Will Increasing Course Loads Save Money?
A Multilevel Analysis and Simulation of Faculty Research Productivity

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Introduction

In the last decade, many commentators inside and outside of higher education have expressed concern with how faculty allocate their time (Bok, 1982; Boyer, 1990; Massy & Zemsky, 1994). As faculty research has received growing negative publicity, policy makers as well as the public have become extremely critical of faculty research activities. Critics of faculty workload come from many different sectors, but their arguments fall into one of three main categories.

First, some scholars believe that the quality of education, especially undergraduate education, has declined in recent years. Numerous studies have shown that faculty devote more and more of their of their time to research (Dey, Milem, & Berger, 1997; Fairweather, 1993; Jacobson, 1992). As a result, faculty have been teaching less, contact with students outside the classroom has declined, and therefore the quality of undergraduate education has suffered (Bok, 1982). Second, some critics have raised basic questions of fairness about faculty activities. Books describing how little faculty work in return for their salaries (Sykes, 1988) and faculty improprieties such as excessive time spent on outside consulting (Braxton, 1999) highlight the concerns that many members of the public have about faculty behavior. Third, as the demands on state revenues have grown over the past decade, state legislators have begun focusing their attention on increasing the productivity of faculty at state-supported universities as an alternative to increased spending (Layzell, 1996; Meyer, 1998).

Taken together, all three arguments suggest a common course of action: increased teaching loads for faculty. As faculty teach more classes, the quality of undergraduate teaching will increase, the privileged status of faculty will end, and states will enjoy reduced budgetary pressures from cost savings. In this context, increased teaching loads for faculty seem to be a simple and easy to implement solution for what ails higher education.

Most faculty members have rejected this course of action as a solution. The American Association of University Professors (AAUP), for example, has argued that larger teaching loads for faculty will result in a *decrease* of quality instruction. In order to maintain a high level of faculty effectiveness in all facets of faculty work, colleges and universities should limit, not increase, the number of courses taught by faculty (AAUP, 2001).

Despite the protests of faculty, state legislators across the country have begun to legislate or are considering legislating both course load amounts and official faculty workload reporting. Some states have passed legislation requiring faculty to teach a minimum of twelve contact hours per week, while others have required faculty to spend a minimum number of hours per week on instructional activities (Meyer, 1998). Over twenty additional states have either mandated course load minimums or have required extensive reporting of faculty work (Hauke, 1994). These efforts have been driven by the belief that significant cost savings would result if faculty, especially faculty at research universities, were required to do more teaching. One study by the Maryland Higher Education Commission (1994) argued that the University of Maryland, College Park, could save $20 million annually if all full-time, tenured and tenure-track faculty were required to teach five courses per year, rather than their currently unregulated teaching load.

Policies regulating faculty work should have a significant impact on faculty productivity. Yet, while many researchers have examined the processes by which faculty workload is measured, few have studied the effects these mandates have on overall faculty research output (Middaugh, 1998). Such an analysis is vital given the substantial revenues generated by faculty research and the likely impact of increased teaching on research activities. A mandated increase in faculty teaching could decrease instructional costs, but these savings might by offset by a concomitant loss in research revenues. Because grant dollars are an important part of an institution's budget, efforts to save money by forcing faculty to teach more could paradoxically cause a loss in revenue.

What would be the impact of policies that require minimum teaching loads? Previous analyses have ignored two important facets of faculty productivity. First, some scholars have ignored likely reductions in research output as faculty work is shifted towards more teaching (Fairweather, 1996; Massy & Zemsky, 1994; Zemsky & Massy, 1990). Teaching course loads and research productivity are examined in isolation by examining only the costs of small teaching loads without taking into account how course loads impact research productivity and grant production. Second, cost savings are calculated across entire institutions (e.g., Maryland Higher Education Commission, 1994) without taking into account the heterogeneous effect of academic discipline. Analyses that demonstrate the number of instructors and teaching assistants who could be replaced if tenured/tenure-track faculty taught more courses assume that these faculty are interchangeable; however, physics faculty cannot teach courses taught by history teaching assistants. Only by calculating shifts in teaching and research at the discipline level can we begin to understand the impact of proposed faculty workload policies.

