FACULTY DEMAND IN HIGHER EDUCATION

By

Danielle Rosenthal*

*Danielle Rosenthal is a sophomore in the School of Industrial and Labor Relations at Cornell University.
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Background Information and Objectives

Conventional microeconomic theory tells us that demand curves typically have negative slopes, demonstrating that as wages rise, less labor is demanded by firms in any given market. The explanation for this phenomenon is two-fold. First, as wages rise, firms must pass the incremental cost of the wages onto their customers, resulting in higher prices and lessened demand for the product. As product prices increase, customers are apt to buy fewer products, and consequently firms are motivated to reduce both their level of output and employment. Secondly, higher labor costs stimulate firms to substitute capital for other less cost-intensive modes of production for workers, subsequently decreasing employment levels as well.

This study analyzes the law of demand as it applies to private not-for profit institutions of higher education. The law of demand tells us that institutions that employ faculty with higher average salaries should have lower faculty-student ratios *ceteris paribus* for the two reasons indicated above. If the average cost of faculty is higher, institutions are likely to cut back on faculty research and course offerings, as well as the number of faculty employed at the school. In addition, high faculty salaries may induce a college or university to substitute teaching assistants for faculty and the use of increased technology, both of which are now relatively less expensive than faculty.

However, if one looks at the simple correlation of average faculty salaries and faculty-student ratios, one finds that those universities that pay higher average salaries to faculty are also those that tend to have high faculty-student ratios. On the surface, this seems to contradict the law of demand, which forecasts that those paying higher salaries would have lower, rather than higher, faculty-student ratios. This finding raises two

questions. First, how can one reconcile the upward sloping faculty demand curve with the traditional principles governing the theory of labor demand? Second, is it possible to estimate demand curves for faculty in a way that would produce a downward sloping function of their salary levels? In simplest terms, the theory of demand predicts a negative relationship between employment and wages, holding other factors constant, and the simple correlation between faculty salaries and faculty student ratios fails to hold other factors constant.

The objective of this study is to identify the factors that shift the demand curve for faculty at not-for-profit private institutions. It is unique in that to my knowledge no other study has directly addressed the question of how the positive correlation between average faculty salaries and faculty-student ratios can be reconciled with the theory of the demand for labor. The hypothesis of this paper is that "richer" universities with greater revenues per student will have a higher ratio of faculty to students *ceteris paribus* because they use a portion of their additional income to increase their number of faculty relative to the number of students enrolled at the school. Furthermore, all else equal, institutions with higher tuition and fees per student will have a higher ratio of faculty to students, meaning that students are effectively paying to have small classes and greater faculty-student interaction.

It is further predicted that those institutions with higher percentages of full time students will have higher ratios *ceteris paribus*, given that part-time students are likely to take fewer classes and demand less use of faculty resources. Lastly, institutions that predominately grant PhD and Masters Degrees as opposed to Baccalaureate Degrees will be associated with higher student faculty ratios *ceteris paribus*. This hypothesis is based

on the assumption that faculty members at PhD and Masters granting institutions have a greater number of responsibilities than faculty members at baccalaureate schools, where their major responsibility is to teach. Because baccalaureate faculty members have a narrower set of responsibilities, a much smaller number are needed for the same level of enrollment as at a PhD or Masters granting school.

Once revenue, tuition and fees, the percentage of part time students, and the type of institution are taken into account, it will be possible to estimate demand curves for faculty as a downward sloping function of faculty salary levels. Average compensation, rather than average salary, is hypothesized to better predict faculty-student ratios as it is a more comprehensive measure of the cost of each faculty member to the institution and I also estimate equations that use average compensation rather than average salary.

