those above and the difference is statistically significant. Welch's statistic is 4.95 for the 90% threshold, 6.15 for the 85% threshold, and 7.39 for the 80% threshold. The critical value is 1.96. The inference does not change when the IHLs are regrouped with 5% gaps in the threshold. Public and private IHLs have nearly identical average scores; 66.5 compared to 66.7.

For the single threshold groupings, I fail to reject both of Banker's statistics except for one group. For the 80% threshold, I reject the null hypothesis when I assume a half-normal distribution. The test statistic is 1.97 which is larger than the critical value of 1.83. Those IHLs below the threshold are more efficient than those above. When a 5% gap in thresholds is used, I reject the null for the above 80%/below 75% group when either an exponential or half-normal distribution is assumed. The test statistics are 2.08 and 2.99, respectively. In addition, when a half-normal distribution is assumed, I reject the null for the above 85%/below 80% group. Those IHLs below the threshold are more efficient than those above.

To summarize the disaggregated model, I find private, doctoral-granting IHLs more efficient than public. I find public, master's-granting IHLs more efficient than private. I find no difference between private and public for bachelor's-granting IHLs. There is no statistical difference between doctoral-granting IHLs when separated by the percent of unrestricted revenue for any of the three groupings. Master's-granting IHLs below 85% and 80% are more efficient than those above while bachelor's-granting IHLs below all three thresholds are more efficient than those above. In

addition, doctoral-granting IHLs are more efficient than master's-granting which are more efficient than bachelor's-granting. I usually fail to reject Banker's statistics. When I do reject, the inference is consistent with the conclusions from Welch's statistic.

2.7.2 Aggregated Model

As discussed in section 2.4, this model uses the aggregated input and output variables to calculate efficiency scores. I use four inputs: total support expenditures, instruction expenditures, total faculty, and number of students. I use three outputs: federal, state, local, and private grants and contracts, public service expenditures, and number of awards.

DEA Results for Doctoral-Granting IHLs

The following two tables provide the results for doctoral-granting IHLs. These institutions obtain the highest average efficiency scores of all three subsamples. Var is the variance of efficiency scores.

Table Twelve: Single Threshold								
Aggregated Model: Doctoral-Granting IHLs								
When Program and Managerial Inefficiencies are Present								
Group	$> 90\%$	$< 90\%$	$> 85\%$	$< 85\%$	$> 80\%$	$< 80\%$	public	private
N	33	189	76	146	129	93	147	75
MES	83.3	82.3	80.7	83.3	80.9	84.5	82.0	83.2
Var	164.0	147.9	150.9	147.7	133.8	166.0	139.3	171.4

Table Thirteen: 5% gaps in Threshold						
Aggregated Model: Doctoral-Granting IHLs						
When Program and Managerial Inefficiencies are Present						
Group	$> 90\%$	$< 85\%$	$> 85\%$	$< 80\%$	$> 80\%$	$< 75\%$
N	33	146	76	93	129	54
MES	83.3	83.3	80.7	84.5	80.9	84.6

Only for the 80% threshold do I find statistical difference between the mean scores

of the groups. Those institutions under the threshold have a larger mean score than those above. Welch's statistic is 2.14 which is larger than the critical value of 1.96. Introducing a 5% gap in the thresholds changes the inference slightly. I find significant differences for the last two groups: above 85% versus below 80% and above 80% versus below 75%. Those IHLs below have a mean score higher than those above. I find no statistical difference between private and public. Welch's statistic is 0.67 which is less than the critical value of 1.96 so I fail to reject the null.

I fail to reject both of Banker's statistics for each grouping. For each grouping, the F statistic does not reach the 5% critical value so I fail to reject the null hypothesis that the variances are the same. Those IHLs above the threshold and public institutions do not have more variance in their efficiency scores.

Comparing the disaggregated and the aggregated models, I find large differences in the mean efficiency scores. All scores fall fairly dramatically; the private IHLs scores fall by 14%. However, the drop in scores makes little difference for the inference using Welch's v statistic. In the aggregated model, I fail to reject the difference between public and private while in the disaggregated model I reject the difference (private IHLs have a higher average score). Generally, the aggregated model produces slightly stronger results that allow me to reject Welch's null more frequently. In the disaggregated model, I reject one out of the seven null hypotheses while in the aggregated model I reject two out of the seven (and three out of seven at the 10% level). When using Banker's statistics, both models produce the same inference. I fail to reject all null hypotheses.

DEA Results for Master's-Granting IHLs

The following two tables provide the results for master's-granting IHLs. The efficiency scores are lower than those for the doctoral-granting IHLs. The public and private MES is lower by 18% and 23%, respectively.

Table Fourteen: Single Threshold								
Aggregated Model: Master's-Granting IHLs								
When Program and Managerial Inefficiencies are Present								
Group	$> 90\%$	$< 90\%$	$> 85\%$	$< 85\%$	$> 80\%$	$< 80\%$	public	private
N	202	305	376	131	447	60	269	238
MES	56.6	58.3	55.5	63.6	56.1	68.7	59.0	56.0
Var	375.6	286.4	290.3	366.7	298.7	360.6	280.9	365.1

Table Fifteen: 5% gaps in Threshold						
Aggregated Model: Master's-Granting IHLs						
When Program and Managerial Inefficiencies are Present						
Group	$> 90\%$	$< 85\%$	$> 85\%$	$< 80\%$	$> 80\%$	$< 75\%$
N	202	131	376	60	447	31
MES	56.6	63.6	55.5	68.7	56.1	72.9

At the 90% threshold, those IHLs below have a higher average score but the difference is not statistically significant. At the 85% and 80% thresholds, those IHLs below have a higher average score and the difference is significant. Welch's statistic is 4.29 and 4.88, respectively. By changing the grouping to include a 5% gap, I find significant difference for all three groups. IHLs below the threshold have a higher average score. Public and private exhibit no statistical difference.

Regarding Banker's statistics, I fail to reject both of them for all groupings except one. For the above 80%/below 75% group, the test statistic is 2.08 which is larger than the critical value of 1.99. I therefore reject the null that the means are the same and conclude those below the threshold are more efficient than those above. For all groupings, the F statistic does not reach the 5% critical value so I fail to reject the null hypothesis that the variances are the same. Those IHLs above the threshold and public institutions do not have more variance in their efficiency scores.

Consistent with the doctoral results, I find large differences in the mean efficiency scores when comparing the disaggregated and aggregated models. All scores fall dramatically; the public IHLs scores fall by 24%. However, the drop in scores makes little difference for the inference using Welch's v statistic. In the aggregated model,

I fail to reject the difference between public and private while in the disaggregated model I reject the difference (public is more efficient). Generally, the aggregated model produces slightly weaker results that allow me to reject Welch's null less frequently. In the disaggregated model, I reject six out of the seven null hypotheses while in the aggregated model I reject five out of the seven.

DEA Results for Bachelor's-Granting IHLs

The following two tables provide the results for bachelor's-granting IHLs. The efficiency scores are lower than those for the doctoral and master's-granting IHLs. The public and private MES are lower by 30% and 31%, respectively, than the doctoral results and by 14% and 10%, respectively, than the master's results.

Table Sixteen: Single Threshold								
Aggregated Model: Bachelor's-Granting IHLs								
When Program and Managerial Inefficiencies are Present								
Group	$> 90\%$	$< 90\%$	$> 85\%$	$< 85\%$	$> 80\%$	$< 80\%$	public	private
N	177	417	351	243	480	114	74	520
MES	48.2	56.5	50.5	59.1	51.3	65.4	55.0	53.9
Var	318.8	308.9	313.4	302.0	298.7	285.1	336.7	325.0

Table Seventeen: 5% gaps in Threshold						
Aggregated Model: Bachelor's-Granting IHLs						
When Program and Managerial Inefficiencies are Present						
Group	$> 90\%$	$< 85\%$	$> 85\%$	$< 80\%$	$> 80\%$	$< 75\%$
N	177	243	351	114	480	59
MES	48.2	59.1	50.5	65.4	51.3	70.9

For each of the three unrestricted revenue thresholds, the IHLs below the threshold have a mean efficiency score greater than those above and the difference is significant. Welch's statistic is 5.21 for the 90% threshold, 5.88 for the 85% threshold, and 7.98 for the 80% threshold. The inference does not change when the IHLs are regrouped with 5% gaps in the threshold. Public and private IHLs have nearly identical average scores so I fail to reject the null hypothesis.

Regarding Banker's statistics, I fail to reject both of them for each grouping except for two. For the above 85%/below 80% group and above 80%/below 75% group, the test statistic is 1.86 and 2.42, respectively, when a half-normal distribution is assumed. Those below the threshold have average inefficiency scores less than those above. Therefore the average efficiency scores are higher. For all groupings, the F statistic does not reach the 5% critical value so I fail to reject the null hypothesis that the variances are the same. Those IHLs above the threshold and public institutions do not have more variance in their efficiency scores.

I again find large differences in the mean scores when comparing the disaggregated and the aggregated models. All scores fall dramatically; the public and private IHLs scores fall by 17% and 19%, respectively. However, the drop in scores makes no difference in the inference. In both models, I fail to reject the difference between public and private when employing Welch's statistic. In both models, I reject the remaining six null hypotheses that the means are the same. Those below have higher average scores than those above. When employing Banker's statistics, I reject 5 null hypotheses in the disaggregated model and reject 3 null hypotheses.

The aggregated model can be summarized as follows. For doctoral-granting IHLs, there is no statistical difference between public and private average scores. Those below the 80% threshold have higher average scores than those above. For master's-granting IHLs, there is no statistical difference between public and private. Those below the 85% and 80% thresholds have higher average scores than those above. For bachelor's-granting IHLs, there is no statistical difference between public and private. Those below the 90%, 85%, and 80% thresholds have higher average scores than those above.

2.8 DEA When Managerial Inefficiencies are Eliminated

This method creates a first-stage frontier for each grouping in the subsample and then projects each IHL onto its efficiency frontier using the Charnes, Cooper, and Rhodes (1978) ratio. I then rerun DEA for the entire subsample and make comparisons from a single, second-stage frontier. This method eliminates any managerial inefficiencies and allows only program inefficiencies to influence the efficiency scores.

For this method, I simplify the level of analysis by only using the aggregated model. In addition, I only use two groupings for each subsample: unrestricted revenue greater than 85% versus less than 85% and private versus public. As indicated in the previous section, I make consistent conclusions across the model and grouping specifications.

2.8.1 DEA Results for Doctoral-Granting IHLs

The following tables provide the results for doctoral-granting IHLs. The results from the first-stage frontier should not be used to make comparisons between the groups because they are generated by separate frontiers. Efficiency scores in each group are affected relative only to members in the same group. The results are presented to identify differences before and after managerial inefficiencies are eliminated. Therefore, comparisons within table eighteen are not meaningful but comparisons between tables eighteen and nineteen for the same group are meaningful.

Table Eighteen: First-Stage Frontiers				
Aggregated Model: Doctoral-Granting IHLs				
Before Managerial Inefficiencies are Eliminated				
Group	$> 85\%$	$< 85\%$	public	private
N	76	146	147	75
MES	86.6	89.3	87.4	84.2
Var	145.6	103.7	110.0	179.6

Table Nineteen: Second-Stage Frontiers				
Aggregated Model: Doctoral-Granting IHLs				
When Managerial Inefficiencies are Eliminated				
Group	> 85%	< 85%	public	private
N	76	146	147	75
MES	93.2	93.3	93.9	98.8
Var	29.7	58.9	56.2	9.0

Private IHLs are more efficient than public and the difference is significant. This result is further supported by the fact that 29 (20%) public IHLs obtain a score of 100 while 44 (59%) private IHLs obtain a 100. In addition, the skewness statistic is more negative for the private than for the public IHLs. Negative (positive) skewness implies that the bulk of the institutions fall into the higher (lower) part of the range and relatively few show very low (high) values. It should be noted that public IHLs do obtain an average efficiency score of over 93 which indicates little program inefficiency. I find no significant difference between the groups above and below 85% unrestricted revenue. Not only do they have nearly identical average scores but they are above 93. In contrast to when managerial inefficiencies were present, I do find differences in the variances of the groups. I reject the null hypothesis for the F statistic and conclude that public and IHLs below 85% have greater variance. A specific listing of efficiency scores for each institution in table nineteen can be found in Appendix E.

2.8.2 DEA Results for Master's-Granting IHLs

The following tables provide the results for master's-granting IHLs.

Table Twenty: First-Stage Frontiers				
Aggregated Model: Master's-Granting IHLs				
Before Managerial Inefficiencies are Eliminated				
Group	> 85%	< 85%	public	private
N	376	131	269	238
MES	63.5	74.4	75.8	56.2
Var	311.2	337.7	238.2	368.8

Table Twenty-One: Second-Stage Frontiers				
Aggregated Model: Master's-Granting IHLs				
When Managerial Inefficiencies are Eliminated				
Group	> 85%	< 85%	public	private
N	376	131	269	238
MES	87.7	85.3	77.5	99.8
Var	108.7	134.1	137.4	1.8

The private IHLs are nearly perfectly efficient while the public IHLs are far less efficient. Only 10 (4%) of public IHLs obtain a score of 100 while 159 (67%) of private IHLs obtain a 100. Those above the 85% threshold are more efficient. While the difference is statistically significant, only 2.4 points separate the two groups. When managerial inefficiencies are eliminated, public IHLs exhibit far greater variance than do private. I find no significant difference between the variances of the groups when separated by the threshold. A specific listing of efficiency scores for each institution in table twenty-one can be found in Appendix E.

2.8.3 DEA Results for Bachelor's-Granting IHLs

The following tables provide the results for bachelor's-granting IHLs.

Table Twenty-Two: First-Stage Frontiers				
Aggregated Model: Bachelor's-Granting IHLs				
Before Managerial Inefficiencies are Eliminated				
Group	> 85%	< 85%	public	private
N	351	243	74	520
MES	74.7	51.5	76.6	53.9
Var	279.3	326.5	303.0	326.3

Table Twenty-Three: Second-Stage Frontiers				
Aggregated Model: Bachelor's-Granting IHLs				
When Managerial Inefficiencies are Eliminated				
Group	$> 85\%$	$< 85\%$	public	private
N	351	243	74	520
MES	98.3	78.6	71.7	99.9
Var	7.6	101.4	214.2	0.3

Consistent with the results from the master's subsample, the private IHLs are nearly perfectly efficient while the public IHLs are far less efficient. Only 5 (7%) of public IHLs obtain a perfect score while 303 (58%) of private IHLs score perfectly. Those above the 85% threshold are more efficient. Here the difference is not only statistically significant but absolutely different by 19.7 points. Of those above the threshold, 109 (31%) obtain a perfect score while only 12 (5%) below the threshold score perfectly. The skewness for those above is negative while it is positive for those below. When managerial inefficiencies are eliminated, public IHLs and those below the threshold exhibit far greater variance than do private and those above the threshold. A specific listing of efficiency scores for each institution in table twenty-three can be found in Appendix E.

To summarize, private IHLs obtain a higher average score than public for all three subsamples. Also, private IHLs are nearly perfectly efficient for all three subsamples. For doctoral-granting IHLs, I find no statistical difference between those below the 85% threshold and those above. However, for master's and bachelor's-granting IHLs, those above the threshold obtain a higher average score than those below. This is the opposite result from the aggregated model when managerial inefficiencies are included. In addition, the scores exhibit two patterns. For public IHLs, doctoral-granting average scores are greater than master's-granting which are greater than bachelor's-granting. For both public and private IHLs below the threshold, doctoral-

granting average scores are greater than master's-granting which are greater than bachelor's-granting. No such pattern exists for those above the threshold.

2.9 Conclusions

I employ two different methods of DEA in this essay. The first constructs a single frontier and then groups the institutions afterwards for comparison. The second uses the Charnes, Cooper, and Rhodes (1978) ratio form. The institutions are initially grouped to generate separate frontiers then added together to construct a single frontier to make comparisons. I make comparisons in two ways. The first is new. I separate IHLs by the percent of unrestricted revenue; those with unrestricted revenue above a certain threshold are grouped together and those with unrestricted revenue below that threshold are grouped together, regardless of their private or public affiliation. The second comparison is the current paradigm for comparisons: private versus public. I also propose two different DEA models; the first using disaggregated inputs and outputs and the second using aggregated inputs and outputs. I also add to the current literature by expanding the number of institutions in my sample. The sample in this study is comprised of 1,323 institutions including research universities, master's-level universities and colleges, and bachelor's-level colleges.

When using the first DEA method that allows program and managerial inefficiencies to be present and using the disaggregated model, I find doctoral-granting, private IHLs have higher average efficiency scores than public. I find master's-granting, public IHLs have higher average efficiency scores than private. Master's-granting IHLs below the 85% and 80% thresholds have higher average scores than those above the thresholds while bachelor's-granting IHLs below all three thresholds have higher average scores than those above.

When the aggregated model is used, doctoral-granting, private IHLs are no longer more efficient; I find no statistical difference between private and public. I find doctoral-granting IHLs below the 80% threshold are more efficient than those above. Master's-granting IHLs below the 85% and 80% thresholds are more efficient than those above while bachelor's-granting IHLs below all three thresholds are more efficient than those above. I usually fail to reject Banker's two test statistics. The inefficiency scores do not generally seem to follow an exponential or half-normal distribution. Only in a few cases do the scores follow a specific distribution. For all hypotheses, I fail to reject the F test so I cannot conclude any differences in variation of efficiency scores. The disaggregated and aggregated models produce consistent conclusions. Therefore, model specification generally does not change the inferences drawn from the statistical tests employed throughout the analysis.

Given the results from this DEA method, I postulate that those IHLs with a smaller percentage of unrestricted revenue are, on average, more efficient than those IHLs with a higher percentage because the restricted nature of the revenue serves as an accountability and efficiency control measure on the managers and the institution. The restricted revenue essentially negates any managerial inefficiency that might exist. Consider an IHL with a particularly inefficient set of presidents and deans. If most of their revenue is received as restricted, they have little discretion of how to allocate their expenditures. The donor has decided for them. Hence, their inefficient behavior is minimized or eliminated, dependent on the actual level of restricted revenue. In essence, the donors are choosing from the available production functions discussed earlier.