For this study we consider the sample of faculty from public Research I and II universities in the 1993 National Survey of Postsecondary Faculty (NSOPF) as a "virtual" public research university. We simulate the impact of a mandatory workload policy on both teaching and research productivity using the results of a hierarchical linear model that describes the relationship between teaching and research at the academic discipline level. In doing so we illustrate several important points about understanding the impact of proposed faculty workload policies. First and not surprisingly, teaching workloads vary by discipline. Mandatory workload policies will have a differential impact on disciplines because faculty in some disciplines teach more than others. Second, the relationship between teaching and research varies by discipline, so the impact of mandatory workload policies on research productivity may be minimal in one discipline and yet have a large impact on another. Third, the costs of teaching by adjunct faculty pale in comparison with the amount of grant dollars brought in by faculty not meeting a mandatory workload.

The paper is structured as follows. After reviewing past research on faculty productivity, we first estimate the impact of a mandatory workload policy on the number of courses taught by tenured/tenure track faculty, as well as the reduction in grant dollars generated and refereed journals published. Next, we calculate the amount of money saved by these additional courses taught by looking at the number of courses taught by instructors and lecturers and the cost of their salaries and benefits. We then compare the gains in course savings with the loss in research output. Our results indicate that the impact of minimum teaching loads on faculty activity is much more complex than critics of faculty productivity realize.

Review of the literature

The controversy over faculty productivity and the "academic ratchet"

Recent research indicates that faculty research productivity has increased significantly over the last three decades (Dey et al., 1997; Milem, Berger, & Dey, 2000). One study reports increases at all institution types in the proportion of time spent on research and teaching between 1972 and 1992. (Milem et al., 2000). Other studies (Bowen, 1977; Cage, 1987; Massy &

Zemsky, 1994) indicate that faculty are spending more time engaged in research activities and less time engaged in instructional activities.

Some scholars have suggested that decreasing course loads have led to more discretionary time among faculty. Massy and Zemsky (1994) conducted one of the best-known studies of faculty work, studying faculty at liberal art colleges and research universities. They suggest that as departmental norms about teaching loads change over time, faculty members have an increasing amount of discretionary time. As a result, faculty spend this discretionary time on research activities and spend less time on instruction and meeting with students. They, along with others (Fairweather, 1996), suggest that faculty reward structures that emphasize research productivity are the reason for such a shift.

This increase in discretionary time, known as the "academic ratchet," has caused numerous critics to argue that teaching activities suffer as faculty spend an increasing amount of time doing research (Massy & Zemsky, 1994). The central theme of the Massy and Zemsky (1994) argument is that decreasing course loads has created a need to hire more faculty, thus "ratcheting up" the costs of higher education.

The growing public concern over how faculty spend their time and the increasing costs of education has caused many state legislatures to respond with mandates of accountability. Of particular interest is the amount of undergraduate teaching. Florida has passed legislation that requires full-time faculty to teach a minimum of twelve contact hours per week (Meyer, 1998). In Colorado, legislators required faculty to spend at least 30 hours a week on instructional activities (Meyer, 1998). Over twenty other states have either mandated course load minimums or have required extensive reporting of faculty work (Hauke, 1994).

Legislatures have also begun to address public concerns about faculty workloads by tying productivity reporting to funding. Over a dozen states now link budget allocations to faculty workloads (Meyer, 1998). With an increase in performance based budgeting, many expect an increasing number of states to link instructional funding to faculty workload (Meyer, 1998).

The impact of proposed mandatory policies

These proposed policies are not without their flaws. One obvious criticism of course load policies is their inability to take into account the different missions of institutions. Several studies (Fairweather, 1993; Milem et al., 2000; Tierney & Rhoads, 1993) have noted the impact that institution type has on how faculty spend their time. The mission of research universities is quite different than liberal arts colleges; therefore, faculty are rewarded differently for their teaching and research productivity at these institutions. Workload policies that do not take into account such differences in mission may significantly affect the functioning of colleges and universities.