Data

The sample size consisted of 400 private, not-for-profit higher education institutions that award four year degrees, for which there was sufficient data. Data was collected from *Academe*, CAE Data Miner, and the IPEDS Peer Analysis System. *Academe's* "Annual Report on the Status of the Profession 2005-2006" provided data on the average salary, the average compensation, and the number of full-time full, associate, and assistant professors, as well as instructors, at each institution. The number of professors, associate professors, assistant professors, and instructors were subsequently summed in order to obtain a figure for the total number of full-time faculty. Average salary is defined as the contracted salary excluding summer teaching stipends, extra load, or other forms of remuneration, while compensation constitutes salary plus institutional contribution to benefits. In addition, *Academe*'s institutional categories were used to

classify each school as predominately a PhD, Masters, or Baccalaureate granting institution. Appendix table one summarizes the mean faculty/student ratio, salary, compensation, percentage of full time students, and total revenue and investment return for each institutional category that was analyzed.

CAE Data Miner provided data on total student enrollment at each institution, which is analyzed according to part-time and full-time enrollment. 2004 data was used as it was the most recent year available. CAE Data Miner collects its data through the Voluntary Support of Education (VSE) Survey. The number of full time students was divided by total enrollment to obtain the percentage of full-time students enrolled at the institution. To determine each institution's faculty-student ratio, the total number of full-time faculty at each school was divided by total enrollment.

The IPEDS Peer Analysis System supplied the financial data for each school. Again, 2004 statistics were the most recent data available. The Integrated Postsecondary Education Data System is the core postsecondary data collection system for the National Center for Education System. Finances were measured through total revenues and investment returns, as well as by tuition and fees, private contributions, grants, and contacts, investment returns, and other revenues. The "other revenue" category including money from federal, state, and local appropriations, federal, state, and local grants and contracts, contributions from affiliated entities, sales and services of educational activities, sales and services of auxiliary enterprises, hospital revenue, and independent operations revenue.

Method

Before performing regression analysis, the logarithm of each variable was taken

in order to obtain unimodal, relatively symmetrical distributions. In addition, each of the five financial variables was divided by total enrollment to account for the institution's varying sizes. Afterwards, the six regression models shown below were run.

Model Number	
1	$\ln(FSR) = \beta_1 + \beta_2 \ln(SAL)$
2	$\ln(FSR) = \beta_1 + \beta_2 \ln(COM)$
3	$Ln(FSR) = \beta_1 + \beta_2 \ln(SAL) + \beta_3 \ln(TRI) + \beta_4 \ln(PFT) + \beta_5 PhD + \beta_6$ Masters
4	$\ln(FSR) = \beta_1 + \beta_2 \ln(SAL) + \beta_3 \ln(TAF) + \beta_4 \ln(PRI) + \beta_5 \ln(IVR) + \beta_6 \ln(OTR) + \beta_7 PhD + \beta_8$ Masters
5	$Ln(FSR) = \beta_1 + \beta_2 \ln(COM) + \beta_3 \ln(TRI) + \beta_4 \ln(PFT) + \beta_5 PhD + \beta_6$ Masters
6	$\ln(FSR) = \beta_1 + \beta_2 \ln(COM) + \beta_3 \ln(TAF) + \beta_4 \ln(PRI) + \beta_5 \ln(IVR) + \beta_6 \ln(OTR) + \beta_7 PhD + \beta_8$ Masters
FSR = Faculty student ratio, SAL = Avg. salary, COM = Avg. compensation, TRI = Total revenue and investment returns per student, PFT = Percentage of full time students, PRI = Private gifts, grants, and contracts per student, IVR = Investment returns per student, OTR = Other revenue per student	

The first two simple regression models were designed to analyze the impact of average salary and average compensation levels on the student faculty ratio at private, not-for-profit institutions without controlling for other variables. They are included in the paper to show that when one fails to control for other factors, schools with higher faculty to student ratios will also tend to have higher average salary and average compensation levels. The third regression modeled the impact of total revenues and investment returns per student, the percentage of full time students, the average salary of faculty, and the type of institution on the faculty-student ratio at not-for-profit institutions.