When using the second DEA method that eliminates managerial inefficiencies and using the aggregated model, I find all private IHLs more efficient than public, regardless of subsample. This is different than the conclusion using the aggregated model when managerial inefficiencies are included. I also find master's-granting and

bachelor's-granting IHLs above the 85% threshold more efficient than those below. This is in direct contrast to when managerial inefficiencies are present.

Since managerial inefficiencies have been eliminated, this implies that institutions that operate with a higher percentage of unrestricted revenue exhibit higher program efficiencies. The presidents and deans seem to have chosen either the optimal production function or a relatively optimal function for their institution. This should be the case since they have more discretion over their allocation of expenditures. They should be able to more easily and quickly respond to their environment and produce outputs more efficiently than those institutions limited by their revenue flexibility.

Presidents and deans of private institutions have chosen a nearly optimal production function which is illustrated by the nearly perfect efficiency scores. Presidents and deans of public institutions have either poorly chosen their production functions or have had their functions chosen for them by stakeholders and are performing the best they can given their constraints. This is especially true for master's and bachelor's-granting IHLs as can be seen by the relatively low average scores.

Upon further analysis of the data, I suggest reasons why private IHLs are more efficient than public. Using data from the aggregated model and when managerial inefficiencies have been eliminated, differences in average output values are readily apparent. It should be noted that the data are not adjusted for institutional size or normalized in any way. Private, doctoral and bachelor's-granting IHLs conduct more research, less public service, and award fewer degrees than public IHLs. Private, master's-granting IHLs conduct only slightly less research than their public counterparts and perform less public service and award fewer degrees. It appears then, that the optimal production function would place a heavier emphasis on research and less emphasis on public service and degrees. Recalling earlier discussions, public IHLs typically are under greater pressure to perform public service and devote more resources to undergraduate instruction because of their sources of revenue. Their

stakeholders impose these constraints and the presidents and deans of the institutions must manage within those constraints.

2.10 References

Ahn, Taesik (1987), "Efficiency and Related Issues in Higher Education: A Data Envelopment Analysis Approach," Doctoral dissertation, The University of Texas at Austin, Austin, TX.

Ahn, Taesik, Victor Arnold, Abraham Charnes, and William W. Cooper (1989), "DEA and Ratio Efficiency Analyses for Public Institutions of Higher Learning in Texas," *Research in Governmental and Nonprofit Accounting*, Volume 5, pp. 165-185.

Ahn, Taesik, Abraham Charnes, and William W. Cooper (1988), "Some Statistical and DEA Evaluations of Relative Efficiencies of Public and Private Institutions of Higher Learning," *Socio-Economic Planning Sciences*, Volume 22, Number 6, pp. 259-269

Ahn, Taesik and L.M. Seiford (1993), "Sensitivity of DEA models and Variable Sets in a Hypothesis Test Setting: the Efficiency of University Operations," in Yuji Ijiri (ed.) *Creative and Innovative Approaches to the Science of Management*. Westport CT: Quorum Books.

Avkiran, Necmi K. (2001), "Investigating Technical and Scale Efficiencies of Australian Universities Through Data Envelopment Analysis," *Socio-Economic Planning Sciences*, Volume 35, pp. 57-80.

Banker, Rajiv D. (1993), "Maximum Likelihood, Consistency and Data Envelopment Analysis: A Statistical Foundation," *Management Science*, Volume 39, Issue 10, pp. 1265-1273.

Beasley, J.E. (1995), "Determining Teaching and Research Efficiencies," *The Journal of the Operational Research Society*, Volume 46, pp. 441-452.

Breu, Theodore M. and Raymond L. Raab (1994), "Efficiency and Perceived Quality of the Nation's "Top 25" National Universities and National Liberal Arts Colleges: An Application of Data Envelopment Analysis to Higher Education," *Socio-Economic Planning Sciences*, Volume 28, pp. 33-45.

Carlson, Daryl E. (1972), "The Production and Cost Behavior of Higher Education Institutions," Ford Foundation Program for Research in University Administration, Office of the Vice President-Planning, University of California, Paper P-36.

Charnes, Abraham, William W. Cooper, and E.L. Rhodes (1978), "Measuring Efficiency of Decision Making Units," *European Journal of Operational Research*, Volume 2, pp. 429-444.

Charnes, Abraham, William W. Cooper, and E.L. Rhodes (1981), "Evaluating Program and Managerial Efficiency: An Application of Data Envelopment Analysis to Program Follow Through," *Management Science*, Volume 27, pp. 668-697.

Coelli, Tim, D.S. Prasada Rao, and George E. Battese (1998), *An Introduction to Efficiency and Productivity Analysis*. Boston: Kluwer Academic Publishers.

Dolan, Robert C., Clarence R. Jung, and Robert M. Schmidt (1985), "Evaluating Education Inputs in Undergraduate Education," *The Review of Economics and Statistics*, Volume 67, pp. 514-520.

Emrouznejad, Ali and E. Thanassoulis (1996), "An Extensive Bibliography of Data Envelopment Analysis (DEA) Volumes 1-5," Working Papers, Warwick Business School.

Hopkins, D. and W.F. Massy (1981), *Planning Models for Colleges and Universities*. Palo Alto, CA: Stanford University Press.

Pastor, Jesús T., José L. Ruiz, and Inmaculada Sirvent (2002), "A Statistical Test for Nested Radial DEA Models," *Operations Research*, Volume 50, No. 4, pp. 728-735.

Rhodes, E.L. and L. Southwick Jr. (1986), "Determinants of efficiency in public and private universities," Mimeo, School of Environmental and Public Affairs, Indiana University, Bloomington, IN.

Rothschild, Michael and Lawrence J. White (1995), "The Analytics of the Pricing of Higher Education and Other Services in Which the Customers Are Inputs," *The Journal of Political Economy*, Volume 103, pp. 573-586.

Sengupta, Jati K. (1975), "Cost and production functions in the university education system: an econometric analysis," in H. Correa, ed. *Analytical Models in Educational Planning and Administration*. New York: David McKay Company, Inc.

Welch, B.L. (1938), "The Significance of the Difference Between Two Means When the Population Variables are Unequal," *Biometrica*, Volume 29, pp. 350-362.

Chapter 3

Cross-subsidizing of Teaching and Research Funds within Institutions: Theory and Evidence

3.1 Introduction

The current financing of American higher education is a complex system of payments and transfers among and between many different parties. An institution receives revenue from students in the form of tuition and fees, from various levels of government in the form of appropriations, grants, and contracts, and from alumni and other private sources in the form of gifts, grants, and contracts. It also collects revenue through licensing fees, gate receipts from sporting events, and other ancillary enterprises such as bookstores. Generally speaking, the revenue is collected as either unrestricted, which can be used at the discretion of the institution, or restricted which means the revenue can only be used as defined by the donor. Public and private four-year institutions of higher learning (IHLs) maintain a three-dimensional mission statement that includes teaching, research, and public service which define their expenditure groups. Very few studies have been completed regarding the public service component. This is partly due to the intangible nature of public service and the difficulty of identifying and measuring performance criteria. In addition, accountability and productivity issues regarding public service have not been as prevalent as they have been regarding teaching and research.

In this essay, I focus exclusively on the teaching and research components and specifically on the reallocation of revenues within an institution. I find as an empirical regularity that public, doctoral-granting institutions are more likely to cross-subsidize from teaching revenues into research expenditures than private, doctoral-granting institutions which are more likely to cross-subsidize in the opposite direction. I postulate that the percent of unrestricted revenue and indirect cost rates for on-campus research are the primary explanatory variables for this behavior.

This essay proceeds as follows. Section 3.2 briefly outlines the history of the theory of the firm to put the models of not-for-profit behavior into perspective. Section 3.3 identifies and describes the data. Section 3.4 develops a theory of cross-subsidization and Section 3.5 constructs an econometric model to test the theory. Section 3.6 presents the results and Section 3.7 offers concluding remarks and ideas for future research.

3.2 A Brief History of the Theory of the Firm

In order to understand and appreciate how and why not-for-profit institutions such as IHLs exist and operate, a brief history is needed. While this discussion is not as extensive as other authors', it provides a context for modern not-for-profit theories.

True institutions do not exist in classical economic theories of the firm. The competitive forces of the market determine price. Costs curves are known for an entire range of potential output and market demand curves are known by the firm. Firms are profit-maximizing entities that use inputs to produce widgets via a "black box" technology.

As the theory of the firm grew in its sophistication and analysts began looking into the black box, they found classical theory inappropriate for some situations.

Other assumptions such as revenue, utility, market share, and social welfare maximization replaced the profit-maximizing assumption. Analysts examined other institutional forms such as not-for-profit corporations, cooperatives, labor-managed firms, government-owned firms, partnerships, and charitable organizations.

More specifically, a great body of literature developed on the dichotomy of for-profit versus not-for-profit organization. The basic legal difference between the two is that for-profit firms can distribute residual earnings while not-for-profit firms cannot. The literature diverges between those authors that seek to explain the existence of private and public not-for-profit firms and those who seek to model the behavior of not-for-profit firms. The existence of not-for-profit firms is explained by a group of theories that identify three forces. Those include asymmetric information, contract failure, and principal-agent problems. These forces give rise to the creation and sustainment of not-for-profit institutions.

Within the not-for-profit organizational forms, another dichotomy emerges between private and public (i.e. government-provided). Weisbrod (1977, 1980) has written on the difference between these two forms. He identifies the dissatisfaction in the level of government-provided services and the substitution for those services as reasons for the existence of private, not-for-profit firms. These firms predominantly exist in six broad types of service industries: health care, education and research, social service, arts and culture, community development, and religion. Health care is the largest with nearly half the total expenditures of the combined six industries. Education and research is the second largest with roughly 18% of total expenditures (James and Rose-Ackerman, 1986). It is no surprise then to find that most of the scholarly work has been devoted to hospitals and health care institutions. This essay studies education and research, specifically research-oriented, postsecondary institutions.

Modelling not-for-profit firms has come in a number of forms. One is revenue maximization subject to a zero-profit constraint. A common model for public firms is total budget maximization. James and Rose-Ackerman (1986) propose a model whereby the firm maximizes utility subject to a cost constraint and a single output is the sole determinant of utility. I will use the model specified by James (1978) in which a multiproduct firm maximizes utility subject to a zero profit constraint.

3.3 Data on Revenue and Expenditures for Teaching and Research

The National Center for Education Statistics (NCES) conducts an annual survey of all institutions of higher education. NCES then stores and maintains the results in the Integrated Postsecondary Education Data System (IPEDS). IPEDS contains multiple component files and I use the Finance, Opening Fall Enrollment, and Faculty Salaries data files for the 1987-88 through 1996-97 academic years. In addition, the National Science Foundation (NSF) collects data from the same institutions. I use NSF's Graduate S&E Students Data and R&D Expenditures files. I include all institutions with Carnegie Classification codes 11 through 14 which include Research and Doctoral Universities. Other types of institutions engage in much less or no research so they will not engage in cross-subsidization. Appendix C contains details of the Carnegie classification system. The sample included in this study is comprised of 143 public and 79 private institutions over a ten year period. The indirect cost rate data is unpublished and graciously provided by Daniel Newlon and Philip Johnson of the National Science Foundation's Economics Program.

The revenue sources are defined in the way the revenue is intended to be used. For example, instruction revenue is revenue received for the purpose of teaching. Instruction revenue can actually come from "private" sources such as alumni contributions. Appendix D contains detailed definitions of the IPEDS variables.

The focus of this essay is on teaching and research revenue and expenditure. The following revenue sources are divided between these two groups. For teaching:

1. tuition and fees,
2. federal appropriations,
3. state appropriations, and
4. local appropriations.

For research:

1. federal grants and contracts,
2. state grants and contracts,
3. local grants and contracts, and
4. private grants and contracts.

The following expenditures are grouped as follows. For teaching:

1. instruction,
2. academic support, and
3. scholarships and fellowships.

For research:

1. research, and
2. libraries.

The descriptive statistics from the data clearly indicate that private and public IHLs behave differently. If the institution cross-subsidizes from teaching into research, then the cross-subsidy is expressed in negative dollars. If the institution cross-subsidizes from research into teaching, then the cross-subsidy is measured in positive dollars. Public institutions are much more likely to cross-subsidize from teaching into research than are private institutions. Forty-nine (34%) cross-subsidize from teaching into research. Eighty (56%) engage in no cross-subsidy, and fourteen (10%) cross-subsidize from research into teaching. The average value of the cross-subsidy is -$985 with a maximum value of $137,257 and a minimum of -$72,544. The skewness is 3.4. Positive skewness implies that the bulk of the institutions fall into the lower part of the range and relatively few show very high values.

Conversely, private institutions are much more likely to cross-subsidize from research into teaching than are public institutions. Two (3%) cross-subsidize from teaching into research. Twenty-seven (34%) engage in no cross-subsidy, and fifty (63%) cross-subsidize from research into teaching. The maximum value of the cross-subsidy is $360,640 with a minimum of -$4,238 and an average value of $23,601. The skewness is 3.1.

In addition to the direction and value of the cross-subsidy, the expenditure patterns vary greatly between the two types of institutions. For public IHLs, the ratio of teaching expenditures to research expenditures is 4.3 on average. For private IHLs, the ratio is 95.2 on average. Private IHLs therefore spend a greater proportion on teaching than do public. This suggests differences in preferences; private IHLs more strongly prefer teaching than do public IHLs. The revenue patterns are nearly the same. For public IHLs, the ratio of teaching revenues to research revenues is 3.8 on average while for private IHLs, the ratio is 3.2 on average. It appears, then, that both types of institutions are able to generate revenues in similar proportions but elect to spend it in very different ways.

3.4 A Theory of Cross-Subsidization

The theory proposed here draws from several authors and previous studies. Generally speaking, the studies identify changes in spending patterns and, in some cases, attempt to identify reasons behind rising costs. I use these studies to identify behavioral incentives and apply them to the practice of resource reallocation or cross-subsidization.

I begin with general behavioral characteristics and incentives common to public and private IHLs. Leslie and Rhoades (1995, p. 192) state that "in the special nonprofit case of higher education, economists and non-economists alike hold that the ultimate aim of revenue maximization is prestige. The implicit presumption is that resources will be allocated principally to the production activities of instruction and, especially in the case of universities, of research." This is consistent with Bowen's revenue theory of cost for colleges and universities (Bowen, 1980). Based on the assumption that the size, type, and mission of each school is given, five "laws" of educational costs can be derived. The five laws are 1) The dominant goals of institutions are educational excellence, prestige, and influence; 2) In quest of excellence, prestige, and influence, there is virtually no limit to the amount of money an institution could spend for seemingly fruitful educational ends; 3) Each institution raises all the money it can; 4) Each institution spends all it raises; and 5) The cumulative effect of the preceding four laws is toward ever-increasing expenditure. Bluntly speaking, institutions will seek revenue from any and all potential sources and will rarely say no to a potential donor.

Ever since colleges existed, they have been subject to economic events outside of their control which directly influence their ability to obtain revenue. This is especially true of public institutions which are at the mercy of state legislatures and the state budgeting process. Higher education is generally viewed as a discretionary item in

the state budget and is often the first item to be cut in difficult budget times. Leslie and Rhoades (1995, p. 193) note "colleges and universities of the 1980s and 1990s accelerated their search for 'new money.' The search contributed to a shift in the distribution of organizational expenditures from instruction to research and service and to administration. The more secure funding base was state government, whose priority was instruction, whereas marginal revenues came from industry and the federal government, whose priorities leaned more toward service and research." From here we can begin to see a difference in the priorities developed by public and private institutions. Some priorities are imposed upon the institution from outside forces, and the state government is clearly a major stakeholder in public higher education. Public IHLs will clearly want to obtain the marginal revenues from industry but will be expected to maintain a high priority for instruction. Private IHLs will face this pressure to a much lesser degree.

Evidence suggests that while public IHLs faced this potential dilemma, they were successful in altering their program mix of research and teaching. Slaughter (1998, p. 213) finds "public research universities' expenditure patterns can also be read as a response to federal and state policy shifts that treated higher education as a subsector of economic policy and promoted higher education as a vehicle for wealth creation. Faced with losses in state revenues, public research universities moved expenditures away from instruction and toward research and administration." It appears as if public IHLs were successful in chasing and obtaining other sources of funds.

One of the major principles of economics is that agents respond to incentives. The preceding discussion applies this principle to the nonprofit sector of higher education. Leslie and Rhoades (1995, p. 194) further illustrate this point by stating that "organizations develop structures that are complementary to the structures of the organization's resource providers." In other words, IHLs change their program mix and emphasis in response to funding sources.

I now turn more specifically to research grant funding as a growing importance to institutions. The growth of the land-grant colleges and other major public universities can be attributed to the large amounts of research they produced. While this is a historical fact, it is true for today's institutions as well. Ehrenberg (1999) finds that public institutions receive more external grant funding in the aggregate and from the National Science Foundation than comparable private institutions.

These incentives and realities of institutional behavior lead directly to the theory of cross-subsidization, especially for public institutions. Ehrenberg (2002b, p. 4) states "What is not well recognized, however, is that in spite of generous external support for research, increasingly the costs of research are being borne by the universities themselves. During the 1970-1971 to 1997-1998 period, the weighted average institutional expenditure on research per faculty member at the 228 universities more than tripled. As a result, the weighted average percentage of total research expenditures per faculty member being financed out of institutional funds rose from about 11 to 20 percent during the period. Increasingly the academic institutions themselves are bearing a greater share of the ever-increasing costs of scientific research." His results are not new however. Southwick (1969) found similar results in his study that covered the period 1956-57 to 1962-63. He found the number of administrators needed per dollar of research grants increased substantially over the period. In addition, the number of researchers, as well as their cost, rapidly increased. In a more recent study Slaughter (1998, p. 213) finds "in public universities, current-fund expenditures shares going to instruction declined by 2.2% between 1980-81 and 1990-91, while expenditure shares for research increased by 2%.