A second flaw with such workload policies is their inability to take into account differences in academic disciplines. Cultural differences, as seen in the rewards for the different types of faculty productivity, exist between disciplines. Fairweather (1996), for example, found significant differences between disciplines in rewards for instructional and research productivity. In addition to cultural differences, course demand varies greatly across disciplines. If all faculty were required to teach a minimum number of courses, many disciplines would likely offer far too many courses, and many disciplines would offer too few courses.

The proposed policies to regulate faculty work and previous research on faculty workload often offer a simplistic way of looking at faculty work. They assume that all faculty in all disciplines behave the same way and are unaffected by disciplinary groupings.

However, we can expect a priori that faculty in different fields will behave differently. If this is the case, then traditional statistical analysis techniques become problematic, as faculty within one discipline will resemble one another more than faculty in other disciplines. This clustering effect can have a large impact on substantive results, and only recently have higher education researchers begun to recognize the need to analyze data by taking into account the structures of higher education institutions (Ethington, 1997).

Multi-level modeling techniques allow researchers to appropriately handle the complex organizational effects of colleges and universities and provide the tools necessary to arrive at more accurate results (Bryk & Raudenbush, 1992; Kreft & DeLeeuw, 1998). These techniques take into account the fact that individual-level observations are nested within larger hierarchies such as academic disciplines.

In an earlier work (Porter & Umbach, 2001) we highlight the importance of accounting for the effect of discipline using multilevel modeling techniques when studying faculty work. Our work suggests that simply controlling for discipline with a series of dummy-coded variables (as in a traditional regression model) can lead to biased estimates, while employing a multilevel modeling technique will yield less biased coefficients and standard errors without compromising degrees of freedom. We use our earlier results to investigate the impact of mandatory workload policies.

A model of faculty research

In our previous work we used two dependent variables to measure faculty research productivity: publications over a two-year period and the dollar amount of external research funding. Respondents to the 1993 National Survey of Postsecondary Faculty (NSOPF) were asked about the number of publications in a variety of categories in the two years previous to the survey. We summed the number of articles published in refereed professional or trade journals, creative works published in juried media and chapters in edited volumes into a single measure of refereed publications. The second dependent variable is the total external grant dollars for the 1992-1993 academic year on which the faculty member was a principal or co-principal investigator. Note that this formulation excludes funds from the faculty member's institution, as well as grants on which the faculty member worked as a staff member.

Table 1 displays the results from our previous study. We used variables measuring the academic and demographic background of the faculty member, as well as teaching load and academic discipline to model research productivity (see Porter and Umbach, 2001, for a full description of the variables used). For this study, the variable measuring the number of undergraduate courses taught is of central concern.

For the teaching variables in both models, the more undergraduate courses faculty taught, the less productive they were. Because the dependent variables were logged to ensure normality, the coefficients are difficult to interpret directly. They indicate a substantial impact on faculty research productivity. On average, a one course increase in undergraduate teaching load for an individual faculty member would result in a 52% decrease in the amount of grant dollars received, and a 7% decrease in the number of refereed publications.

Of particular interest when examining results of multilevel models are the intercept and slope variances and their significance. When the intercept is allowed to vary by academic discipline, its relationship with the dependent variable is significant. This would support the notion that discipline is an important variable when examining publication productivity. Most importantly, when the coefficient of undergraduate courses was allowed to vary across disciplines, the relationship was statistically significant. In other words, the multilevel model results indicate that the number of undergraduate courses taught has a *differential* impact across disciplines on both grant dollars received and publications produced. This finding has serious implications for the potential impact of any proposed workload policy, as any policy will have a differential effect across departments within a university.