The fourth model considered the total revenue variable by analyzing specifically tuition and fees per student, private contributions, grants, and contracts per student, investment returns per student, and other revenues per student in order to asses the individual impact of different revenue sources. The fifth and sixth regression models are

identical to the fourth and fifth except average compensation is substituted for average salary of faculty members. This substitution was made to test the hypothesis that average compensation levels would better predict faculty-student ratios, as average compensation is a more comprehensive measure of each faculty member's cost to the institution.

Results

Table 1

Estimates of the Determinants of Faculty/Student Ratios in Private Higher Education
(Absolute value of t statistics)

The statistical results of the six regression models are displayed in the table 1 below.

	Model Number					
	1	2	3	4	5	6
Constant	-2.074	-2.126	-2.469	-2.536	-2.412	-2.488
	13.9	13.6	19.4	16.8	18.4	16.3
Avg. Salary	.442		-.210	-.291		
	5.4		2.5	3.5		
Avg. Compensation		.445			-.239	-.325
		5.5			2.9	4.0
Total Revenue and Investment Returns			.344		.349	
			12.1		12.7	
Tuition and Fees				.210		.221
				5.6		5.9
Private Gifts, Grants, and Contracts				.055		.056
				3.4		3.5
Investment Returns				.089		.089
				6.8		6.9
Other Revenue				.097		.098
				5.3		5.3
Full Time/Total Students			.644	.482	.651	.489
			10.0	7.2	10.2	7.5
PhD			.111	.109	.109	.106
			5.9	5.8	5.9	5.8
Masters			.106	.107	.106	.107
			5.6	5.8	5.6	5.8
R^2	6.8%	7.0%	64.8%	68.2%	65.1%	68.5%
N	400	400	400	400	400	400

The first simple regression model shows that without controlling for other variables, private not-for-profit institutions with higher faculty-student ratios do in fact tend to pay higher average salaries. As predicted, the coefficient of average salary was strongly positive. A one percent increase in average salary is associated with approximately a .442 percent increase in the faculty-student ratio. The second model, which substituted average compensation for average salary, again confirmed the initial hypothesis that the coefficient of average compensation would be positive; a one percent increase in average compensation is associated with approximately a .445 percent increase in the faculty-student ratio. Finally, as expected, the model with average compensation in column two has a slightly better "fit" than the model with average salary in column one.

The third regression model analyzed the impact of average salary on the student-faculty ratio, while controlling for the percentage of full time students, the total revenue at the schools, and the type of institution. The R^2 of the regression is equal to 64.8%, which indicates that the model is relatively successful in explaining which factors affect the faculty-student ratio at the analyzed institutions. As predicted, schools with higher total revenue also have higher faculty-student ratios *ceteris paribus*. The coefficient of .344 means that an additional percentage point of total revenue is associated with .344 percentage increase in the student faculty ratio after taking into account the effects of the average salary, the percentage of full time students, and the type of institution. In addition, each additional percentage of full time students is associated with a .644 percent increase in the ratio among schools that pay equal average salaries and have equal levels of total revenue.

When analyzing the impact of the type of institution on the faculty-student ratio, PhD degree institutions are associated with approximately a .111 percent higher faculty student ratio than the omitted category (baccalaureate schools) *ceteris paribus*. Furthermore, masters degree institutions are associated with approximately a .106 percent higher faculty student ratio than the omitted category. Finally, once the effects of the percentage of full time students and the level of total revenue are accounted for, the demand curve for faculty, as predicted, becomes a downward sloping function of average salary levels.

The fourth multiple regression model separates out the multiple components of the total revenue variable and seeks to estimate their independent impacts on the faculty student ratio. These components are tuition and fees per student, private revenue, contracts, and grants per student, investment returns per student, and other revenues per student. The R^2 value of this model is equal to 68.2%, slightly better than the model presented in column three that constrains the effect of each revenue source to be the same.