Hansmann (1986, p. 79) directly addresses the potential for not-for-profit institutions to cross-subsidize. "The nondistribution constraint provides the consumer with some assurance that the sums he pays to a commercial nonprofit will go in their entirety to the production of services. It offers no assurance, however, that the

services he pays for will be provided to *him*. In general, a nonprofit remains relatively free to use the sums paid by one consumer to subsidize another, especially if, as is often the case, the consumer is in a poor position to determine whether he is getting exactly what he paid for." This concept can be applied to higher education. Because of the complex financing discussed previously, an undergraduate student is highly unlikely to be able to determine if he is getting the kind and level of education he paid for. Through the nature of research, a grant donor is unlikely to be able to determine if he is getting the kind and quality of research he paid for. It is likely that he will be better able to make a determination than the undergraduate, but there exists a certain amount of ambiguity. This argument, along with the unrestrictive nature of some revenue, allows the institution to cross-subsidize from one function to another.

James and Rose-Ackerman (1986) propose a variation to their single output model to allow for several outputs. They immediately recognize the likelihood of cross-subsidization and backward-bending supply curves. These firms will earn a surplus for some outputs which can be used to offset losses incurred by other outputs. In addition, increases in prices or donations may cause the firm to produce less of a particular product.

James (1986) observes that religious groups are the major founders of private not-for-profit institutions. Their primary objective is to maintain and attract new believers. In order to achieve this objective, they may have to charge a lower price in order to compete with public institutions and attract students. Separately, James (1978, p. 181) models the product mix of IHLs and states "It follows that, consistent with empirical observation, undergraduate institutions can survive very well without graduate students, while graduate institutions cannot exist without a large undergraduate base." Therefore, if private IHLs respond to the incentive to alter its program mix to emphasize research and they identify the need to maintain a

large undergraduate base, they will then have the incentive to cross-subsidize from research into teaching.

Consider a multiproduct, not-for-profit institution that produces Q_i, i = 1,...,n, at costs C_i and parametric prices P_i in order to maximize a utility function U$[Q_i, (Q_i/C_i)]$ subject to the zero-profit constraint $\sum C_i - \sum P_i Q_i$ - FR = 0, where $\partial U/\partial Q_i \gtreqless 0, \partial U/\partial(Q_i/C_i) < 0$, and FR = fixed revenue (donations or income from endowments) which are independent of current decisions about Q_i or C_i. In this model higher output does not necessarily imply higher dollar costs, but if Q_i increases with C_i constant, this implies a technological (or quality) deterioration, hence a loss of utility and a subjective cost. Output and costs are determined simultaneously by the IHL, such that

$$\partial U/\partial Q_i + [\partial U/\partial(Q_i/C_i)](1/C_i) + \lambda P_i = 0 \tag{3.1}$$

$$[\partial U/\partial(Q_i/C_i)][-(Q_i/C_i^2] - \lambda = 0 \tag{3.2}$$

Rearranging (3.1) we have:

$$\partial U/\partial Q_i + \lambda P_i = -[\partial U/\partial(Q_i/C_i)](1/C_i) \tag{3.3}$$

On the left-hand side of equation (3.3) are the positive effects of increasing Q_i – more direct utility as well as revenue. On the right-hand side are the negative effects – the decline in average cost and thus also in utility (U) as Q rises. Production increases so long as the positive effects outweigh the negative, with the equilibrium output mix implying that relative (dis)utilities equal relative prices:

$$\{\partial U/\partial Q_i + [\partial U/\partial(Q_i C_i)](1/C_i)\} \tag{3.4}$$
$$\div\{\partial U/\partial Q_j + [\partial U/\partial(Q_j C_j)](1/C_j)\} = P_i/P_j$$

relative utilities equal relative net costs:

$$(\partial U/\partial Q_i)/(\partial U/\partial Q_j) = [(C_i/Q_i) - P_i]/[(C_j/Q_j) - P_j] \tag{3.5}$$

and with total revenues allocated such that the gain from marginal expenditures have been equalized across goods:

$$\{[\partial U/\partial(Q_i/C_i)][-(Q_i/C_i^2)]\} \div \{[\partial U/\partial(Q_j/C_j)][-(Q_j/C_j^2)]\} = 1 \tag{3.6}$$

In the context of the analysis in this paper, teaching and research are the two outputs. As James (1978) illustrates, three hypotheses emerge from this model:

1. some goods will be produced at a loss,
2. some goods will be produced at a profit, and
3. the less preferred goods will either contract or be produced more cheaply to yield a profit which can be used to pay for the preferred goods.

In her analysis, she assumes that graduate teaching and research are the preferred goods while undergraduate teaching is the less preferred good. I generalize her assumption slightly and assume that for both public and private IHLs, research is the preferred good while teaching is the less preferred good. Since public IHLs, on average, already have a relatively large undergraduate base and receive explicit and implicit directives from stakeholders to produce teaching, they will seek to produce a profit on teaching. The surplus will then be used for research. Private IHLs, on average, have a relatively small undergraduate base. They need to maintain or perhaps increase this base as a support for the institution. They will seek to produce a profit on research and cross-subsidize into teaching.

3.5 The Econometric Model

$$\begin{aligned} XSUB_{it} &= \beta_1 PUNREVT_{it} + \beta_2 PUNREVR_{it} + \beta_3 ICRON_{it} + \\ &\quad \beta_4 SERV_{it} + \beta_5 SUPPORT_{it} + \beta_6 PLANT_{it} + \\ &\quad \beta_7 GSTUD_{it} + \beta_8 USTUD_{it} + \beta_9 FAC_{it} + \\ &\quad \beta_{10} ENDOW_{it} + \beta_{11} ENDTR_{it} + e_i + u_{it} \end{aligned} \tag{3.7}$$

XSUB is a measure of the degree and direction of cross-subsidization. If the institution cross-subsidizes from teaching into research, then XSUB is negative. If no cross-subsidy occurs, then XSUB is zero. If the institution cross-subsidizes from research into teaching, then XSUB is positive. XSUB is calculated from teaching and research revenues and teaching and research expenditures. Appendix F contains details of the calculation of XSUB.

PUNREVT is the percent of unrestricted teaching revenue from the institution's operating budget, PUNREVR is the percent of unrestricted research revenue from the institution's operating budget, ICRON is the indirect cost rate of on-campus research, SERV is the expenditure of student services, SUPPORT is the expenditure of institutional support, PLANT is the expenditure on plant and maintenance, GSTUD is the total number of graduate students, USTUD is the total number of undergraduate students, FAC is the total number of faculty, ENDOW is the market value of the endowment at the end of the fiscal year, and ENDTR is the amount of the endowment transferred to the current operating budget. Appendix D for details of the definitions for SERV, SUPPORT, and PLANT.

The indirect cost rate is included due to recent findings by Ehrenberg (1999, p. 13). His analysis finds that "higher indirect cost rates are associated with higher levels of total external grant funding for institutions in the top four quintiles of recipients." More specifically, "in 1983 the average indirect cost rate at private research

and doctoral universities was over 60 percent, while the average at public research and doctoral universities was about 45 percent" (2002a, p. 15).

I wish to control for unobservable institutional effects which are captured in e_i and potentially correlated with the independent variables. The u_{it} are assumed to be independently distributed across institutions but no restrictions are placed on the form of the autocovariances for a single institution. Thus, the model allows heteroskedasticity and serial correlation of unknown form. Consistent standard error estimates are computed following Arellano (1987). A fixed-effects transformation of the variables into deviations from time means eliminates e_i. Estimating as a ten-equation seemingly unrelated regression model with the restriction that the slopes are equal across equations produces a fixed-effects estimator of $\hat{\beta}$ and consistent standard errors.

3.6 Results

The results for public institutions are presented in the following table.

Table One		
XSUB for All Public IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
PUNREVT	-20450.20 (16766.40)	0.22
PUNREVR	-342.44 (4402.74)	0.94
ICRON	782.93 (2554.17)	0.76
SERV	0.03 (0.04)	0.52
SUPPORT	0.12 (0.05)	0.02
PLANT	-0.13 (0.06)	0.03
GSTUD	0.21 (0.59)	0.72
USTUD	-0.12 (0.10)	0.21
FAC	6.40 (3.15)	0.04
ENDOW	0.00 (0.00)	0.66
ENDOWTR	-0.20 (0.12)	0.09
N = 143		
$R^2 = 0.04$		

The three primary explanatory variables, PUNREVT, PUNREVR, and ICRON, are all not statistically significant. However, the signs of the estimated coefficients are consistent with the theory. As the percent of unrestricted revenue (for either teaching or research) increases, XSUB will decrease which suggests more cross-subsidization from teaching to research will occur. PUNREVT and PUNREVR are measured as percentages, so a one percent increases causes an increase in cross-subsidy dollars from teaching to research. As the indirect cost rate for on-campus research increases,

XSUB will increase which suggests less cross-subsidization from teaching to research will occur. This is to be expected. As an institution receives more indirect costs through grants, there is less need to cross-subsidize because the research expenses can be recouped through the cost rates. ICRON is measured as a percent, so a one percent increase in the rate will decrease cross-subsidy dollars from teaching to research. The other explanatory variables are economically not significant.

The results for private institutions are presented in the following table.

Table Four		
XSUB for All Private IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
PUNREVT	43088.70 (16766.40)	0.03
PUNREVR	-36805.70 (4402.74)	0.07
ICRON	7767.64 (2554.17)	0.33
SERV	0.76 (0.04)	0.13
SUPPORT	0.00 (0.05)	0.93
PLANT	0.35 (0.06)	0.23
GSTUD	7.61 (0.59)	0.08
USTUD	-0.89 (0.10)	0.09
FAC	7.58 (3.15)	0.13
ENDOW	0.00 (0.00)	0.04
ENDOWTR	0.01 (0.12)	0.87
N = 79		
R^2 = 0.03		

The estimated coefficient for PUNREVT is statistically significant and the sign is consistent with the theory. As the percent of unrestricted revenue rises, more cross-subsidy will occur from research into teaching. The estimated coefficient for PUNREVR is statistically significant but the sign is inconsistent with the theory. The negative sign indicates that as the percent of unrestricted revenue rises, less cross-subsidy will occur from research into teaching. I would expect that as the percentage increases, it would give the institution more discretion in its use of funds and would allow more cross-subsidization to occur. Although the estimated coefficient for ICRON is not statistically significant, the sign suggests an interesting behavior. The positive sign suggests that as the indirect cost rate increases, more cross-subsidy will occur from research to teaching. It appears that the increase in indirect costs are used for teaching expenditures, not research expenditures. The other explanatory variables are economically not significant.

3.7 Conclusions and Future Research

I focus on teaching and research functions at doctoral-granting institutions and attempt to model behavior for two different types of organizational structure, public and private nonprofit. Through descriptive statistics of the data, it is clearly evident that the two types of institutions behave differently. Public IHLs are more likely to cross-subsidize from teaching revenues into research expenditures while private IHLs are more likely to cross-subsidize from research revenues into teaching expenditures. I postulate that the percent of unrestricted revenue from either teaching or research are indicators for the ability to cross-subsidize and the indirect cost rate of research overhead is a reason for cross-subsidization. However, the data do not fully support the theoretical model presented here.

One of the more interesting results I obtain is for private IHLs and the indirect cost rate. The econometric results indicate that an increase in the indirect cost rate will increase XSUB which suggests more cross-subsidization from research into teaching. Ehrenberg (2002a) and I both calculate the average indirect cost rate and find nearly identical results; private IHLs have much higher rates than do public. In addition, I find that private IHLs have a far greater expenditure pattern towards teaching than research. All of this suggests that private IHLs use the higher indirect cost rates as a revenue source to be used for teaching expenditures.

For public IHLs, the econometric results are not statistically significant but the signs of the estimated coefficients are consistent with the theoretical model presented. As the percent of unrestricted revenue increases, more cross-subsidization will occur from teaching to research. As the indirect cost rate for on-campus research increases, less cross-subsidization will occur from teaching to research. As an institution receives more indirect costs through grants, research expenses can be recouped through the cost rates and there will be less need to cross-subsidize.

Since the results to do not fully support the theoretical model, the first criticism should be directed toward the model itself. The model could be misspecified or incomplete by a variety of econometric errors. An equally plausible difficulty is the attempt itself. The groups of public and private IHLs used here are fairly homogeneous. I select only four-year, doctoral-granting institutions and separate them by a single identifier, public or private organizational form. Upon closer examination, each institution in a particular group is defined by its history, geographic location, preferences of stakeholders, and a variety of other factors that add unique characteristics. Therefore, each institution is going to have a certain degree of idiosyncratic behavior that cannot be possibly measured in econometric terms. It is well known that many private, nonprofit IHLs were created by religious organizations which rep-

resent a great variety of doctrines and philosophies. Grouping these IHLs into a single category and attempting to model behavior then becomes even more problematic.

The descriptive statistics clearly indicate a difference in behavior and the theory clearly indicates incentives for differences in behavior. A great deal has been learned through this analysis even though the econometric results are generally negative. I am encouraged by the challenge presented here and wish to pursue the explanation of this behavior. I formally conclude this essay with a few thoughts of where next to turn.

First, I believe the explanatory variables should be normalized to account for institution size. Normalizing by the number of students, number of faculty, or physical plant would make comparisons more consistent. Even though the sample is a fairly homogeneous group of institutions regarding their mission (i.e. doctoral-granting), the size of the institutions vary greatly. Second, I need to establish stronger links between the theoretical model and the explanatory variables. Perhaps I am missing a key variable.

3.8 References

Arellano, M. (1987), "Computing Robust Standard Errors for Within-Groups Estimators," *Oxford Bulletin of Economics and Statistics*, Volume 49, pp. 431-434.

Bowen, Howard R. (1980), "What Determines the Costs of Higher Education?" in David W. Breneman, Larry L. Leslie, and Richard E. Anderson, eds., *ASHE Reader on Finance in Higher Education*, Boston: Pearson Custom Publishing, 1996.

Ehrenberg, Ronald G. (2002a), "Studying Ourselves: The Academic Labor Market," NBER Working Paper, No. 8965.

Ehrenberg, Ronald G. and Jaroslava K. Mykula (1999), "Do Indirect Cost Rates Matter?" NBER Working Paper, No. 6976.

Ehrenberg, Ronald G., Michael J. Rizzo, and George H. Jakubson (2002b), "Who Bears the Growing Cost of Science at Universities?" Working Paper, Cornell University.

Hansmann, Henry B. (1986), "The Role of Nonprofit Enterprise," in Susan Rose-Ackerman, ed. *The Economics of Nonprofit Institutions*. Oxford: Oxford University Press, pp. 57-84.

James, Estelle (1978), "Product Mix and Cost Disaggregation: A Reinterpretation of the Economics of Higher Education," *The Journal of Human Resources*, Volume 13, Issue 2, pp. 157-186.

James, Estelle (1986), "The Private Nonprofit Provision of Education: A Theoretical Model and Application to Japan," *Journal of Comparative Economics*, Volume 10, pp. 255-276.

James, Estelle and Susan Rose-Ackerman (1986), *The Nonprofit Enterprice in Market Economics*. New York: Harwood Academic Publishers.

Leslie, Larry L. and Gary Rhoades (1995), "Rising Administrative Costs: Seeking Explanations," *Journal of Higher Education*, Volume 66, Issue 2, pp. 187-212.

Slaughter, Sheila (1998), "Federal Policy and Supply-Side Institutional Resource Allocation at Public Research Universities," *The Review of Higher Education*, Volume 21, Issue 3, pp. 209-244.

Southwick, Lawrence Jr. (1969), "Cost Trends in Land Grant Colleges and Universities," *Applied Economics*, Volume 1, pp. 167-182.

Weisbrod, Burton (1977), "Toward a Theory of the Voluntary Nonprofit Sector in a Three-Sector Economy," in Burton Weisbrod, ed., *The Voluntary Nonprofit Sector*. Lexington, Mass: D.C. Heath, 1977, pp. 51-76. Reprinted in Rose-Ackerman, ed., *The Economics of Nonprofit Institutions: Studies in Structure and Policy*. N.Y.: Oxford University Press, 1986, pp. 21-44.

Weisbrod, Burton (1980), "Private Goods, Collective Goods: The Role of the Nonprofit Sector," in Clarkson and Martin, eds., *The Economics of Nonproprietary Organizations*. Greenwich: JAI press, 1980, pp. 139-169.

Appendix A

List of States and Governing Structures

State	Governing Structure	State	Governing Structure
AK	State	MT	State
AL	Non-State	NC	State
AR	State	ND	State
AZ	Non-State	NE	Non-State
CA	State	NH	State
CO	State	NJ	Non-State
CT	State	NM	Non-State
DC	Non-State	NV	State
DE	State	NY	State
FL	State	OH	Non-State
GA	State	OK	State
HI	State	OR	State
IA	Non-State	PA	State
ID	State	RI	State
IL	Non-State	SC	Non-State
IN	Non-State	SD	State
KS	State	TN	State
KY	Non-State	TX	State
LA	State	UT	State
MA	State	VA	Non-State
MD	Non-State	VT	State
ME	State	WA	Non-State
MI	Non-State	WI	State
MN	State	WV	Non-State
MO	State	WY	Non-State
MS	State		

Appendix B

Calculation of INSTENROLL and OUTSTENROLL

In "The Impact of Governing Structure on the Pricing Behavior and Market Structure of Public Institutions of Higher Learning" (Chapter 1), I use the following OLS model using cross-section data:

$$\begin{aligned} TuitionRatio &= \alpha + \beta_1 GOVERN + \beta_2 INSTENROLL + \\ &\quad \beta_3 OUTSTENROLL + \beta_4 STINCSHARE + \\ &\quad \beta_5 PCNTSTAY + \beta_6 PCTAX + \epsilon \end{aligned}$$

INSTENROLL is the number of in-state undergraduate students enrolled, and OUTSTENROLL is the number of out-of-state undergraduates enrolled. The calculations for these two variables is a potential source of measurement error in the model. I would like to explain the calculations in further detail and describe alternative calculations. I believe the model specification in the essay is the best alternative and any measurement error is very small.

