Appendix

Calculating Speed of Adjustment for Faculty Demand

Think about institutions making dynamic faculty hiring decisions to maximize the discounted sum of one period preference functions subject to a long-run budget constraint. Institutions attempt to match faculty numbers in each field proportional to student enrollment where the factors of proportionality will likely differ both by field and by institution. The canonical model of dynamic labor demand in Sargent (1978) can be adapted and applied here.

Let the institution's per period preference function be quadratic in the deviation of actual faculty from "desired" faculty where desired faculty in each field equals the factor of proportionality described above times the best forecast of next period's student demand. The timing assumption is that faculty must be hired a period before the student demand is realized. In the absence of adjustment costs, this set-up would give a very simple decision rule: choose next period's faculty to equal the desired faculty needed to satisfy the best prediction of student demand. Deviations over time in the ratio of faculty to students will be generated entirely by student demand forecast errors. Now add the second ingredient of the Sargent (1978) model: adjustment costs. Mathematical tractability suggests quadratic adjustment costs. The dynamic solution to this problem parallels Sargent's: Faculty demand in any period will be a linear function of last period's faculty plus a term which depends on the forecast of student demand. The adjustment cost adds a second distinct reason for faculty dynamics; the greater the adjustment cost the more actual faculty will deviate from its "long-run" value. If we can represent student demand for a field as a stochastic autoregressive process, faculty demand will be an autoregressive distributed lag function of student enrollment. With parameter estimates from such a representation we can estimate the time pattern of the impacts on numbers of faculty of changes in student demand.

This model is convenient because it is mathematically very tractable. As is well known, however, the quadratic adjustment cost assumption imposes the twin unrealistic assumptions that net and not gross adjustments impose costs and that the costs of decreasing and increasing faculty size are symmetric. Hamermesh (1993) discusses why both of these assumptions are likely to be unrealistic. Anyone who has gone through the hiring process in an economics department knows that not only are adjustment costs not zero, the costs of engaging in enough hiring to keep net changes to the faculty equal to zero are often substantial. The academic tenure system would likely reinforce the asymmetry in adjustment costs.

In this model, faculty demand in any period will be a linear function of last period's faculty plus a term that depends on the forecast of student demand, with adjustment cost adding an additional reason for faculty dynamics—the greater the adjustment cost, the more actual faculty will deviate from its "long-run" value. Empirically, by representing student demand for a field as a stochastic autoregressive process, faculty demand is characterized as an autoregressive distributed lag function of student enrollment, and parameter estimates from such a representation yield the time pattern of the impacts on numbers of faculty of changes in student demand.

Using data on faculty counts from the Oklahoma State Salary Survey combined with data on degrees awarded by field from 1985 to 2001, estimates of autoregressive distributed lag faculty demand functions are presented in Table A1. Column 1 shows a bare bones specification, with faculty this year depending on faculty last year and current and past student demand as measured by BA degrees. The lag length is chosen to satisfy the Bayesian Information Criterion. As we argued above, degrees are not perfect reflectors of student demand because fields and disciplines differ in the degree to which they generate course enrollments relative to majors. However, it is reasonable to assume that the ratio of degrees to course enrollments remains stable over time so that the dynamic behavior of the log of degrees will mimic the dynamic pattern of the log of course enrollments that we do not observe. The large coefficient on lagged faculty implies slow adjustment: the one period impact of a 1 percent increase in student demand implies a .044 percent rise in faculty, while the long run effect of sustained one percent rise would be a 0.6 percent rise in faculty. The response is sluggish, and incomplete, in the sense that these estimates imply that even in the long run faculty does not respond proportionately to changes in student demand.

In equations 2 and 3, fixed effects for discipline groups and for institutions are added. The coefficient on lagged faculty declines, but the short- and long-run impact multipliers are roughly the same as in equation 1. In specifications 4 and 5, we test for the possibility that faculty responses differ by subject. In specification 4, we interact field with lagged faculty, testing the equality of adjustment costs across fields. Both education and social sciences seem to have lower adjustment costs (that is, less dependence on lagged faculty) than other fields. In specification 5, we interact field with contemporaneous BAs and see that education and social science are less responsive, while engineering, science and other professions are more responsive. This result might arise from differences in the stochastic behavior of student demand in those fields.

As one test for the effect of tenure on adjustment speed, we looked at whether the average fraction of tenured faculty in a field-institution cell affects the speed of adjustment in that cell. No evidence of such an interaction effect was found. Differences in tenure across fields and institutions do not show up as differences in the speed of faculty adjustment.

Another hypothesis is that the more university decisionmakers are shielded from the consequences of defying student demand, the less responsive they will be. This suggests that institutions that depend heavily on student tuition revenue will be more “market-oriented” than institutions whose revenues derive more heavily from sources somewhat insulated from student demand such as endowment earnings or tax revenues. A clear test of this notion requires data from a range of institutions including some that depend heavily on student tuition. While there is some variation in tuition dependence in the institutions in our data it is probably insufficient to provide a clear test of this hypothesis.

Table A1
Autoregressive Distributed Lag Models of Faculty on BA Degrees

Dependent variable: log of faculty by year, institution, discipline group

	(1)	(2)	(3)	(4)	(5)
Log faculty (t-1)	.873*** (.014)	.686*** (.023)	.577*** (.027)	.605*** (.024)	.556*** (.027)
Log BA degrees (t)	.044 (.030)	.057* (.031)	.068** (.030)	.066** (.029)	.079** (.031)
Log BA degrees (t-1)	.070* (.040)	.066 (.041)	.062 (.039)	.061 (.038)	.066 (.037)
Log BA degrees (t-2)	.048 (.044)	.062 (.040)	.062 (.040)	.063 (.041)	.057 (.037)
Log BA degrees (t-3)	-.006 (.040)	.005 (.034)	.005 (.037)	.012 (.028)	.006 (.034)
Log BA degrees (t-4)	-.080* (.029)	.014 (.026)	.020 (.028)	.020 (.028)	.018 (.027)
				Interactions with log faculty (t-1)	Interactions with log BA degrees (t)
Education				-.164*** (.043)	-.049** (.022)
Engineering				.025 (.023)	.064*** (.019)
Humanities				-.063* (.032)	.013 (.024)
Professional				.022 (.032)	.056** (..027)
Science				.029 (.023)	.066*** (.022)
Social Science				-.103*** (.022)	-.031* (.018)
Group Fixed Effects	No	Yes	Yes	Yes	Yes
Institution Fixed Effects	No	No	Yes	Yes	Yes

Note: Data are from Oklahoma State Salary Survey and the Integrated Postsecondary Education Data System (IPEDS). There are 3,266 observations for each regression. Robust standard errors in parentheses. *** = 1% significance, ** = 5% significance, * = 10% significance.