The model indicates that a one percentage increase in full time students is associated with an approximately .482 percentage increase in the faculty-student ratio *ceteris paribus*. Again, this coefficient was positive, as predicted. Furthermore, after allowing for the effects of the other variables in the model, a one percentage increase in tuition per student is associated with a .210 percentage increase in the faculty-student ratio, a one percentage increase in the private gifts, grants, and contributions per student is associated with approximately an .055 percentage increase in the faculty-student ratio, a one percentage increase in investment returns per student is associated with approximately a .089 percentage increase in the faculty-student ratio, and finally a one

percentage increase in other revenues per student is associated with approximately an .097 percentage increase in the faculty-student ratio. All else equal, PhD institutions are associated with approximately a .109 percent higher, and masters institutions approximately a .106 percent higher, faculty-student ratio over baccalaureate schools. Again, once the effects of the other variables in the regression are accounted for, the faculty demand curve is a downward sloping function of the average salary level.

The fifth and sixth multiple regression models were identical to the third and fourth except for the fact that they were designed to assess the impact of switching the average salary variable with average compensation. The fifth regression model yields an R^2 value of 65.1%, which is slightly better than the R^2 value (64.8%) in model three. Therefore, average compensation only slightly better predicted the faculty-student ratio when accounting for the effects of the percentage of full time students, the total revenue per student, and the type of institution, than did average salary. The sixth, and final, regression model switched average compensation for average salary when total compensation was broken down into the four components discussed at length earlier. Again, the adjusted R^2 value is only slightly better for the average compensation model.

Conclusion

This study looked at factors affecting private not-for-profit institutions' faculty student ratios. The study confirmed that without controlling for revenues and the percentage of full time students, the correlation between either average salary or average compensation level and the faculty-student ratio is positive. However, when a multivariate regression model is estimated, it is affirmed that *ceteris paribus*, a higher percentage of full time students and higher total revenues are associated with higher

faculty-student ratios. This indicates that schools with higher revenues do in fact use a portion of their additional funds to increase their number of faculty relative to their level of enrollment. Furthermore, schools with a higher percentage of part-time, as opposed to full time, students have lower student-faculty ratios, perhaps because these students are apt to take fewer classes and consume faculty members' time. Once the effects of these two factors were taken into account, we do observe the faculty demand curve became a downward sloping function of average salary or compensation, as was predicted.

The study also looked at whether the type of institution, as determined by *Academe*, was associated with higher student faculty ratios *ceteris paribus*. The study found that all else equal, doctorate and masters degree granting institutions are associated with higher faculty-student ratios, as compared to baccalaureate institutions. More research would have to be completed in order to determine why doctorate and masters granting institutions tend to have higher student faculty ratios than baccalaureate schools all else equal. A possible explanation for this finding is that faculty members at such schools have a wide array of responsibilities including research, which requires that the institution hire a greater number of faculty per student.

When the components of total revenues and investment returns were analyzed separately, each of the four components all had positive, significant effects on the faculty-student ratio at private institutions *ceteris paribus*. The level of tuition and fees per student had the strongest effect followed by the level of other revenue per student, investment return per student, and finally and private gifts, contributions, and grants per student. Lastly, I found that average compensation only slightly better predicts faculty-student ratios than average salary levels.

This research paper only looked at non-profit private institutions. Further research should focus on public schools to see if similar results are obtained. Public schools present further complications as many have multiple campuses, and insufficient data exists frequently as to how various revenue streams are split between the different branches of each school. More research would have to be done to find a way to resolve this problem.

Appendix 1

Type of School	Count	Mean Faculty/Student Ratio	Mean Salary (thousands)	Mean Compensation (thousands)	Mean Total Revenue/Student	Mean Full Time/Total Student
PhD	228	.063	60.881	78.070	40,999.9	.877
Masters	112	.048	64.305	82.090	23,775.5	.738
Baccalaureate	60	.053	88.718	112.26	86,121.1	.813