In even-numbered years, IPEDS collects residency status for freshmen in the fall enrollment data. Since my data came from academic year 1997-98, I used 1996-97 fall enrollment data. Assuming the 1996 freshmen class is representative of 1997 is a possible source of error. I do not believe this error is large as public institutions are generally larger than their private counterparts and their enrollment is more stable. While a better measure would be to average three or four years, the time involved to complete the average calculation would be extensive as the data manipulation is tedious.

The fall enrollment data are provided at the institution level. For each institution, I calculated the percentage of freshmen who were in-state students and applied this percentage to the total number of undergraduates to obtain INSTENROLL. Total enrollment less INSTENROLL thus becomes OUTSTENROLL. The second source of possible measurement error comes in the form of omitted data. In the 1996 fall enrollment file, 174 of the 1,656 institutions used did not report any data. My first alternative was to use 1994 or 1998 data, but nearly all 174 institutions did not report in either of those years. Of the 174 missing data points, almost all were two-year schools.

The variables were calculated as follows. The average percentage of in-state students for the type of institution in that state was used for the missing data. For example, for missing data points in Florida, the average percentage for two-year schools in Florida was used for any missing data for a two-year school. The results used in the paper are shown in Tables One and Two.

Table One		
TuitionRatio for All Public Four-Year IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-2.707 (0.665)	0.000
GOVERN	0.465 (0.074)	0.000
INSTENROLL	0.000 (0.000)	0.048
OUTSTENROLL	0.000 (0.00)	0.001
STINCSHARE	4.235 (1.295)	0.001
PCNTSTAY	5.487 (0.659)	0.000
PCTAX	-0.000 (0.000)	0.501
N = 579		
$R^2 = 0.268$		

Table Two		
TuitionRatio for All Public Two-Year IHLs		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-15.960 (1.374)	0.000
GOVERN	1.30 (0.132)	0.000
INSTENROLL	0.000 (0.000)	0.528
OUTSTENROLL	0.000 (0.00)	0.566
STINCSHARE	25.327 (2.221)	0.000
PCNTSTAY	15.289 (1.389)	0.000
PCTAX	0.002 (0.000)	0.000
N = 1077		
R^2 = 0.425		

As the first alternative calculation, I used the following method. I estimated the model without the 174 missing data points and ran OLS of the remaining 1,482 observations. The results are presented in Tables Three and Four.

Table Three		
TuitionRatio for All Public Four-Year IHLs When Observations are Omitted		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-2.551 (0.682)	0.000
GOVERN	0.471 (0.075)	0.000
INSTENROLL	0.000 (0.000)	0.004
OUTSTENROLL	0.000 (0.00)	0.001
STINCSHARE	3.694 (1.324)	0.005
PCNTSTAY	5.190 (0.673)	0.000
PCTAX	-0.000 (0.000)	0.716
N = 541		
$R^2 = 0.274$		

Table Four		
TuitionRatio for All Public Two-Year IHLs When Observations are Omitted		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-18.276 (1.541)	0.000
GOVERN	1.249 (0.139)	0.000
INSTENROLL	0.000 (0.000)	0.708
OUTSTENROLL	0.000 (0.00)	0.561
STINCSHARE	24.651 (2.293)	0.000
PCNTSTAY	17.396 (1.538)	0.000
PCTAX	0.002 (0.000)	0.000
N = 941		
R^2 = 0.446		

As the second alternative calculation, I used the following method. For any missing data point, I assumed the percentage of in-state students to equal 100%. The results are presented in Tables Five and Six.

Table Five		
TuitionRatio for All Public Four-Year IHLs When Observations Assumed to Equal 100%		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-2.686 (0.665)	0.000
GOVERN	0.465 (0.074)	0.000
INSTENROLL	0.000 (0.000)	0.039
OUTSTENROLL	0.000 (0.00)	0.001
STINCSHARE	4.184 (1.294)	0.001
PCNTSTAY	5.473 (0.659)	0.000
PCTAX	-0.000 (0.000)	0.481
N = 579		
$R^2 = 0.268$		

Table Six		
TuitionRatio for All Public Two-Year IHLs When Observations Assumed to Equal 100%		
Variable	Estimated Coefficient (Standard Error)	P value
CONSTANT	-15.962 (1.374)	0.000
GOVERN	1.302 (0.132)	0.000
INSTENROLL	0.000 (0.000)	0.451
OUTSTENROLL	0.000 (0.00)	0.725
STINCSHARE	25.244 (2.221)	0.000
PCNTSTAY	15.294 (1.389)	0.000
PCTAX	0.002 (0.000)	0.000
N = 1077		
R^2 = 0.425		

The results are nearly the same for each of the three model specifications. Since these two variables are not the focus of my paper, the estimated coefficients are zero, and the calculations do not substantially change the estimated coefficient for GOVERN, I am not concerned about any measurement error that might be included in the model presented in the essay.

Appendix C

Carnegie Code Definitions

The 1994 classification system created by the Carnegie Foundation for the Advancement of Teaching is included in the IPEDS data files to help users of this information further delineate institutions by type. This classification, which dates back to 1970, currently includes approximately 3,600 colleges and universities in the United States that are degree-granting and accredited by an agency recognized by the Secretary, U.S. Department of Education. The 10 categories that make up the new classification scheme are based largely on academic mission and are not intended to measure quality. Institutions are classified according to their highest level of offering, the number of degrees conferred by discipline, and the amount of federal support for research received by the institution. Some categories also rely on the selectivity of the institution's admissions.

Information provided by the Carnegie Foundation was matched against the IPEDS "Institutional Characteristics" file and the codes are indicated in the institutional listings where matches were certain. It is important for users to note that IPEDS includes separate listings for all branches of an institution, whereas, in some instances, Carnegie lists only one campus (which encompasses the main campus and all branches). Each of the categories, and the coding scheme used in this file, are explained below:

11 - RESEARCH UNIVERSITIES I

These institutions offer a full range of baccalaureate programs, are committed to

graduate education through the doctorate, and give high priority to research. They award 50 or more doctoral degrees each year. In addition, they receive annually $40 million or more in federal support.

12 - RESEARCH UNIVERSITIES II

These institutions offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. They award 50 or more doctoral degrees each year. In addition, they receive annually between $15.5 million and $40 million in federal support.

13 - DOCTORAL UNIVERSITIES I

These institutions offer a full range of baccalaureate programs and are committed to graduate education through the doctorate. They award at least 40 doctoral degrees annually in five or more disciplines.

14 - DOCTORAL UNIVERSITIES II

These institutions offer a full range of baccalaureate programs and are committed to graduate education through the doctorate. They award at least 10 doctoral degrees (in three or more disciplines), or 20 or more doctoral degrees in one or more disciplines.

21 - MASTER'S UNIVERSITIES AND COLLEGES I

These institutions offer a full range of baccalaureate programs and are committed to graduate education through the master's degree. They award 40 or more master's degrees annually in three or more disciplines.

22 - MASTER'S UNIVERSITIES AND COLLEGES II

These institutions offer a full range of baccalaureate programs and are committed to graduate education through the master's degree. They award 20 or more master's degrees annually in one or more disciplines.

31 - BACCALAUREATE (LIBERAL ARTS) COLLEGES I

These institutions are primarily undergraduate colleges with major emphasis on baccalaureate degree programs. They award 40 percent or more of the baccalaureate degrees in liberal arts fields and are restrictive in admissions.

32 - BACCALAUREATE COLLEGES II

These institutions are primarily undergraduate colleges with major emphasis on baccalaureate degree programs. They award less than 40 percent of their baccalaureate degrees in liberal arts fields or are less restrictive in admissions.

Appendix D

IPEDS Definitions

Educational and General (E&G) Revenues. Consists of current fund revenues from federal, state, and local appropriations; tuition income; government grants and contracts; private gifts, grants, and endowment income; sales and services of educational activities; and other revenues. Excluded from E&G revenues are income from sales and services of auxiliary enterprises, sales and services of hospitals, independent operations, and revenues for capital purposes. E&G funds include only those funds intended for operating purposes. Pell Grants are excluded.

Restricted Educational and General (E&G) Revenues. Those funds available for financing operations but which are limited by donors and other external agencies to specific purposes, programs, departments, or schools. Externally imposed restrictions are to be contrasted with internal designations imposed by the governing board on unrestricted funds.

Endowment Income (revenues). Includes the unrestricted income of endowment and similar funds; restricted income of endowment and similar funds to the extent expended for current operating purposes; and income from funds held in trust by others under irrevocable trusts. Does not include capital gains or losses. Such gains when spent for current operations are treated as transfers, not revenues.

Federal Appropriations (revenues). Includes dollars appropriated or made available by the Federal Government to public or private institutions of higher education for current operating expenses and not for specific projects or programs.

Examples are federal land-grant appropriations and federal revenue sharing funds. Federal appropriations received through state channels are included in the total for federal appropriations. Federal grants and contracts are excluded.

Federal Grants and Contracts (revenues). Includes revenues from Federal agencies that are for specific research projects or other types of programs such as administrative allowances for student aid. Examples are research projects, training programs, and similar activities for which amounts are received or expenditures are reimbursable under the terms of a Government grant or contract. Includes indirect costs recovered. Pell Grants awarded to student are excluded, although the administration allowance for Pell Grants are included.

Other Sources (revenues). Includes sales and services of educational activities and revenues derived from the sales of goods or services that are incidental to the conduct of instruction, research, or public service. Examples include film rentals, scientific and literary publications, testing services, university presses, and dairy products. Also includes all items or revenues not covered elsewhere. Examples are interest income and gains (net of losses) from investments of unrestricted current funds. Includes revenues resulting from the sales and services of internal service departments to persons or agencies external to the institution (e.g., the sale of computer time).

Private Gifts, Grants, and Contracts (revenues). Revenues from private donors for which no legal consideration is involved and from private contracts for specific goods and services provided to the funder as stipulation for receipt of the funds. Includes only those gifts, grants, and contracts that are directly related to instruction, research, public service, or other institutional purposes. Includes monies received as a result of gifts, grants, or contracts from a foreign government. Also includes the estimated dollar amount of contributed services.

State and Local Appropriations (revenues). Dollars appropriated or made available by State and local governments to public or private postsecondary institutions for current operating expenses and not for specific projects or programs. Grants and contracts are excluded. Charges for room, board, and other services rendered by auxiliary enterprises are not included here.

State and Local Grants and Contracts (revenues). Includes revenues from State and local government agencies which are for specific research projects or other types of programs such as student aid. Examples are research projects, training programs, and similar activities for which amounts are received or expenditures are reimbursable under the terms of a government grant or contract. Includes indirect costs recovered.

Tuition and Fees (revenues). Charges assessed against students for educational purposes. Includes tuition and fee remissions or exemptions even though there is no intention of collecting from the student. Includes those tuitions and fees that are remitted to the State as an offset to the State appropriation. Excludes charges for room, board, and other services rendered by auxiliary enterprises.

Educational and General (E&G) Expenditures. Educational and general expenditures include current fund expenditures for instruction, research, public service, academic support, student services, institutional support, operation and maintenance of plant, scholarships and fellowships, and educational and general mandatory transfers. Educational and general expenditures exclude expenditures for auxiliary enterprises, hospitals, and independent operations. Pell grants are excluded.

Educational and General(E&G) Mandatory Transfers (expenditures). Those transfers that must be made to fulfill a binding legal obligation of the institution. Includes mandatory debt-service provisions relating to academic and

administrative buildings, including (1) amounts set aside for debt retirement and interest, and (2) required provisions for renewal and replacements to the extent not financed from other sources. Also includes the institutional matching portion for Perkins Loans when the source of funds is current revenue.

Institutional Support (expenditures). Expenditures for the day-to-day operational support of the institution. Includes expenditures for general administrative services, executive direction and planning, legal and fiscal operations, and public relations/development. Excludes expenditures for physical plant operations.

Instruction (expenditures). Expenditures of the colleges, schools, departments, and other instructional divisions of the institution and expenditures for departmental research and public service that are not separately budgeted. Includes expenditures for credit and noncredit activities. Excludes expenditures for academic administration where the primary function is administration (e.g., academic deans). This category also includes general academic instruction, occupational and vocational instruction, special session instruction, community education, preparatory and adult basic education, and remedial and tutorial instruction conducted by the teaching faculty for the institution's students.

Libraries (expenditures). Expenditures for all print material, microfilm, microfiche, audiovisual materials such as records and films, and computer software. Excludes expenditures for hardware of any kind (e.g., computer terminals, microfiche readers, record players, and projectors).

Operation and Maintenance of Plant (expenditures). Expenditures for operations established to provide service and maintenance related to campus grounds and facilities used for educational and general purposes. Pell Grant Expenditures. Expenditures for scholarships and fellowships funded by Pell Grants. Pell grants are a type of Federal student financial aid that provides eligible undergraduate students

with need-based grants to help them defray the cost of postsecondary education. (Public Law 92-318, as amended, Public Law 94-482, Education Amendments of 1972, Title IV; 20 U.S. Code, Sec. 107a-1976.)

Public Service (expenditures). Funds budgeted specifically for public service and expended for activities established primarily to provide non-instructional services beneficial to groups external to the institution. Examples are seminars and projects provided to particular sectors of the community, and expenditures for community services and cooperative extension services.

Research (expenditures). Funds expended for activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution.

Student Services (expenditures). Funds expended for admissions, registrar activities, and activities whose primary purpose is to contribute to students' emotional and physical well-being and to their intellectual, cultural, and social development outside the context of the formal instructional program. Examples are career guidance, counseling, financial aid administration, and student health services (except when operated as a self-supporting auxiliary enterprise).

Academic Support (expenditures). Expenditures for the support services that are an integral part of the institution's primary mission of instruction, research, or public service. Includes expenditures for museums, galleries, audiovisual services, academic computing support, ancillary support, academic administration, personnel development, and course and curriculum development. Also includes expenditures for veterinary and dental clinics if their primary purpose is to support the institutional program. Excludes expenditures for libraries.

Scholarships and Fellowships (expenditures). Expenditures given in the form

of outright grants and trainee stipends to individuals enrolled in formal coursework, either for credit or non-credit. Excludes Pell Grants. Includes aid to students in the form of tuition or fee remissions. Excludes those remissions that are granted because of faculty or staff status. Also excludes College Work Study Program expenses.

Institutional. Expenditures for scholarships and fellowships from revenues generated by the institution such as tuition and fees revenues, endowment income, sales and services of educational activities, and other sources.

1. Other Federal. Expenditures for scholarships and fellowships, excluding Pell Grants, received from Federal government agencies.

2. Private. Expenditures for scholarships and fellowship received from private sources such as businesses, foundations, individuals and foreign governments.

3. State and Local. Expenditures for scholarships and fellowships provided by state and local governments.

Appendix E

Efficiency Score Tables

Table Nineteen Supplement	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SOUTHERN ILLINOIS UNIVERSITY-CARBONDALE	100
ALLEGHENY UNIVERSITY OF THE HEALTH SCIENCES	100
UNIVERSITY OF THE PACIFIC	100
LOMA LINDA UNIVERSITY	100
TEXAS A&M UNIVERSITY-COMMERCE	100
UNIVERSITY OF LAVERNE	100
NOVA SOUTHEASTERN UNIVERSITY	100
BRIGHAM YOUNG UNIVERSITY	100
THE UNION INSTITUTE	100
ADELPHI UNIVERSITY	100
U S INTERNATIONAL UNIVERSITY	100
FORDHAM UNIVERSITY	99.6
AMERICAN UNIVERSITY	99.5
CUNY GRADUATE SCHOOL AND UNIVERSITY CENTER	99.3
COLLEGE OF WILLIAM AND MARY	98.1
INDIANA STATE UNIVERSITY	97.6
UNIVERSITY OF SAN DIEGO	97.4
UNIVERSITY OF NORTH TEXAS	97.4
INDIANA UNIVERSITY OF PENNSYLVANIA	97.3
BOSTON COLLEGE	97.3

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
BIOLA UNIVERSITY	97.3
DUQUESNE UNIVERSITY	97.0
LOYOLA UNIVERSITY OF CHICAGO	97.0
TEXAS WOMAN'S UNIVERSITY	97.0
SETON HALL UNIVERSITY	96.6
OHIO UNIVERSITY MAIN CAMPUS	96.6
MIDDLE TENNESSEE STATE UNIVERSITY	96.5
SAINT JOHNS UNIVERSITY-NEW YORK	96.3
MIAMI UNIVERSITY-OXFORD	96.2
SOUTHERN METHODIST UNIVERSITY	96.2
UNIVERSITY OF CONNECTICUT	96.2
MARQUETTE UNIVERSITY	95.9
UNIVERSITY OF DENVER	95.7
CLARKSON UNIVERSITY	95.1
SYRACUSE UNIVERSITY	94.8
SAN DIEGO STATE UNIVERSITY	94.7
CATHOLIC UNIVERSITY OF AMERICA	94.4
CLARK UNIVERSITY	94.3
VIRGINIA COMMONWEALTH UNIVERSITY	94.2
BALL STATE UNIVERSITY	93.7

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
FLORIDA INSTITUTE OF TECHNOLOGY	93.6
PACE UNIVERSITY-NEW YORK	93.5
BOWLING GREEN STATE UNIVERSITY-MAIN CAMPUS	93.5
THE UNIVERSITY OF ALABAMA	93.2
SUNY AT STONY BROOK	92.3
GEORGE WASHINGTON UNIVERSITY	92.0
UNIVERSITY OF PENNSYLVANIA	91.9
UNIVERSITY OF MISSOURI-ST LOUIS	91.6
UNIVERSITY OF NORTHERN COLORADO	90.8
KENT STATE UNIVERSITY-MAIN CAMPUS	90.8
TEXAS TECH UNIVERSITY	90.7
SAINT LOUIS UNIVERSITY-MAIN CAMPUS	90.7
UNIVERSITY OF MEMPHIS	90.2
NORTHERN ILLINOIS UNIVERSITY	90.2
DEPAUL UNIVERSITY	90.0
UNIVERSITY OF KANSAS MAIN CAMPUS	89.9
HOWARD UNIVERSITY	89.6
NORTHERN ARIZONA UNIVERSITY	89.5
UNIVERSITY OF ROCHESTER	89.1
UNIVERSITY OF TOLEDO	88.7