Method

This study is a follow-up to our previous study (Porter & Umbach, 2001) of faculty work. We take a different approach than previous studies of faculty workload (Dey et al., 1997; Fairweather, 1996; Milem et al., 2000). Our study focuses on the overall impact that policies requiring faculty to teach minimum course loads have on research productivity at an institution, taking into account academic discipline. We attempt to provide an understanding of the complexity of faculty work and the impact that workload mandates have on non-instructional productivity.

The "virtual" public research university

The NSOPF sample offers a unique way to understand the complex results of any mandatory teaching workload policy. Because the NSOPF data represent a stratified sample of faculty from across the United States, by selecting out faculty from public Research I and II institutions we can create a "virtual" university that resembles the average public Research I or II institution. With these data we can then test the impact of increased workloads on research outputs such as grant dollars awarded or articles published, as well as use the individual salary data to estimate any cost savings from the increased teaching by tenured and tenure-track faculty.

The results of such a selection are presented in Table 2. As can be seen, the numbers and distribution of faculty types correspond with what one would see at a large, public state research university. The proportion of courses taught by faculty type also corresponds to other studies of faculty workload (Middaugh, 1998). The sample is almost all faculty in the NSOPF database at public Research I and II institutions. Faculty are classified by whether they were full- or part-time tenured or tenure-track faculty, a department chair, or a non-tenured faculty member. We included all tenured or tenure-track faculty who taught at least one course in the fall 1992 semester. Deleted from the analysis are all department chairs. The resulting N is 1,104 faculty.

Teaching assistants and their teaching workload present a problem because teaching assistants are not included in the NSOPF sampling frame. We derived an estimate of the number of teaching assistants in our virtual university and their teaching load using the national means data from Research I and II institutions in the 1999 Delaware Productivity Study (for more information see Middaugh, 2001). Although the national means are calculated on both private and public institutions, the Delaware Research I and II participants are overwhelmingly publics, so the means should closely correspond with the national averages for public institutions.

We used the proportion of total courses taught by teaching assistants at the academic college level (after creating an academic college structure in the Delaware data similar to the one for the NSOPF data), and applied that to the total number of undergraduate courses taught in each college in the NSOPF data. This amount, 147.1 courses, became the number of courses taught by teaching assistants in our virtual university. We assume that each teaching assistant is held responsible for teaching one course per semester; hence our count of teaching assistants is 147.

Results of the simulation

Although our simulation is based on two national datasets, we believe it is important to emphasize that we are *not* trying to generalize our results to all public Research I and II institutions in the country. What may occur in our particular dataset after an increase in course loads certainly does not mean that one would necessarily see the exact same changes in a particular Research I or II institution, or all Research I or II institutions across the country. Instead, we view our simulation as a heuristic device that can be used to understand the complex outcomes from a simple mandated workload proposal.

Because the simulations become complex, we exclude both part-time tenured and tenure-track faculty as well as chairs. They are excluded because of their unique position vis-à-vis mandated workloads (would such mandates even apply to these faculty members given their time commitments and administrative burdens?). In addition, they would have little impact on the final results even if they were included due to their small numbers.

Our simulation strategy is as follows. First, we calculate the base productivity outputs (teaching, research dollars and publications) for full-time tenured and tenure-track faculty, as well as how these outputs would change under a mandated workload of 2.5 course units for the Fall semester. This formulation closely corresponds to the AAUP (2001) recommendations for faculty workload, which recommend a teaching load of nine hours per week for undergraduate instruction and six hours per week for graduate level instruction.

Second, we calculate the number of courses taught by non-tenured faculty and teachings assistants and their cost in terms of salary at the college level. These data are used to estimate the average cost of courses taught by non-tenured faculty and teaching assistants that would instead be taught by tenured and tenure-track faculty if their teaching workloads were increased.

Third, we combine these data with the increased undergraduate teaching by tenured and tenure-track faculty to estimate the cost savings in teaching under our mandated workload policy, and compare these savings with the loss in grant revenues and institutional prestige (as proxied by the reduction in articles published).