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF WISCONSIN-MILWAUKEE	88.3
UNIVERSITY OF MISSOURI-COLUMBIA	88.2
INDIANA UNIVERSITY-BLOOMINGTON	88.2
UNIVERSITY OF AKRON MAIN CAMPUS	88.2
UNIVERSITY OF NORTH CAROLINA AT GREENSBORO	87.8
TEMPLE UNIVERSITY	87.1
UNIVERSITY OF LOUISVILLE	86.1
ILLINOIS STATE UNIVERSITY	85.8
GEORGIA STATE UNIVERSITY	85.1
ANDREWS UNIVERSITY	84.8
VANDERBILT UNIVERSITY	84.3
WESTERN MICHIGAN UNIVERSITY	83.9
UNIVERSITY OF PITTSBURGH-MAIN CAMPUS	83.7
UNIVERSITY OF IOWA	81.9
NEW SCHOOL FOR SOCIAL RESEARCH	80.9
UNIVERSITY OF KENTUCKY	77.2

Table Nineteen Supplement	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
HARVARD UNIVERSITY	100
CALIFORNIA INSTITUTE OF TECHNOLOGY	100
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	100
ROCKEFELLER UNIVERSITY	100
YALE UNIVERSITY	100
COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK	100
UNIVERSITY OF ALABAMA IN HUNTSVILLE	100
UNIVERSITY OF CALIFORNIA-BERKELEY	100
STANFORD UNIVERSITY	100
UNIVERSITY OF MINNESOTA TWIN CITIES	100
WAYNE STATE UNIVERSITY	100
PENNSYLVANIA STATE UNIVERSITY-MAIN CAMPUS	100
UNIVERSITY OF WASHINGTON	100
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL	100
UNIVERSITY OF CALIFORNIA-SAN FRANCISCO	100
UNIVERSITY OF ILLINOIS AT URBANA	100
THE UNIVERSITY OF TEXAS AT AUSTIN	100
UNIVERSITY OF CALIFORNIA-SAN DIEGO	100
UNIVERSITY OF WISCONSIN-MADISON	100
PURDUE UNIVERSITY-MAIN CAMPUS	100

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF SOUTH FLORIDA	100
OHIO STATE UNIVERSITY-MAIN CAMPUS	100
UNIVERSITY OF FLORIDA	100
UNIVERSITY OF NEW MEXICO-MAIN CAMPUS	100
MICHIGAN STATE UNIVERSITY	100
YESHIVA UNIVERSITY	100
FLORIDA STATE UNIVERSITY	100
UNIVERSITY OF UTAH	100
NEW YORK UNIVERSITY	100
TEXAS A & M UNIVERSITY	100
UNIVERSITY OF CENTRAL FLORIDA	100
UNIVERSITY OF CALIFORNIA-LOS ANGELES	100
UNIVERSITY OF MICHIGAN-ANN ARBOR	100
BOSTON UNIVERSITY	100
UNIVERSITY OF HOUSTON-UNIVERSITY PARK	100
ARIZONA STATE UNIVERSITY-MAIN CAMPUS	100
GEORGE MASON UNIVERSITY	100
COLORADO STATE UNIVERSITY	100
UNIVERSITY OF SOUTHERN CALIFORNIA	100
UNIVERSITY OF GEORGIA	100

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
FLORIDA INTERNATIONAL UNIVERSITY	100
UNIVERSITY OF ALABAMA AT BIRMINGHAM	100
GEORGIA INSTITUTE OF TECHNOLOGY MAIN CAMPUS	99.9
UNIVERSITY OF ALASKA FAIRBANKS	99.9
UTAH STATE UNIVERSITY	99.8
NORTH CAROLINA STATE UNIVERSITY AT RALEIGH	99.7
UNIVERSITY OF CINCINNATI-MAIN CAMPUS	99.6
UNIVERSITY OF NEBRASKA AT LINCOLN	99.5
UNIVERSITY OF MARYLAND COLLEGE PARK CAMPUS	99.5
UNIVERSITY OF TENNESSEE-KNOXVILLE	99.3
LOUISIANA ST UNIV & AG & MECH & HEBERT LAWS CTR	99.1
UNIVERSITY OF COLORADO AT BOULDER	98.8
UNIVERSITY OF MASSACHUSETTS-AMHERST	98.7
UNIVERSITY OF OKLAHOMA NORMAN CAMPUS	98.7
UNIVERSITY OF ARIZONA	98.7
UNIVERSITY OF VIRGINIA-MAIN CAMPUS	98.6
IOWA STATE UNIVERSITY	98.5
UNIVERSITY OF CALIFORNIA-DAVIS	98.5
UNIVERSITY OF SOUTH CAROLINA AT COLUMBIA	98.4
UNIVERSITY OF CHICAGO	98.2

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIV	98.2
UNIVERSITY OF MIAMI	98.2
AUBURN UNIVERSITY MAIN CAMPUS	98.0
UNIVERSITY OF ILLINOIS AT CHICAGO	97.8
KANSAS STATE UNIV OF AGRICULTURE AND APP SCI	97.5
THE UNIVERSITY OF TEXAS AT ARLINGTON	97.3
OKLAHOMA STATE UNIVERSITY-MAIN CAMPUS	97.2
NORTHWESTERN UNIVERSITY	97.1
UNIVERSITY OF HAWAII AT MANOA	97.1
INDIANA UNIVERSITY-PURDUE UNIV-INDIANAPOLIS	96.9
CASE WESTERN RESERVE UNIVERSITY	96.7
SUNY AT BUFFALO	96.7
UNIVERSITY OF CALIFORNIA-SANTA BARBARA	96.5
NEW MEXICO STATE UNIVERSITY-MAIN CAMPUS	96.4
UNIVERSITY OF DELAWARE	95.9
FLORIDA ATLANTIC UNIVERSITY	95.8
GEORGETOWN UNIVERSITY	95.6
UNIVERSITY OF SOUTHWESTERN LOUISIANA	95.5
UNIVERSITY OF NEW HAMPSHIRE-MAIN CAMPUS	95.4
WEST VIRGINIA UNIVERSITY	95.4

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
WASHINGTON UNIVERSITY	95.2
CARNEGIE MELLON UNIVERSITY	95.2
OLD DOMINION UNIVERSITY	95.2
OREGON STATE UNIVERSITY	95.0
SUNY AT ALBANY	94.5
PORTLAND STATE UNIVERSITY	94.3
MISSISSIPPI STATE UNIVERSITY	94.3
UNIVERSITY OF OREGON	93.6
WASHINGTON STATE UNIVERSITY	93.5
UNIVERSITY OF SOUTHERN MISSISSIPPI	93.3
CLEMSON UNIVERSITY	93.3
UNIVERSITY OF ARKANSAS AT FAYETTEVILLE	93.2
CLEVELAND STATE UNIVERSITY	92.6
UNIVERSITY OF NEVADA-RENO	92.3
WICHITA STATE UNIVERSITY	92.2
UNIVERSITY OF RHODE ISLAND	92.1
UNIVERSITY OF NORTH DAKOTA-MAIN CAMPUS	91.9
UNIVERSITY OF MASSACHUSETTS-LOWELL	91.7
UNIVERSITY OF NEW ORLEANS	90.8
UNIVERSITY OF IDAHO	90.6

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
TEXAS SOUTHERN UNIVERSITY	90.6
WAKE FOREST UNIVERSITY	90.5
WRIGHT STATE UNIVERSITY-MAIN CAMPUS	90.4
CLARK ATLANTA UNIVERSITY	90.3
MONTANA STATE UNIVERSITY-BOZEMAN	89.4
IDAHO STATE UNIVERSITY	89.2
UNIVERSITY OF WYOMING	89.0
UNIVERSITY OF NOTRE DAME	88.9
TULANE UNIVERSITY OF LOUISIANA	88.3
UNIVERSITY OF MAINE	88.3
NEW JERSEY INSTITUTE OF TECHNOLOGY	88.1
BAYLOR UNIVERSITY	88.1
SUNY AT BINGHAMTON	88.1
UNIVERSITY OF COLORADO AT DENVER	87.1
THE UNIVERSITY OF MONTANA-MISSOULA	87.0
PRINCETON UNIVERSITY	87.0
UNIVERSITY OF MISSISSIPPI MAIN CAMPUS	86.3
BROWN UNIVERSITY	86.2
UNIVERSITY OF MARYLAND-BALTIMORE COUNTY	86.0
TUFTS UNIVERSITY	85.2

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
UNIV OF VERMONT AND STATE AGRICULTURAL COLL	84.8
RENSSELAER POLYTECHNIC INSTITUTE	84.6
UNIVERSITY OF CALIFORNIA-SANTA CRUZ	84.4
NORTH DAKOTA STATE UNIVERSITY MAIN CAMPUS	84.3
LOUISIANA TECH UNIVERSITY	83.9
UNIVERSITY OF MISSOURI-KANSAS CITY	83.7
DARTMOUTH COLLEGE	83.5
UNIVERSITY OF CALIFORNIA-RIVERSIDE	83.5
MICHIGAN TECHNOLOGICAL UNIVERSITY	82.7
DREXEL UNIVERSITY	82.5
UNIVERSITY OF SOUTH DAKOTA	82.1
POLYTECHNIC UNIVERSITY	81.1
TENNESSEE STATE UNIVERSITY	80.3
LEHIGH UNIVERSITY	79.9
BRANDEIS UNIVERSITY	79.6
ILLINOIS INSTITUTE OF TECHNOLOGY	79.5
TEXAS CHRISTIAN UNIVERSITY	79.1
UNIVERSITY OF MISSOURI-ROLLA	78.7
RICE UNIVERSITY	77.5
THE UNIVERSITY OF TEXAS AT DALLAS	77.1

Table Nineteen Supplement, Continued	
Aggregated Model: Doctoral-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF DETROIT MERCY	76.4
UNIVERSITY OF TULSA	75.2
STEVENS INSTITUTE OF TECHNOLOGY	74.9
WORCESTER POLYTECHNIC INSTITUTE	74.6
SUNY COLLEGE OF ENVIRON SCIENCE AND FORESTRY	73.2
COLORADO SCHOOL OF MINES	68.1

Table Twenty-One Supplement	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SAINT JOSEPH COLLEGE	100
NATIONAL-LOUIS UNIVERSITY	100
PARK COLLEGE	100
HOLY NAMES COLLEGE	100
LOYOLA COLLEGE	100
GODDARD COLLEGE	100
COLLEGE OF ST FRANCIS	100
WILLIAM PATERSON COLLEGE OF NEW JERSEY	100
THE COLLEGE OF NEW JERSEY	100
CALIFORNIA STATE UNIVERSITY-LONG BEACH	100
EASTERN MICHIGAN UNIVERSITY	100
UNIVERSITY OF CENTRAL TEXAS	100
CARDINAL STRITCH COLLEGE	100
SONOMA STATE UNIVERSITY	100
TROY STATE UNIVERSITY-DOTHAN	100
CALIFORNIA STATE UNIVERSITY-FULLERTON	100
SAN JOSE STATE UNIVERSITY	100
GOLDEN GATE UNIVERSITY-SAN FRANCISCO	100
GALLAUDET UNIVERSITY	100
ROCHESTER INSTITUTE OF TECHNOLOGY	100

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF MARYLAND UNIVERSITY COLLEGE	100
ALASKA PACIFIC UNIVERSITY	100
NEW YORK INST OF TECHNOLOGY-OLD WESTBURY	100
WEBSTER UNIVERSITY	100
WILMINGTON COLLEGE	100
NATIONAL UNIVERSITY	100
SEATTLE UNIVERSITY	100
CITY UNIVERSITY	100
SAINT JOSEPHS UNIVERSITY	100
WEST COAST UNIVERSITY	100
UNIVERSITY OF DAYTON	100
AMBER UNIVERSITY	100
FAIRLEIGH DICKINSON UNIVERSITY-ALL CAMPUSES	100
BLOOMSBURG UNIVERSITY OF PENNSYLVANIA	100
HUMBOLDT STATE UNIVERSITY	100
SUFFOLK UNIVERSITY	100
WESTERN NEW ENGLAND COLLEGE	100
CALIFORNIA STATE UNIVERSITY-STANISLAUS	99.9
ITHACA COLLEGE	99.8
RIVIER COLLEGE	99.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
JERSEY CITY STATE COLLEGE	99.8
SANTA CLARA UNIVERSITY	99.6
WIDENER UNIVERSITY-MAIN CAMPUS	99.5
UNIVERSITY OF BALTIMORE	99.4
LOYOLA MARYMOUNT UNIVERSITY	99.4
LESLEY COLLEGE	99.3
EMERSON COLLEGE	99.0
MARIST COLLEGE	98.9
FAIRFIELD UNIVERSITY	98.8
CALIFORNIA STATE UNIVERSITY-SACRAMENTO	98.8
ROWAN COLLEGE OF NEW JERSEY	98.7
SPRINGFIELD COLLEGE	98.6
TEXAS A & M UNIVERSITY-TEXARKANA	98.6
SALISBURY STATE UNIVERSITY	98.6
SAINT MARYS COLLEGE OF CALIFORNIA	98.5
VILLANOVA UNIVERSITY	98.4
SOUTHERN CONNECTICUT STATE UNIVERSITY	98.3
AZUSA PACIFIC UNIVERSITY	98.2
CALIFORNIA STATE UNIVERSITY-BAKERSFIELD	98.2
REGIS UNIVERSITY	98.2

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
BENEDICTINE UNIVERSITY	98.2
SIMMONS COLLEGE	98.1
CREIGHTON UNIVERSITY	98.1
MARYVILLE UNIVERSITY OF SAINT LOUIS	98.1
ARIZONA STATE UNIVERSITY-WEST	98.0
EAST STROUDSBURG UNIVERSITY OF PENNSYLVANIA	98.0
GONZAGA UNIVERSITY	98.0
BALDWIN-WALLACE COLLEGE	97.8
UNIVERSITY OF MICHIGAN-DEARBORN	97.7
CHAPMAN UNIVERSITY	97.7
IONA COLLEGE	97.6
CALIFORNIA STATE UNIVERSITY-SAN BERNARDINO	97.4
FERRIS STATE UNIVERSITY	97.3
FONTBONNE COLLEGE	97.2
UNIVERSITY OF HOUSTON-CLEAR LAKE	97.2
ANNA MARIA COLLEGE	97.1
CALIFORNIA STATE UNIVERSITY-HAYWARD	97.1
TOWSON STATE UNIVERSITY	97.0
QUINNIPIAC COLLEGE	96.9
CALIFORNIA STATE UNIVERSITY-SAN MARCOS	96.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
WESTERN CONNECTICUT STATE UNIVERSITY	96.7
UNIVERSITY OF BRIDGEPORT	96.7
TRUMAN STATE UNIVERSITY	96.6
COLLEGE OF CHARLESTON	96.5
WESTFIELD STATE COLLEGE	96.5
CANISIUS COLLEGE	96.4
BRIDGEWATER STATE COLLEGE	96.4
PENNSYLVANIA STATE UNIV-HARRISBURG CAPITAL	96.2
KUTZTOWN UNIVERSITY OF PENNSYLVANIA	96.1
THE UNIVERSITY OF TEXAS AT TYLER	96.1
WEST CHESTER UNIVERSITY OF PENNSYLVANIA	96.1
CENTRAL WASHINGTON UNIVERSITY	96.0
SAINT AMBROSE UNIVERSITY	96.0
SUNY COLLEGE AT GENESEO	96.0
FITCHBURG STATE COLLEGE	96.0
SAINT MARTINS COLLEGE	95.9
SALVE REGINA UNIVERSITY	95.9
CALIFORNIA STATE UNIVERSITY-DOMINGUEZ HILLS	95.9
PACIFIC UNIVERSITY	95.9
UNIVERSITY OF NORTH CAROLINA AT WILMINGTON	95.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
RIDER UNIVERSITY	95.8
RADFORD UNIVERSITY	95.7
BRENAU UNIVERSITY	95.6
HAWAII PACIFIC UNIVERSITY	95.6
BUTLER UNIVERSITY	95.6
GEORGIA SOUTHERN UNIVERSITY	95.6
INDIANA UNIVERSITY-SOUTH BEND	95.6
CALIFORNIA STATE UNIVERSITY-CHICO	95.5
NORTHERN KENTUCKY UNIVERSITY	95.5
SUNY COLLEGE AT BROCKPORT	95.5
MONMOUTH UNIVERSITY	95.4
VALPARAISO UNIVERSITY	95.3
SUNY COLLEGE AT NEW PALTZ	95.3
KENNESAW STATE UNIVERSITY	95.3
MANHATTAN COLLEGE	95.2
ELON COLLEGE	95.1
LINDENWOOD COLLEGE	95.1
DOWLING COLLEGE	95.1
CALIFORNIA POLYTECHNIC ST UNIV-SAN LUIS OBISPO	94.8
CALIFORNIA STATE UNIVERSITY-FRESNO	94.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
MARYMOUNT UNIVERSITY	94.7
UNIVERSITY OF NEW HAVEN	94.7
EDINBORO UNIVERSITY OF PENNSYLVANIA	94.6
JOHN CARROLL UNIVERSITY	94.5
UNIVERSITY OF WISCONSIN-WHITEWATER	94.5
WINONA STATE UNIVERSITY	94.5
MERCER UNIVERSITY	94.5
STATE UNIVERSITY OF WEST GEORGIA	94.4
NIAGARA UNIVERSITY	94.3
CURRY COLLEGE	94.2
AVERETT COLLEGE	94.2
WAGNER COLLEGE	94.2
WORCESTER STATE COLLEGE	94.1
SUNY COLLEGE AT OSWEGO	93.9
UNIVERSITY OF CENTRAL OKLAHOMA	93.8
SAM HOUSTON STATE UNIVERSITY	93.8
CENTRAL MISSOURI STATE UNIVERSITY	93.7
JAMES MADISON UNIVERSITY	93.7
UNIVERSITY OF NORTH FLORIDA	93.6
MOUNT SAINT MARYS COLLEGE	93.6

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
WESTERN WASHINGTON UNIVERSITY	93.6
OAKLAND UNIVERSITY	93.5
WESTERN ILLINOIS UNIVERSITY	93.5
UNIVERSITY OF REDLANDS	93.1
NORTH CAROLINA CENTRAL UNIVERSITY	93.0
FRIENDS UNIVERSITY	92.9
KEAN COLLEGE OF NEW JERSEY	92.9
SLIPPERY ROCK UNIVERSITY OF PENNSYLVANIA	92.9
CAPITAL UNIVERSITY	92.9
CALIFORNIA STATE POLYTECHNIC UNIVERSITY-POMONA	92.8
LONG ISLAND UNIVERSITY-BROOKLYN CAMPUS	92.8
MANKATO STATE UNIVERSITY	92.8
OKLAHOMA CITY UNIVERSITY	92.7
APPALACHIAN STATE UNIVERSITY	92.4
STEPHEN F AUSTIN STATE UNIVERSITY	92.4
UNIVERSITY OF MASSACHUSETTS-DARTMOUTH	92.3
NORWICH UNIVERSITY	92.2
UNIVERSITY OF WISCONSIN-OSHKOSH	92.1
TROY STATE UNIVERSITY-MONTGOMERY	92.1
SAINT MICHAELS COLLEGE	92.0

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SUNY COLLEGE AT CORTLAND	92.0
ROLLINS COLLEGE	91.9
BARRY UNIVERSITY	91.9
MARY WASHINGTON COLLEGE	91.5
INDIANA UNIVERSITY-PURDUE UNIV-FORT WAYNE	91.5
MARIAN COLLEGE OF FOND DU LAC	91.4
SUNY COLLEGE AT PLATTSBURGH	91.3
INDIANA UNIVERSITY-SOUTHEAST	91.2
WAYNE STATE COLLEGE	91.1
AMERICAN INTERNATIONAL COLLEGE	91.0
BOWIE STATE UNIVERSITY	91.0
SAINT THOMAS UNIVERSITY	91.0
LINFIELD COLLEGE	90.9
UNIVERSITY OF SOUTHERN INDIANA	90.8
ASHLAND UNIVERSITY	90.7
UNIVERSITY OF NEBRASKA AT KEARNEY	90.5
CALIFORNIA STATE UNIVERSITY-LOS ANGELES	90.2
THE COLLEGE OF SAINT ROSE	90.1
UNIVERSITY OF WISCONSIN-EAU CLAIRE	89.9
PHILADELPHIA COLLEGE OF TEXTILES AND SCIENCE	89.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
BELLEVUE UNIVERSITY	89.7
UNIVERSITY OF HARTFORD	89.7
UNIVERSITY OF SOUTH ALABAMA	89.7
YOUNGSTOWN STATE UNIVERSITY	89.6
MONTCLAIR STATE UNIVERSITY	89.6
CALVIN COLLEGE	89.6
MOUNT SAINT MARYS COLLEGE	89.5
ST MARYS UNIVERSITY	89.5
EASTERN CONNECTICUT STATE UNIVERSITY	89.4
EDGEWOOD COLLEGE	89.4
JACKSONVILLE STATE UNIVERSITY	89.4
EMPORIA STATE UNIVERSITY	89.3
EASTERN COLLEGE	89.3
SEATTLE PACIFIC UNIVERSITY	89.3
UNIVERSITY OF PORTLAND	89.2
HOOD COLLEGE	89.2
AURORA UNIVERSITY	88.9
ANGELO STATE UNIVERSITY	88.9
THE SAGE COLLEGES	88.9
BEAVER COLLEGE	88.7

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
FRANCIS MARION UNIVERSITY	88.7
PLYMOUTH STATE COLLEGE	88.7
CENTRAL CONNECTICUT STATE UNIVERSITY	88.7
GOVERNORS STATE UNIVERSITY	88.6
WESTMINSTER COLLEGE OF SALT LAKE CITY	88.5
KEENE STATE COLLEGE	88.5
FORT HAYS STATE UNIVERSITY	88.3
JACKSONVILLE UNIVERSITY	88.3
NAZARETH COLLEGE OF ROCHESTER	88.3
UNIVERSITY OF TAMPA	88.2
UNIVERSITY OF NORTHERN IOWA	88.2
CALIFORNIA UNIVERSITY OF PENNSYLVANIA	88.1
HARDING UNIVERSITY	88.0
UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE	88.0
NORTHWEST MISSOURI STATE UNIVERSITY	87.9
MOORHEAD STATE UNIVERSITY	87.8
SOUTHWEST TEXAS STATE UNIVERSITY	87.7
UNIVERSITY OF THE INCARNATE WORD	87.6
MIDWESTERN STATE UNIVERSITY	87.5
UNIVERSITY OF RICHMOND	87.5

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
MADONNA UNIVERSITY	87.4
NORTH GEORGIA COLLEGE AND STATE UNIVERSITY	87.4
LINCOLN MEMORIAL UNIVERSITY	87.3
SUL ROSS STATE UNIVERSITY	87.3
PURDUE UNIVERSITY-CALUMET CAMPUS	87.2
UNIVERSITY OF NEBRASKA AT OMAHA	87.1
XAVIER UNIVERSITY	87.0
SUNY COLLEGE AT FREDONIA	87.0
LYNCHBURG COLLEGE	87.0
LA SALLE UNIVERSITY	86.9
POINT LOMA NAZARENE COLLEGE	86.9
TEXAS A & M UNIVERSITY-CORPUS CHRISTI	86.9
SAMFORD UNIVERSITY	86.8
ASSUMPTION COLLEGE	86.8
BRADLEY UNIVERSITY	86.8
AUGUSTA STATE UNIVERSITY	86.7
NOTRE DAME COLLEGE	86.6
TARLETON STATE UNIVERSITY	86.4
UNIVERSITY OF NORTH ALABAMA	86.2
SOUTHWEST MISSOURI STATE UNIVERSITY	86.2

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
GEORGIAN COURT COLLEGE	85.9
SAINT JOHN FISHER COLLEGE	85.8
LOYOLA UNIVERSITY IN NEW ORLEANS	85.7
MANSFIELD UNIVERSITY OF PENNSYLVANIA	85.7
GRAND VALLEY STATE UNIVERSITY	85.4
EAST CAROLINA UNIVERSITY	85.4
ABILENE CHRISTIAN UNIVERSITY	85.4
STETSON UNIVERSITY	85.1
AVILA COLLEGE	85.1
UNIVERSITY OF NEW ENGLAND	85.1
COLLEGE OF NOTRE DAME MARYLAND	85.0
INDIANA UNIVERSITY-KOKOMO	85.0
QUEENS COLLEGE	84.8
ELMIRA COLLEGE	84.7
SAINT BONAVENTURE UNIVERSITY	84.4
ROCKHURST COLLEGE	84.2
LANDER UNIVERSITY	84.2
ROSARY COLLEGE	84.0
UNIVERSITY OF SCRANTON	83.9
SAGINAW VALLEY STATE UNIVERSITY	83.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
LIBERTY UNIVERSITY	83.7
NORTH CENTRAL COLLEGE	83.7
UNIVERSITY OF MONTEVALLO	83.7
SUNY COLLEGE AT ONEONTA	83.7
JOHN F KENNEDY UNIVERSITY	83.7
SUNY COLLEGE AT POTSDAM	83.6
ROOSEVELT UNIVERSITY	83.4
BELLARMINE COLLEGE	83.1
TEXAS WESLEYAN UNIVERSITY	83.0
AQUINAS COLLEGE	83.0
MOUNT SAINT MARY COLLEGE	82.9
DALLAS BAPTIST UNIVERSITY	82.9
VITERBO COLLEGE	82.9
TROY STATE UNIVERSITY-MAIN CAMPUS	82.8
EASTERN ILLINOIS UNIVERSITY	82.8
FROSTBURG STATE UNIVERSITY	82.7
MURRAY STATE UNIVERSITY	82.5
CITADEL MILITARY COLLEGE OF SOUTH CAROLINA	82.4
UNIVERSITY OF WISCONSIN-LA CROSSE	82.4
DELTA STATE UNIVERSITY	82.3

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
WEST VIRGINIA WESLEYAN COLLEGE	82.3
UNIVERSITY OF TENNESSEE-MARTIN	82.3
INDIANA UNIVERSITY-NORTHWEST	82.2
UNIVERSITY OF INDIANAPOLIS	82.1
SAINT EDWARDS UNIVERSITY	81.8
WEST TEXAS A & M UNIVERSITY	81.6
SOUTHEAST MISSOURI STATE UNIVERSITY	81.6
LAMAR UNIVERSITY-BEAUMONT	81.3
LONGWOOD COLLEGE	81.2
UNIVERSITY OF EVANSVILLE	81.2
UNIVERSITY OF WEST ALABAMA	81.0
CASTLETON STATE COLLEGE	80.9
UNIVERSITY OF MARY HARDIN BAYLOR	80.5
UNIVERSITY OF WISCONSIN-PLATTEVILLE	80.5
WHITWORTH COLLEGE	80.2
TREVECCA NAZARENE UNIVERSITY	80.2
SAINT MARYS UNIVERSITY OF MINNESOTA	80.0
COLLEGE OF MOUNT SAINT JOSEPH	79.6
SOUTHWESTERN OKLAHOMA STATE UNIVERSITY	79.6
CARTHAGE COLLEGE	79.5

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SOUTHERN NAZARENE UNIVERSITY	79.4
AUSTIN PEAY STATE UNIVERSITY	79.3
D'YOUVILLE COLLEGE	79.0
UNIVERSITY OF WISCONSIN-PARKSIDE	78.8
EMMANUEL COLLEGE	78.8
CAMPBELL UNIVERSITY INC	78.8
MILLERSVILLE UNIVERSITY OF PENNSYLVANIA	78.2
UNIVERSITY OF WISCONSIN-RIVER FALLS	78.1
COLLEGE MISERICORDIA	77.8
HOUSTON BAPTIST UNIVERSITY	77.6
WALSH UNIVERSITY	77.4
SUNY INSTITUTE OF TECHNOLOGY AT UTICA-ROME	77.0
TEXAS A & M INTERNATIONAL UNIVERSITY	76.9
DOMINICAN COLLEGE OF SAN RAFAEL	76.8
CHRISTIAN BROTHERS UNIVERSITY	76.7
CONCORDIA UNIVERSITY	76.6
NORTHEASTERN ILLINOIS UNIVERSITY	76.6
UNIVERSITY OF WISCONSIN-STEVENS POINT	76.5
UNIVERSITY OF SAINT THOMAS	76.2
DRAKE UNIVERSITY	76.2

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF WISCONSIN-STOUT	75.9
WINTHROP UNIVERSITY	75.9
UNIVERSITY OF MICHIGAN-FLINT	75.8
MIDAMERICA NAZARENE COLLEGE	75.7
CALIFORNIA LUTHERAN UNIVERSITY	75.6
SHENANDOAH UNIVERSITY	75.5
AUBURN UNIVERSITY AT MONTGOMERY	75.3
SPALDING UNIVERSITY	75.1
UNIVERSITY OF NORTH CAROLINA-PEMBROKE	74.8
SHIPPENSBURG UNIVERSITY OF PENNSYLVANIA	74.6
DRURY COLLEGE	74.0
MEREDITH COLLEGE	73.9
GANNON UNIVERSITY	73.9
UNIVERSITY OF THE DISTRICT OF COLUMBIA	73.7
FRANCISCAN UNIVERSITY OF STEUBENVILLE	73.7
WESTERN CAROLINA UNIVERSITY	73.7
OLIVET NAZARENE UNIVERSITY	73.4
PACIFIC LUTHERAN UNIVERSITY	73.2
LAKE SUPERIOR STATE UNIVERSITY	73.2
SOUTHWEST BAPTIST UNIVERSITY	72.9

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF MOBILE	72.8
TRINITY UNIVERSITY	72.4
UNIVERSITY OF WISCONSIN-SUPERIOR	71.3
SOUTHERN OREGON STATE COLLEGE	70.9
JOHNSON STATE COLLEGE	70.8
MONTANA STATE UNIVERSITY-BILLINGS	70.4
WALLA WALLA COLLEGE	70.4
WOODBURY UNIVERSITY	70.4
SPRING HILL COLLEGE	70.3
CABRINI COLLEGE	70.2
GARDNER-WEBB UNIVERSITY	70.1
THE UNIVERSITY OF TEXAS OF THE PERMIAN BASIN	69.5
CHAMINADE UNIVERSITY OF HONOLULU	69.2
UNIVERSITY OF WISCONSIN-GREEN BAY	69.0
MARSHALL UNIVERSITY	69.0
SAINT FRANCIS COLLEGE	68.9
EASTERN NAZARENE COLLEGE	68.5
TRINITY COLLEGE	67.4
PFEIFFER UNIVERSITY	66.5
NORTHERN MICHIGAN UNIVERSITY	66.3

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
LA ROCHE COLLEGE	65.6
CENTENARY COLLEGE OF LOUISIANA	65.3
SAINT PETERS COLLEGE	64.6
UNIVERSITY OF ALASKA SOUTHEAST	64.6
QUEENS COLLEGE	64.6
FRESNO PACIFIC COLLEGE	64.3
CHESTNUT HILL COLLEGE	63.6
PACIFIC CHRISTIAN COLLEGE	62.7
LA SIERRA UNIVERSITY	61.1
CONVERSE COLLEGE	58.9
ROCKFORD COLLEGE	58.3
LINCOLN UNIVERSITY	58.2
BAKER UNIVERSITY COLLEGE OF ARTS AND SCIENCES	58.0
IMMACULATA COLLEGE	57.8
ORAL ROBERTS UNIVERSITY	49.7
CORNERSTONE COLLEGE	48.3

Table Twenty-One Supplement	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
WHEELING JESUIT UNIVERSITY	100
TUSKEGEE UNIVERSITY	100
NEW MEXICO HIGHLANDS UNIVERSITY	100
UNIVERSITY OF CENTRAL ARKANSAS	100
MAHARISHI UNIVERSITY OF MANAGEMENT	100
CENTRAL MICHIGAN UNIVERSITY	100
SOUTH DAKOTA STATE UNIVERSITY	100
INDIANA WESLEYAN UNIVERSITY	100
UNIVERSITY OF ST THOMAS	100
SAN FRANCISCO STATE UNIVERSITY	100
WILLIAM CAREY COLLEGE	100
UNIVERSITY OF ILLINIOS AT SPRINGFIELD	100
TUSCULUM COLLEGE	100
THE UNIVERSITY OF TEXAS AT BROWNSVILLE	100
MONTANA STATE UNIVERSITY-NORTHERN	100
FORT VALLEY STATE UNIVERSITY	99.9
LINCOLN UNIVERSITY	99.5
ALABAMA STATE UNIVERSITY	99.4
THE UNIVERSITY OF WEST FLORIDA	98.9
NORTHWESTERN STATE UNIVERSITY OF LOUISIANA	98.6

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
PRAIRIE VIEW A & M UNIVERSITY	98.4
VIRGINIA STATE UNIVERSITY	98.0
CHARLESTON SOUTHERN UNIVERSITY	97.7
CALIFORNIA STATE UNIVERSITY-NORTHRIDGE	97.4
EAST CENTRAL UNIVERSITY	97.3
DELAWARE STATE UNIVERSITY	96.6
ARMSTRONG ATLANTIC STATE UNIVERSITY	96.6
SOUTHEASTERN OKLAHOMA STATE UNIVERSITY	95.8
ALABAMA A & M UNIVERSITY	95.5
ARKANSAS TECH UNIVERSITY	95.4
WESTERN NEW MEXICO UNIVERSITY	94.6
NORTHWESTERN OKLAHOMA STATE UNIVERSITY	94.6
THE UNIVERSITY OF TEXAS-PAN AMERICAN	94.5
LOUISIANA STATE UNIVERSITY-SHREVEPORT	94.4
SOUTHERN UNIVERSITY AND A & M COLLEGE	93.4
MINOT STATE UNIVERSITY	93.4
MONTANA TECH OF THE UNIVERSITY OF MONTANA	93.3
SAINT XAVIER UNIVERSITY	93.0
HAMPTON UNIVERSITY	92.8
NORTH CAROLINA AGRICULTURAL AND TECH ST UNIV	92.7

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
CHICAGO STATE UNIVERSITY	92.4
NORTHERN STATE UNIVERSITY	92.1
MARYGROVE COLLEGE	92.1
ALCORN STATE UNIVERSITY	91.8
TEXAS A & M UNIVERSITY-KINGSVILLE	91.6
NORTHEAST LOUISIANA UNIVERSITY	91.2
HENDERSON STATE UNIVERSITY	90.7
XAVIER UNIVERSITY OF LOUISIANA	90.5
MORGAN STATE UNIVERSITY	90.5
SOUTHERN ILLINOIS UNIVERSITY-EDWARDSVILLE	90.3
NORFOLK STATE UNIVERSITY	89.8
SOUTH CAROLINA STATE UNIVERSITY	89.6
JACKSON STATE UNIVERSITY	89.6
BOISE STATE UNIVERSITY	89.6
KENTUCKY STATE UNIVERSITY	89.3
UNIVERSITY OF MARY	89.0
ADAMS STATE COLLEGE	88.8
GWYNEDD-MERCY COLLEGE	88.2
SUNY COLLEGE AT BUFFALO	88.1
THE UNIVERSITY OF TEXAS AT EL PASO	87.9