Finally, while it is important to take into account the impact of workload changes at the academic field level, presentation of results for over 100 different fields would be difficult at best. We calculate our simulations at the individual faculty member level, but we aggregate the results to ten different academic colleges for ease of exposition. Enough differences between the academic colleges remain that the differential impact of mandated teaching workloads across academic disciplines is still quite visible.

Table 3 illustrates the impact of the 2.5 course mandatory teaching policy on three faculty outputs: undergraduate courses taught, grant dollars earned, and articles published. The base column describes these outputs under the teaching loads recorded in the NSOPF dataset for each full-time tenured and tenure-track faculty member. Overall, these faculty taught 1,089 undergraduate courses, brought in $92.2 million dollars in grant revenue, and published 1,410 articles in the previous two years.

The column labeled "simulation" lists the outputs after simulating a change in workload to conform to a mandatory teaching policy, using the model results in Table 1 and aggregating the changes in output at the individual level. If faculty taught less than 2.5 total courses (undergraduate plus graduate) in the Fall 1992 semester, their undergraduate teaching load was increased until their total teaching load for the semester equaled 2.5. The impacts are quite dramatic, mirroring some of the individual level results in our earlier paper (Porter & Umbach, 2001). The number of undergraduate courses taught almost doubles, increasing by 1,220 over the original 1,089. Total grant revenues fall by over half, while articles published drop by almost 10%.

How can we determine if these additional 1,220 courses taught are actually needed by the institution? One approach would be to assume that courses taught by non-tenured instructional faculty and teaching assistants represent demand for courses taught by tenured and tenure-track faculty. With this formulation an academic department within the university determines the number of courses that it should be teaching to undergraduates. After a department assigns courses to tenured and tenure-track faculty, any leftover courses are then filled by hiring non-tenured faculty and teaching assistants to teach them. Under a mandatory workload policy, these courses would instead be taught by tenured and tenure-track faculty instead of adjunct faculty.

Table 4 presents estimates of this demand for courses taught by tenured and tenure-track faculty. Demand is listed in the second and third columns of the table. Under this formulation every college has excess demand for courses taught by tenured and tenure-track faculty. The demand as a percentage of total courses taught is listed in the fifth column to provide some idea of the heterogeneity between colleges. Clearly the amount of demand differs greatly between colleges, and this heterogeneity must be taken into account when estimating the impact of any mandatory teaching policies.

The second half of Table 4 estimates the cost of meeting this excess demand for courses. First, from the NSOPF data the annualized salary and benefits for the individual non-tenured instructional faculty in each college are totaled, multiplied by .15 to estimate the cost of benefits at our virtual university, and then halved to correspond to a semester of costs. Second, the number of teaching assistants teaching courses in each college (recall that we assume each teaching assistant teaches exactly one course) are multiplied by $7,500 to estimate the cost of hiring a teaching assistant for a semester. These two figures are combined for each college and divided by the total number of courses taught by non-tenured and teaching assistants to obtain the average cost of fulfilling the demand for one course taught by tenured and tenure-track faculty.

The estimates of additional courses taught by tenured and tenure-track faculty and the excess demand for courses taught by these faculty are compared in the first two columns in Table 5. As can be seen, the additional courses taught almost always surpass the demand. The percentage of demand met is listed in the third column. In only two colleges, Arts and Humanities, is the excess demand not met. This result is not surprising. Faculty in these two colleges tend to have heavier teaching loads than faculty in other colleges, so the mandatory policy does not result in a dramatic increase in number of courses taught. Returning to Table 3, we can see that these two colleges have the two smallest percentage increases in number of undergraduate courses taught under our simulated mandatory workload policy.

The next two columns in Table 5 list course over- and under-supply. In other words, under our mandatory policy are the impacts on each college equal? Are some colleges still facing some excess demand for courses taught by tenured and tenure-track faculty? And if not, how much over-supply of courses occurs?