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
COLUMBUS STATE UNIVERSITY	87.6
SOUTHERN ARKANSAS UNIVERSITY MAIN CAMPUS	87.3
ALBANY STATE UNIVERSITY	87.0
CHADRON STATE COLLEGE	86.9
GEORGIA COLLEGE AND STATE UNIVERSITY	86.8
CUNY HUNTER COLLEGE	86.5
UNIVERSITY OF NEVADA-LAS VEGAS	86.3
EAST TENNESSEE STATE UNIVERSITY	85.8
CUNY LEHMAN COLLEGE	85.2
NORTHEASTERN STATE UNIVERSITY	85.2
MCNEESE STATE UNIVERSITY	85.1
SACRED HEART UNIVERSITY	85.1
GRAMBLING STATE UNIVERSITY	85.0
THE UNIVERSITY OF TEXAS AT SAN ANTONIO	84.8
UNIVERSITY OF ARKANSAS AT LITTLE ROCK	84.6
UNIVERSITY OF MASSACHUSETTS-BOSTON	84.4
WASHBURN UNIVERSITY OF TOPEKA	84.3
EASTERN KENTUCKY UNIVERSITY	84.2
UNIVERSITY OF MINNESOTA-DULUTH	84.1
HARDIN-SIMMONS UNIVERSITY	83.9

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
SOUTHERN UNIVERSITY-NEW ORLEANS	83.8
CUNY CITY COLLEGE	83.2
UNIVERSITY OF MARYLAND EASTERN SHORE	83.1
FLORIDA AGRICULTURAL AND MECHANICAL UNIVERSITY	83.0
CUNY BROOKLYN COLLEGE	82.8
MOREHEAD STATE UNIVERSITY	81.8
UNIVERSITY OF ALASKA ANCHORAGE	81.6
CUNY BERNARD M BARUCH COLLEGE	80.6
EASTERN WASHINGTON UNIVERSITY	80.0
CUMBERLAND COLLEGE	79.7
NICHOLLS STATE UNIVERSITY	79.5
GEORGIA SOUTHWESTERN STATE UNIVERSITY	79.4
ALFRED UNIVERSITY	79.4
BEMIDJI STATE UNIVERSITY	79.4
WESTERN OREGON STATE COLLEGE	79.3
LEWIS UNIVERSITY	79.0
SOUTHEASTERN LOUISIANA UNIVERSITY	78.8
COLLEGE OF SAINT SCHOLASTICA	78.8
UNIVERSITY OF TENNESSEE-CHATTANOOGA	78.7
CUNY COLLEGE OF STATEN ISLAND	78.4

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF COLORADO AT COLORADO SPRINGS	78.3
WESTERN KENTUCKY UNIVERSITY	77.6
MISSISSIPPI COLLEGE	77.4
TENNESSEE TECHNOLOGICAL UNIVERSITY	77.1
ARKANSAS STATE UNIVERSITY-MAIN CAMPUS	76.9
COPPIN STATE COLLEGE	76.5
UNIVERSITY OF HOUSTON-VICTORIA	76.3
VALDOSTA STATE UNIVERSITY	76.1
WEBER STATE UNIVERSITY	76.0
SAINT CLOUD STATE UNIVERSITY	75.7
CLARION UNIVERSITY OF PENNSYLVANIA	75.5
PENNSYLVANIA ST UNIV-ERIE BEHREND COLLEGE	74.5
COLLEGE OF NEW ROCHELLE	74.4
FAYETTEVILLE STATE UNIVERSITY	74.0
LENOIR-RHYNE COLLEGE	73.9
WILKES UNIVERSITY	72.6
OUR LADY OF THE LAKE UNIVERSITY-SAN ANTONIO	69.9
THE UNIVERSITY OF CHARLESTON	69.8
PITTSBURG STATE UNIVERSITY	69.3
MARYWOOD COLLEGE	66.8

Table Twenty-One Supplement, Continued	
Aggregated Model: Master's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
SALEM STATE COLLEGE	65.9
COLLEGE OF SAINT CATHERINE	65.1
FRAMINGHAM STATE COLLEGE	64.2
CHEYNEY UNIVERSITY OF PENNSYLVANIA	63.6
RHODE ISLAND COLLEGE	62.5
SAINT FRANCIS COLLEGE	60.8
UNION COLLEGE	59.7
HERITAGE COLLEGE	56.2
UNIVERSITY OF DUBUQUE	55.7
MARYCREST INTERNATIONAL UNIVERSITY	53.0
LAKE ERIE COLLEGE	49.4

Table Twenty-Three Supplement	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
DAKOTA STATE UNIVERSITY	100
CARSON-NEWMAN COLLEGE	100
ALBERTUS MAGNUS COLLEGE	100
OAKLAND CITY UNIVERSITY	100
MARYVILLE COLLEGE	100
WARREN WILSON COLLEGE	100
SAINT LEO COLLEGE	100
DEVRY INSTITUTE OF TECHNOLOGY	100
GEORGETOWN COLLEGE	100
NORTHWEST CHRISTIAN COLLEGE	100
CHRISTOPHER NEWPORT UNIVERSITY	100
LIMESTONE COLLEGE	100
BENNINGTON COLLEGE	100
BELHAVEN COLLEGE	100
ROSEMONT COLLEGE	100
BARD COLLEGE	100
ILLINOIS COLLEGE	100
THOMAS AQUINAS COLLEGE	100
ST JOHN'S COLLEGE	100
POINT PARK COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SUNY EMPIRE STATE COLLEGE	100
CONCORDIA COLLEGE	100
BETHEL COLLEGE	100
CHRISTIAN HERITAGE COLLEGE	100
SIERRA NEVADA COLLEGE	100
UNIV OF NEW ENGLAND-WESTBROOK COLL CAMPUS	100
OAKWOOD COLLEGE	100
PINE MANOR COLLEGE	100
GRACE COLLEGE AND THEOLOGICAL SEMINARY	100
MORNINGSIDE COLLEGE	100
NORTHWESTERN COLLEGE	100
CULVER-STOCKTON COLLEGE	100
JUDSON COLLEGE	100
DEVRY INSTITUTE OF TECHNOLOGY	100
MARYMOUNT MANHATTAN COLLEGE	100
TRINITY CHRISTIAN COLLEGE	100
COLLEGE OF THE OZARKS	100
PURDUE UNIVERSITY-NORTH CENTRAL CAMPUS	100
MONTREAT COLLEGE	100
MOUNT SENARIO COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
MISSOURI WESTERN STATE COLLEGE	100
CONCORDIA UNIVERSITY-WISCONSIN	100
KING COLLEGE	100
NOTRE DAME COLLEGE OF OHIO	100
DANA COLLEGE	100
SAINT MARYS COLLEGE	100
WAYLAND BAPTIST UNIVERSITY	100
CALVARY BIBLE COLLEGE	100
GREEN MOUNTAIN COLLEGE	100
NEW COLLEGE OF CALIFORNIA	100
BENEDICTINE COLLEGE	100
DORDT COLLEGE	100
FREED-HARDEMAN UNIVERSITY	100
MIDLAND LUTHERAN COLLEGE	100
MISSOURI BAPTIST COLLEGE	100
MOUNT ST CLARE COLLEGE	100
HOLY APOSTLES COLLEGE AND SEMINARY	100
DEVRY INSTITUTE OF TECHNOLOGY	100
SAINT MEINRAD COLLEGE	100
HANNIBAL-LAGRANGE COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SAINT ANDREWS PRESBYTERIAN COLLEGE	100
WISCONSIN LUTHERAN COLLEGE	100
SAINT THOMAS AQUINAS COLLEGE	100
JAMESTOWN COLLEGE	100
OLIVET COLLEGE	100
OKLAHOMA PANHANDLE STATE UNIVERSITY	100
CAZENOVIA COLLEGE	100
CLARKE COLLEGE	100
THOMAS COLLEGE	100
BRIGHAM YOUNG UNIVERSITY-HAWAII CAMPUS	100
WEST LIBERTY STATE COLLEGE	100
METROPOLITAN STATE UNIVERSITY	100
SOUTHWESTERN COLLEGE	100
SOUTHERN CALIFORNIA COLLEGE	100
SHIMER COLLEGE	100
THE MASTERS COLLEGE	100
GREENVILLE COLLEGE	100
GRACELAND COLLEGE	100
EVANGEL COLLEGE	100
PALM BEACH ATLANTIC COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
MISSOURI VALLEY COLLEGE	100
ATLANTIC UNION COLLEGE	100
SOUTHERN WESLEYAN UNIVERSITY	100
EAST TEXAS BAPTIST UNIVERSITY	100
OGLETHORPE UNIVERSITY	100
CEDARVILLE COLLEGE	100
OKLAHOMA BAPTIST UNIVERSITY	100
UNIVERSITY OF HAWAII AT WEST OAHU	100
BORICUA COLLEGE	100
DIVINE WORD COLLEGE	100
CHRISTENDOM COLLEGE	100
VILLA JULIE COLLEGE	100
LAKELAND COLLEGE	100
COLLEGE OF SAINT ELIZABETH	100
MOUNT VERNON COLLEGE	100
VIRGINIA INTERMONT COLLEGE	100
MILLIGAN COLLEGE	100
TRINITY COLLEGE OF VERMONT	100
SIMONS ROCK COLLEGE OF BARD	100
THOMAS MORE COLLEGE OF LIBERAL ARTS	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
WESTMINSTER COLLEGE	100
REGENTS COLLEGE-UNIVERSITY OF THE STATE OF NY	100
ACADEMY OF THE NEW CHURCH	100
CALDWELL COLLEGE	100
UNIVERSITY OF JUDAISM	100
OUACHITA BAPTIST UNIVERSITY	100
PRINCIPIA COLLEGE	100
NEW ENGLAND COLLEGE	100
SCHREINER COLLEGE	100
ROBERTS WESLEYAN COLLEGE	100
BLACKBURN COLLEGE	100
LYNDON STATE COLLEGE	100
CENTENARY COLLEGE	100
COLLEGE OF THE ATLANTIC	100
MOUNT VERNON NAZARENE COLLEGE	100
DAEMEN COLLEGE	100
CATAWBA COLLEGE	100
HOLY FAMILY COLLEGE	100
HOUGHTON COLLEGE	100
CONCORDIA UNIVERSITY	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
HILBERT COLLEGE	100
CORNELL COLLEGE	100
LORAS COLLEGE	100
GOSHEN COLLEGE	100
GROVE CITY COLLEGE	100
HUNTINGTON COLLEGE	100
ST JOHN'S COLLEGE	100
ST FRANCIS COLLEGE	100
SETON HILL COLLEGE	100
NYACK COLLEGE	100
EUREKA COLLEGE	100
WESTMAR UNIVERSITY	100
STEPHENS COLLEGE	100
HASTINGS COLLEGE	100
COLLEGE OF SAINT MARY	100
STERLING COLLEGE	100
NEUMANN COLLEGE	100
COVENANT COLLEGE	100
WESLEY COLLEGE	100
MOUNT MARY COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
PRESCOTT COLLEGE	100
LEE COLLEGE	100
LASELL COLLEGE	100
SHEPHERD COLLEGE	100
SAINT JOSEPHS COLLEGE	100
KENDALL COLLEGE	100
GENEVA COLLEGE	100
OHIO DOMINICAN COLLEGE	100
URSULINE COLLEGE	100
DOMINICAN COLLEGE OF BLAUVELT	100
COLLEGE OF MOUNT SAINT VINCENT	100
UNIVERSITY OF PITTSBURGH-JOHNSTOWN	100
MCMURRY UNIVERSITY	100
COKER COLLEGE	100
SALEM-TEIKYO UNIVERSITY	100
CALIFORNIA BAPTIST COLLEGE	100
ALDERSON BROADDUS COLLEGE	100
HEIDELBERG COLLEGE	100
TOCCOA FALLS COLLEGE	100
GRAND VIEW COLLEGE	100

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
ALVERNIA COLLEGE	100
TENNESSEE TEMPLE UNIVERSITY	100
SOUTHERN ADVENTIST UNIVERSITY	100
CENTRAL METHODIST COLLEGE	100
WESTERN STATE COLLEGE COLORADO	99.9
UNIVERSITY OF MAINE AT FORT KENT	99.9
MARY BALDWIN COLLEGE	99.9
CUMBERLAND UNIVERSITY	99.9
IOWA WESLEYAN COLLEGE	99.9
CARROLL COLLEGE	99.9
SAINT MARY COLLEGE	99.9
GRAND CANYON UNIVERSITY	99.8
WILLIAMS BAPTIST COLLEGE	99.8
MUSKINGUM COLLEGE	99.8
UNION UNIVERSITY	99.7
SAINT OLAF COLLEGE	99.7
DEVRY INSTITUTE OF TECHNOLOGY	99.6
LETOURNEAU UNIVERSITY	99.6
YORK COLLEGE PENNSYLVANIA	99.6
REGIS COLLEGE	99.6

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
AMBASSADOR UNIVERSITY	99.6
LOURDES COLLEGE	99.4
ASBURY COLLEGE	99.4
MARIETTA COLLEGE	99.4
ROGER WILLIAMS UNIVERSITY	99.3
HOBE SOUND BIBLE COLLEGE	99.3
FRANKLIN PIERCE COLLEGE	99.3
BUENA VISTA UNIVERSITY	99.3
DICKINSON STATE UNIVERSITY	99.3
COLUMBIA UNION COLLEGE	99.3
CEDAR CREST COLLEGE	99.2
HIGH POINT UNIVERSITY	99.2
OUR LADY OF HOLY CROSS COLLEGE	99.2
ALLENTOWN COLLEGE OF SAINT FRANCIS DE SALES	99.2
ANDERSON UNIVERSITY	99.1
LAWRENCE TECHNOLOGICAL UNIVERSITY	99.1
MARYMOUNT COLLEGE	99.1
MOLLOY COLLEGE	99.0
TENNESSEE WESLEYAN COLLEGE	99.0
MERCY COLLEGE-MAIN CAMPUS	99.0

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
BRYAN COLLEGE	99.0
STONEHILL COLLEGE	99.0
UNION COLLEGE	99.0
PITZER COLLEGE	99.0
UNIVERSITY OF PITTSBURGH-BRADFORD	98.9
AUGUSTANA COLLEGE	98.9
WILLAMETTE UNIVERSITY	98.9
ELMHURST COLLEGE	98.9
GEORGE FOX UNIVERSITY	98.9
QUINCY UNIVERSITY	98.9
SCRIPPS COLLEGE	98.8
EVERGREEN STATE COLLEGE	98.8
MANHATTANVILLE COLLEGE	98.7
WARNER PACIFIC COLLEGE	98.7
CENTRAL COLLEGE	98.7
AUGUSTANA COLLEGE	98.7
OTTAWA UNIVERSITY	98.6
SUSQUEHANNA UNIVERSITY	98.6
PRESBYTERIAN COLLEGE	98.6
JUDSON COLLEGE	98.5

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SIENA COLLEGE	98.5
UNIVERSITY OF SIOUX FALLS	98.5
BRADFORD COLLEGE	98.5
ROANOKE COLLEGE	98.5
SPRING ARBOR COLLEGE	98.5
LE MOYNE COLLEGE	98.4
ECKERD COLLEGE	98.3
UNIVERSITY OF DALLAS	98.3
SIMPSON COLLEGE	98.3
BEREA COLLEGE	98.3
KALAMAZOO COLLEGE	98.2
MOUNT IDA COLLEGE	98.2
COLLEGE OF OUR LADY OF THE ELMS	98.2
MERRIMACK COLLEGE	98.1
COLBY-SAWYER COLLEGE	98.1
PROVIDENCE COLLEGE	98.1
DAVID LIPSCOMB UNIVERSITY	98.1
GETTYSBURG COLLEGE	98.0
HILLSDALE COLLEGE	98.0
COLLEGE OF WOOSTER	97.9

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
COE COLLEGE	97.9
PERU STATE COLLEGE	97.9
WESTERN MARYLAND COLLEGE	97.9
COLLEGE OF SAINT BENEDICT	97.9
MALONE COLLEGE	97.9
SOUTHWESTERN ADVENTIST COLLEGE	97.9
TRANSYLVANIA UNIVERSITY	97.8
DELAWARE VALLEY COLLEGE	97.8
CONCORDIA UNIVERSITY	97.8
OKLAHOMA CHRISTIAN UNIV OF SCIENCE AND ARTS	97.8
MORAVIAN COLLEGE	97.8
MOUNT UNION COLLEGE	97.7
BLUEFIELD COLLEGE	97.7
RAMAPO COLLEGE OF NEW JERSEY	97.7
HAMPDEN-SYDNEY COLLEGE	97.7
SAINT MARYS COLLEGE	97.7
AGNES SCOTT COLLEGE	97.6
THE UNIVERSITY OF FINDLAY	97.6
UNIVERSITY OF PITTSBURGH-GREENSBURG	97.6
OHIO NORTHERN UNIVERSITY	97.5

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
SAINT JOSEPHS COLLEGE-MAIN CAMPUS	97.5
BRIDGEWATER COLLEGE	97.4
DENISON UNIVERSITY	97.4
SAINT JOSEPHS COLLEGE	97.4
WESTMINSTER COLLEGE	97.3
FURMAN UNIVERSITY	97.3
WHITTIER COLLEGE	97.3
KENTUCKY CHRISTIAN COLLEGE	97.3
LAFAYETTE COLLEGE	97.3
LOCK HAVEN UNIVERISTY OF PENNSYLVANIA	97.3
ELIZABETHTOWN COLLEGE	97.2
URSINUS COLLEGE	97.2
WASHINGTON AND JEFFERSON COLLEGE	97.1
FORT LEWIS COLLEGE	97.1
MIDWAY COLLEGE	97.1
ILLINOIS WESLEYAN UNIVERSITY	97.1
AUGSBURG COLLEGE	97.1
COLBY COLLEGE	97.0
SKIDMORE COLLEGE	96.9
WESTMONT COLLEGE	96.9

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
LEWIS AND CLARK COLLEGE	96.9
MUHLENBERG COLLEGE	96.9
SAINT MARYS COLLEGE OF MARYLAND	96.8
LUTHER COLLEGE	96.8
OTTERBEIN COLLEGE	96.8
LAKE FOREST COLLEGE	96.7
SAINT JOHNS UNIVERSITY	96.7
MESSIAH COLLEGE	96.6
WITTENBERG UNIVERSITY	96.5
COLLEGE OF THE HOLY CROSS	96.5
ALMA COLLEGE	96.5
BARTLESVILLE WESLEYAN COLLEGE	96.4
SOUTHWESTERN UNIVERSITY	96.3
CLEARWATER CHRISTIAN COLLEGE	96.3
WHITMAN COLLEGE	96.3
COLGATE UNIVERSITY	96.2
RANDOLPH-MACON COLLEGE	96.2
HOPE COLLEGE	96.2
BELOIT COLLEGE	96.1
OBERLIN COLLEGE	96.1

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
GORDON COLLEGE	96.1
REED COLLEGE	96.0
UNION COLLEGE	96.0
GUSTAVUS ADOLPHUS COLLEGE	96.0
SAINT ANSELM COLLEGE	95.9
CONCORDIA COLLEGE AT MOORHEAD	95.9
UNIVERSITY OF PUGET SOUND	95.9
WHEATON COLLEGE	95.9
HOBART WILLIAM SMITH COLLEGES	95.8
LYCOMING COLLEGE	95.8
HAMILTON COLLEGE	95.8
GUILFORD COLLEGE	95.8
HARTWICK COLLEGE	95.8
BETHEL COLLEGE	95.5
DICKINSON COLLEGE	95.5
SARAH LAWRENCE COLLEGE	95.4
BERRY COLLEGE	95.3
BUCKNELL UNIVERSITY	95.1
MILLSAPS COLLEGE	95.1
WHEATON COLLEGE	95.1

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
CONNECTICUT COLLEGE	94.8
ALLEGHENY COLLEGE	94.7
SAINT NORBERT COLLEGE	94.7
KING'S COLLEGE	94.7
FRANKLIN AND MARSHALL COLLEGE	94.7
DREW UNIVERSITY	94.6
TRINITY COLLEGE	94.5
MISSOURI SOUTHERN STATE COLLEGE	94.3
WILLIAMS COLLEGE	94.2
HOLLINS COLLEGE	94.1
UNIVERSITY OF THE SOUTH	94.1
GRINNELL COLLEGE	94.0
ALBION COLLEGE	93.9
KENYON COLLEGE	93.8
ST LAWRENCE UNIVERSITY	93.8
RHODES COLLEGE	93.5
HAVERFORD COLLEGE	93.5
DAVIDSON COLLEGE	92.9
SUNY COLLEGE AT PURCHASE	92.8
WELLESLEY COLLEGE	92.1

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Greater than 85% Unrestricted Revenue	
Institution Name	Score
HAMPSHIRE COLLEGE	91.6
KNOX COLLEGE	91.3
OCCIDENTAL COLLEGE	91.1
MOUNT HOLYOKE COLLEGE	91.0
THE RICHARD STOCKTON COLLEGE OF NEW JERSEY	90.8
UNIVERSITY OF SOUTH CAROLINA AT SPARTANBURG	90.6
LEBANON VALLEY COLLEGE	89.9
OHIO WESLEYAN UNIVERSITY	89.0
UNIVERSITY OF SOUTH CAROLINA AT AIKEN	88.9
UNIVERSITY OF NORTH CAROLINA AT ASHEVILLE	77.9
COASTAL CAROLINA UNIVERSITY	75.6

Table Twenty-Three Supplement	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
THE NATIONAL HISPANIC UNIVERSITY	100
BRYN MAWR COLLEGE	100
BARBER-SCOTIA COLLEGE	100
CRICHTON COLLEGE	100
UNIVERSITY OF SOUTHERN COLORADO	100
TOURO COLLEGE	100
EDWARD WATERS COLLEGE	100
METROPOLITAN STATE COLLEGE OF DENVER	100
SOUTHERN UTAH UNIVERSITY	100
COLLEGE OF SAINT JOSEPH	100
LIVINGSTONE COLLEGE	100
JOHN BROWN UNIVERSITY	100
TEXAS COLLEGE	98.3
PAUL QUINN COLLEGE	98.0
UTICA COLLEGE OF SYRACUSE UNIVERSITY	97.9
MIDDLEBURY COLLEGE	97.3
UPPER IOWA UNIVERSITY	97.0
SHAW UNIVERSITY	94.8
HUSTON-TILLOTSON COLLEGE	93.4
TOUGALOO COLLEGE	92.8

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
LANGSTON UNIVERSITY	92.8
COLLEGE OF THE SOUTHWEST	92.5
FELICIAN COLLEGE	92.2
MORRIS COLLEGE	91.7
VASSAR COLLEGE	91.3
MOREHOUSE COLLEGE	91.1
WILSON COLLEGE	90.9
MILES COLLEGE	90.8
URBANA UNIVERSITY	90.5
WILBERFORCE UNIVERSITY	90.4
BARNARD COLLEGE	89.7
BLUEFIELD STATE COLLEGE	89.4
ALLEN UNIVERSITY	89.3
WESLEYAN UNIVERSITY	89.1
SAINT MARY-OF-THE-WOODS COLLEGE	88.8
SMITH COLLEGE	88.8
RUST COLLEGE	88.8
ARKANSAS BAPTIST COLLEGE	88.7
KNOXVILLE COLLEGE	88.1
CLAFLIN COLLEGE	87.9

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
LAWRENCE UNIVERSITY	87.9
WILEY COLLEGE	87.7
METHODIST COLLEGE	87.7
LINDSEY WILSON COLLEGE	87.4
COLUMBIA COLLEGE	87.3
WINGATE UNIVERSITY	87.2
DEVRY INSTITUTE OF TECHNOLOGY	86.8
HOWARD PAYNE UNIVERSITY	86.8
LANE COLLEGE	86.5
COLUMBIA COLLEGE	86.2
THIEL COLLEGE	86.1
MONMOUTH COLLEGE	86.0
PAINE COLLEGE	86.0
WINSTON-SALEM STATE UNIVERSITY	86.0
UNIVERSITY OF HAWAII AT HILO	85.8
BETHANY COLLEGE OF THE ASSEMBLIES OF GOD	85.5
LOUISIANA COLLEGE	85.4
GLENVILLE STATE COLLEGE	85.1
WAYNESBURG COLLEGE	85.0
BENNETT COLLEGE	84.9

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
SAVANNAH STATE UNIVERSITY	84.8
SHAWNEE STATE UNIVERSITY	84.5
SILVER LAKE COLLEGE	84.4
BENEDICT COLLEGE	84.2
BETHEL COLLEGE	84.1
MERCYHURST COLLEGE	83.7
ERSKINE COLLEGE AND SEMINARY	83.7
BETHUNE COOKMAN COLLEGE	83.6
DAKOTA WESLEYAN UNIVERSITY	83.6
ATHENS STATE COLLEGE	83.6
MACMURRAY COLLEGE	83.5
TABOR COLLEGE	83.5
UNIVERSITY OF RIO GRANDE	83.4
FLORIDA MEMORIAL COLLEGE	83.4
UNIVERSITY OF MAINE AT FARMINGTON	83.4
HAMLINE UNIVERSITY	83.3
VIRGINIA UNION UNIVERSITY	83.3
CAMPBELLSVILLE UNIVERSITY	83.1
ALICE LLOYD COLLEGE	83.1
UNIVERSITY OF ARKANSAS AT MONTICELLO	82.9

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
UNIVERSITY OF SCIENCE AND ARTS OF OKLAHOMA	82.6
JARVIS CHRISTIAN COLLEGE	82.6
CUNY YORK COLLEGE	82.6
UNIVERSITY OF THE OZARKS	82.5
CONCORD COLLEGE	82.4
WEST VIRGINIA UNIVERSITY INSTITUTE OF TECHNOLOGY	82.3
TALLADEGA COLLEGE	82.1
WILLIAM TYNDALE COLLEGE	82.1
UNIVERSITY OF GREAT FALLS	82.1
FLORIDA SOUTHERN COLLEGE	82.0
LE MOYNE-OWEN COLLEGE	81.8
PIEDMONT COLLEGE	81.7
CARLOW COLLEGE	81.6
GREENSBORO COLLEGE	81.5
SAINT PAULS COLLEGE	81.4
MISSISSIPPI VALLEY STATE UNIVERSITY	81.4
HUNTINGDON COLLEGE	81.3
BLACK HILLS STATE UNIVERSITY	80.9
SHORTER COLLEGE	80.8
FAULKNER UNIVERSITY	80.6

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
PIKEVILLE COLLEGE	80.3
BREWTON-PARKER COLLEGE	80.2
KEUKA COLLEGE	80.2
JOHNSON C SMITH UNIVERSITY	80.2
NORTH CAROLINA WESLEYAN COLLEGE	80.2
WESTERN BAPTIST COLLEGE	80.0
ELIZABETH CITY STATE UNIVERSITY	79.9
SIMPSON COLLEGE	79.9
WARNER SOUTHERN COLLEGE	79.8
CAMERON UNIVERSITY	79.7
FLAGLER COLLEGE	79.4
WILLIAM JEWELL COLLEGE	79.3
ROCKY MOUNTAIN COLLEGE	79.2
UNIVERSITY OF ARKANSAS AT PINE BLUFF	79.2
BARAT COLLEGE	79.0
SHELDON JACKSON COLLEGE	79.0
WASHINGTON AND LEE UNIVERSITY	78.9
MESA STATE COLLEGE	78.4
COLUMBIA COLLEGE	78.3
UNIVERSITY OF HOUSTON-DOWNTOWN	78.2

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
SUNY COLLEGE AT OLD WESTBURY	78.1
BETHANY COLLEGE	78.0
VOORHEES COLLEGE	77.8
DEFIANCE COLLEGE	77.6
BRESCIA COLLEGE	77.6
UNIVERSITY OF MAINE AT MACHIAS	77.6
ALVERNO COLLEGE	77.5
EASTERN OREGON STATE COLLEGE	77.4
LYON COLLEGE	77.2
WILMINGTON COLLEGE	77.2
BLUFFTON COLLEGE	77.0
BLOOMFIELD COLLEGE	76.9
CROWN COLLEGE	76.9
WOFFORD COLLEGE	76.8
CONCORDIA COLLEGE	76.6
COLLEGE OF SANTA FE	76.5
LEWIS-CLARK STATE COLLEGE	76.5
WEST VIRGINIA STATE COLLEGE	76.5
NORTH PARK COLLEGE AND THEOLOGICAL SEMINARY	76.5
DEPAUW UNIVERSITY	76.4

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
LAGRANGE COLLEGE	76.2
MARS HILL COLLEGE	76.1
SPELMAN COLLEGE	76.0
MILLIKIN UNIVERSITY	76.0
UNIVERSITY OF MINNESOTA-MORRIS	75.9
DAVIS AND ELKINS COLLEGE	75.8
CARLETON COLLEGE	75.8
CALUMET COLLEGE OF SAINT JOSEPH	75.7
NORTHWESTERN COLLEGE	75.0
KENTUCKY WESLEYAN COLLEGE	74.9
LEES-MCRAE COLLEGE	74.9
NEWBERRY COLLEGE	74.7
WILLIAM PENN COLLEGE	74.7
CUNY MEDGAR EVERS COLLEGE	74.3
SOUTHWEST STATE UNIVERSITY	74.3
MARIAN COLLEGE	74.2
ADRIAN COLLEGE	74.2
EMORY AND HENRY COLLEGE	74.2
MORRIS BROWN COLLEGE	74.1
KANSAS WESLEYAN UNIVERSITY	74.1

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
PHILANDER SMITH COLLEGE	74.0
LAMBUTH UNIVERSITY	74.0
SWARTHMORE COLLEGE	74.0
UNIVERSITY OF VIRGINIA-CLINCH VALLEY COLLEGE	73.4
KANSAS NEWMAN COLLEGE	73.4
NORTHLAND COLLEGE	73.4
SIENA HEIGHTS COLLEGE	73.4
MANCHESTER COLLEGE	73.1
SAINT AUGUSTINES COLLEGE	73.1
INDIANA UNIVERSITY-EAST	72.9
CONCORDIA UNIVERSITY AT AUSTIN	72.8
MOUNT OLIVE COLLEGE	72.8
ALBERTSON COLLEGE OF IDAHO	72.7
CENTRAL STATE UNIVERSITY	72.7
MCKENDREE COLLEGE	72.7
FAIRMONT STATE COLLEGE	72.6
FRANKLIN COLLEGE OF INDIANA	72.5
MOUNT MARTY COLLEGE	72.5
VALLEY CITY STATE UNIVERSITY	72.5
STILLMAN COLLEGE	72.3

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
THOMAS MORE COLLEGE	72.3
TRI-STATE UNIVERSITY	72.3
BETHANY COLLEGE	72.2
TEXAS A & M UNIVERSITY-GALVESTON	72.2
BELMONT ABBEY COLLEGE	72.0
TEXAS LUTHERAN COLLEGE	71.7
SWEET BRIAR COLLEGE	71.4
MISSISSIPPI UNIVERSITY FOR WOMEN	71.4
EASTERN MENNONITE UNIVERSITY	71.4
CONCORDIA TEACHERS COLLEGE	71.3
AMHERST COLLEGE	71.2
CARROLL COLLEGE	71.1
FERRUM COLLEGE	70.9
DEVRY INSTITUTE OF TECHNOLOGY-POMONA	70.8
BOWDOIN COLLEGE	70.8
WASHINGTON COLLEGE	70.8
DOANE COLLEGE	70.7
COLORADO COLLEGE	70.2
BARTON COLLEGE	69.9
HENDRIX COLLEGE	69.5

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
CENTRE COLLEGE	69.5
BIRMINGHAM SOUTHERN COLLEGE	69.5
ANTIOCH COLLEGE	69.5
POMONA COLLEGE	69.4
MARLBORO COLLEGE	69.1
MACALESTER COLLEGE	68.9
NEBRASKA WESLEYAN UNIVERSITY	68.4
UNIVERSITY OF MAINE AT PRESQUE ISLE	68.1
CONCORDIA COLLEGE	68.1
WARTBURG COLLEGE	68.1
VIRGINIA WESLEYAN COLLEGE	67.9
UNITY COLLEGE	67.8
BRIAR CLIFF COLLEGE	67.7
RANDOLPH-MACON WOMAN'S COLLEGE	67.5
MCPHERSON COLLEGE	67.1
ALBRIGHT COLLEGE	67.1
BLUE MOUNTAIN COLLEGE	66.9
SALEM COLLEGE	66.9
MEDAILLE COLLEGE	66.7
WILLIAM WOODS UNIVERSITY	66.5

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
MOUNT MERCY COLLEGE	66.3
MAYVILLE STATE UNIVERSITY	66.3
BETHEL COLLEGE	66.3
HIRAM COLLEGE	65.4
HURON UNIVERSITY	64.5
VIRGINIA MILITARY INSTITUTE	63.8
CHATHAM COLLEGE	63.6
SELMA UNIVERSITY	63.4
NORTH ADAMS STATE COLLEGE	63.4
MARTIN UNIVERSITY	63.0
SAINT VINCENT COLLEGE	63.0
PACIFIC UNION COLLEGE	62.8
MILLS COLLEGE	61.0
AUSTIN COLLEGE	60.6
JUNIATA COLLEGE	60.2
EARLHAM COLLEGE	59.7
GRATZ COLLEGE	59.3
HANOVER COLLEGE	58.6
WESTERN MONTANA COLLEGE-UNIV OF MONTANA	58.1
WESLEYAN COLLEGE	57.8

Table Twenty-Three Supplement, Continued	
Aggregated Model: Bachelor's-Granting IHLs	
When Managerial Inefficiencies are Eliminated	
Group: Less than 85% Unrestricted Revenue	
Institution Name	Score
WELLS COLLEGE	57.6
PILLSBURY BAPTIST BIBLE COLLEGE	49.7
WABASH COLLEGE	49.4

Appendix F

Calculation of Dependent Variable XSUB

XSUB is a measurement of the degree and direction of cross-subsidization. If the institution cross-subsidizes from teaching into research, then XSUB is negative. If no cross-subsidy occurs, then XSUB is zero. If the institution cross-subsidizes from research into teaching, then XSUB is positive. XSUB is derived in the following manner.

REVR equals Federal, State, Local, and Private Grants and Contracts,

EXPR equals Research and Library Expenditures,

REVT equals Tuition & Fees and Federal, State, and Local Appropriations,

EXPT equals Instruction and Academic Support Expenditures plus Scholarships & Fellowships,

First, a dummy variable is assigned to each institution for each year which indicates the direction of cross-subsidization. The institution does not cross-subsidize when $\delta = 0$.

$\delta = 0$ if $(REVT - EXPT) > 0$ and $(REVR - EXPR) > 0$

or $(REVT - EXPT) < 0$ and $(REVR - EXPR) < 0$

The institution cross-subsidizes from teaching into research when $\delta = -1$.

$\delta = -1$ if $(REVT - EXPT) > 0$ and $(REVR - EXPR) < 0$

The institution cross-subsidizes from research into teaching when $\delta = 1$.

$\delta = 1$ if $(REVT - EXPT) < 0$ and $(REVR - EXPR) > 0$

Now, if $(REVT - EXPT) > 0$ and $(REVR - EXPR) < 0$, then

either $(REVT - EXPT) > -(REVR - EXPR) \Rightarrow$

$X = -(REVR - EXPR)$

or $(REVT - EXPT) < -(REVR - EXPR) \Rightarrow$

$X = (REVT - EXPT)$

Therefore, if $\delta = -1$,

$\mathrm{X} = \min\{(REVT - EXPT), -(REVR - EXPR)\} > 0$

If $\delta = 1$,

$\mathrm{X} = \min\{-(REVT - EXPT), (REVR - EXPR)\} > 0$

$XSUB = \delta X$