We can see from Table 5 that the supply varies greatly. Both Arts and Humanities are undersupplied, by 27% and 13% respectively. More dramatically, the oversupply of courses, which could be viewed as “waste” in that the demand for these additional courses does not exist, can be quite large. Agriculture is oversupplied by almost 4,000%, while Natural Sciences is oversupplied by roughly 2,000%.

The amount of money saved by these additional courses taught is presented in the last column of the table. This is calculated by taking the average cost per course from the last column in Table 4, and multiplying it by the demand met in the third column of Table 5. According to our analysis, the overall average cost per course is $9,870. If a faculty member were paid for five courses based on this average, he or she would make just under $50,000 a year.

The overall impact of the simulated teaching policy change is presented in Table 6, which combines data from the previous tables. The loss in grant dollars is listed in the first column, and the cost savings from meeting the demand for courses taught by tenured and tenure-track faculty are listed in the second column. The revenue impact is listed in the third column. This impact is positive for only two colleges, Arts and Humanities. This result occurs because faculty in these two colleges bring in low amounts of grant revenues, so the impact of a mandatory workload policy is minimal. For some of the other colleges, however, the impact is quite large. Engineering and the Natural Sciences, for example, would lose over $15 million dollars each. Overall the institution would lose almost $50 million dollars, even taking into account the savings from having tenured and tenure-track faculty teach additional courses.

The last two columns list other effects on our virtual university. Although prestige is difficult to quantify, research has shown that many quality ratings of universities are strongly correlated with the amount of publications generated (Baughman & Goldman, 1999). Given this, over time our virtual university would likely experience a loss in prestige as faculty publication productivity dropped. Conversely, the large oversupply of courses in some colleges could allow the institution to drastically reduce class size in these colleges. As average class size is one variable used in the college rankings published by U.S. News & World Report, this loss might be offset by an improvement in the rankings.

Limitations of the study

We readily admit that a study of this nature has its limitations. We have created an institution from a random sample of faculty across the United States, which can be problematic. Some of our assumptions about the nested nature of the data, faculty nested within disciplines, may also be weakened based on the fact that respondents are also nested within universities. We have no ability to control for the effect of the university.

Similarly, we have concerns about the simultaneity of our independent and dependant variables. Our statistical models, like most complex models involving survey data, suffer from flaws in the timing of survey responses. We include in independent variables in our model and make assumptions about their relationships with the dependant variables regardless of the obvious temporal constraints. For example, we use courses taught during the fall semester of 1992 and grants awarded for the 1992-1993 academic year to assess the impact of courses taught on grant earning potential. In reality, the work that went into the grant award occurred long before the fall 1992. However, one could also assume that faculty teaching loads remain quite steady and that their ability to earn grants remains stable over time.

Regardless of these limitations, this study is quite instructive. We provide an analysis that has potential implications for policy and research. Using this as a guide, researchers and policy analysts can perform similar studies making certain that our limitations are remedied.

Discussion

As with most studies, our simulation raises many more questions than it answers. What is the appropriate number of courses a faculty member should teach? How should policymakers respond to public concerns about faculty work and the increasing costs of higher education? What responsibility do colleges and their faculty have in terms of how they communicate the complexities of faculty work?

While limited in our ability to answer these questions, the results from our simulation can be quite instructive. As faculty increase the amount of time spent on research and teach fewer courses, most would expect a "ratcheting" up of costs to the institution (Massy & Zemsky, 1994). If one only examines the number of courses taught by a full-time faculty member and derives a total cost savings by simply calculating the money saved on teaching, the resulting savings may be illusionary.

We offer a somewhat contradictory argument. Faculty work has many facets, teaching and research being the most time consuming. Only looking at instructional outputs provides a simplistic view of faculty work and prevents scholars and policymakers from obtaining a full accounting of institutional costs. Our simulation shows what a tremendous impact increasing course loads has on the grant production of faculty. A loss of $50 million dollars, after taking into account the savings of increased teaching loads of tenured and tenure-track faculty, would be significant to any institution. Looking at instructional costs in a vacuum and not considering the impact that course loads have on grant revenues would not reveal such losses.

Additionally, forcing tenured and tenure-track faculty to teach more courses may not be needed in every discipline. In fact, in most disciplines, if faculty are forced to teach a greater number of courses, the results presented here indicate that the supply would not match the demand. Physics faculty might be forced to teach more courses, but many of them would likely be cancelled due to a lack of student demand.

Finally, the relationship between institutional prestige and non-instructional productivity is often overlooked when discussing faculty work. College rankings look to surveys of academic reputation to rank undergraduate institutions and individual graduate program. Publication productivity and grant dollars awarded to faculty undoubtedly affect how respondents assess academic reputation in these surveys. Given the results of our simulation, minimum course load mandates are likely to have an effect on non-instructional productivity and in turn may effect institutional reputation.

Policymakers should certainly view faculty workload reporting as a guide, but they must also look at the larger scope of faculty work when evaluating productivity. Focusing only on undergraduate course loads prevents them from seeing the larger impact that minimum course load requirements can have on an institution. An in-depth analysis of the costs of such mandates would suggest that they are not warranted. In fact, our analysis reveals that mandated course loads could have unintended consequences that would further "ratchet" up the costs of higher education and harm institutional reputations.

In reality, we are dealing with larger issues than simply small course loads. The bigger issue here is public perception. Public distrust of faculty is certainly not new. Colleges and their faculty have long been ineffective in explaining the work of faculty and as a result have been under attack. Faculty and the colleges that employ them would be wise to be more candid in their discussions about their work. However, a part of this discussion should be focused on the purposes of higher education and the role that faculty play in achieving these purposes. Until the public and policymakers understand and support the many purposes of higher education, the work of faculty will always be criticized.

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Table 1. Multilevel Model Results for Research Productivity

	Grant dollars		Publications	
	Coefficient	SE	Coefficient	SE
Slope coefficients (fixed effects)				
Intercept	5.652 **	-1.405	1.693 **	-0.234
Research assistantship	2.092 **	-0.311	0.195 **	-0.052
Scholarship	0.007	-0.295	0.023	-0.05
Ph.D.	0.233	-0.559	0.499 **	-0.091
Professional	0.159	-0.781	0.337 **	-0.13
Opportunity-research	0.398 *	-0.194	0.135 **	-0.033
Opportunity-teach	-0.749 **	-0.197	-0.144 **	-0.034
Full professor	0.837	-0.51	0.427 **	-0.087
Associate professor	0.212	-0.432	0.178 *	-0.074
Years in rank	-0.082 **	-0.028	0.002	-0.005
Courses-undergraduate	-0.729 **	-0.179	-0.077 *	-0.031
Courses-graduate	-0.138	-0.232	-0.025	-0.045
Age	-0.021	-0.027	-0.025 **	-0.005
Non-white	-0.439	-0.472	0.094	-0.08
Married	0.576	-0.488	0.095	-0.083
Female	-1.399 +	-0.742	-0.145	-0.126
Female*Married	1.606 +	-0.868	0.03	-0.147
Female*Children	-0.321	-0.345	-0.004	-0.059
Children	-0.004	-0.131	-0.025	-0.022
Slope variances (random effects)				
Intercepts	9.13 **	-2.533	0.114 *	-0.051
Courses-undergraduate	0.607 *	-0.363	0.024 *	-0.011
Courses-graduate	0.391	-0.568	0.041 +	-0.027
Residual	19.106 **	-0.891	0.557 **	-0.027
Model statistics				
-2 Log likelihood	6785.1		2917.1	
N	1,104		1,104	

Note: ** p<.01, * p<.05, + p<.10.
Source: Porter and Umbach (2001).

Table 2. Productivity by Faculty Type

	N	Courses taught: UG	Courses taught: Grad	Courses taught: Total	Grant dollars	Publications
Full-time tenured/tenure-track	1,103	1,089.2	604.5	1,693.7	$184,429,043	4,714.9
Part-time tenured/tenure-track	32	22.8	7.2	30.0	$20,315,676	104.9
Department chairs	116	62.8	56.0	118.8	$67,484,109	535.4
Non-tenured (instructional)	195	263.0	87.5	350.5	$12,681,098	238.9
Non-tenured (research)	136	0.0	0.0	0.0	$77,143,308	459.8
Teaching assistants	147	147.1		147.1	NA	NA
Total	1,582	1,584.9	755.2	2,340.1	$362,053,234	6,053.9
Full-time tenured/tenure-track	70%	69%	80%	72%	51%	78%
Part-time tenured/tenure-track	2%	1%	1%	1%	6%	2%
Department chairs	7%	4%	7%	5%	19%	9%
Non-tenured (instructional)	12%	17%	12%	15%	4%	4%
Non-tenured (research)	9%	0%	0%	0%	21%	8%
Teaching assistants	9%	9%	0%	6%	NA	NA
Total	100%	100%	100%	100%	100%	100%

Note: all data taken from NSOPF 1993 except for teaching assistants (TA). TA courses taught data are derived from average proportions of total courses taught by TAs (at the college level) for Research I and II institutions in the 1999 Delaware study. TA N is calculated assuming TAs teach one course per semester.

Table 3. Impact of Mandatory Workload on Courses Taught, Grant Dollars, and Articles Published (Full-time Tenured/Tenure-track Faculty)

Courses taught			Difference	
Unit	Base	Simulation	N	%
Agriculture	52.3	229.4	177.1	338.6%
Arts	114.6	155.9	41.3	36.0%
Business	72.2	124.9	52.7	73.0%
Education	51.6	110.4	58.8	114.0%
Engineering	129.2	263.0	133.8	103.6%
Humanities	178.8	306.8	128.0	71.6%
Math & CS	82.9	170.7	87.8	105.9%
Nat'l Sciences	128.1	425.1	297.0	231.9%
Social Sciences	188.1	333.4	145.3	77.2%
All other fields	91.5	189.6	98.1	107.2%
University	1,089.2	2,309.2	1,220.0	112.0%
Grant dollars earned[a]			Difference	
	Base	Simulation	$	%
Agriculture	$9,707,278	$3,772,810	-$5,934,469	-61.1%
Arts	$527,385	$434,413	-$92,972	-17.6%
Business	$6,826,155	$4,343,758	-$2,482,397	-36.4%
Education	$1,808,766	$752,595	-$1,056,171	-58.4%
Engineering	$29,757,421	$14,508,516	-$15,248,905	-51.2%
Humanities	$576,782	$300,974	-$275,808	-47.8%
Math & CS	$2,274,509	$559,929	-$1,714,581	-75.4%
Nat'l Sciences	$29,408,494	$12,521,597	-$16,886,897	-57.4%
Social Sciences	$6,311,530	$1,855,076	-$4,456,454	-70.6%
All other fields	$5,016,756	$389,828	-$4,626,928	-92.2%
University	$92,215,073	$39,439,494	-$52,775,580	-57.2%
Articles published			Difference	
	Base	Simulation	N	%
Agriculture	144	147	3.0	2.1%
Arts	36	33	-3.0	-8.3%
Business	74	68	-6.0	-8.1%
Education	77	68	-9.0	-11.7%
Engineering	171	155	-16.0	-9.4%
Humanities	149	139	-10.0	-6.7%
Math & CS	101	96	-5.0	-5.0%
Nat'l Sciences	355	289	-66.0	-18.6%
Social Sciences	211	193	-18.0	-8.5%
All other fields	92	89	-3.0	-3.3%
University	1,410	1,277	-133.0	-9.4%

Note: Simulations based on coefficients in Table 1 and the 1993 NSOPF data for individual faculty. Faculty teaching load is increased to 2.5 if faculty member taught less than 2.5 courses during the Fall 1992 semester.

[a]Amounts have been halved to convert to a semester basis.

Table 4. Demand for Additional Undergraduate Courses and Related Personnel Costs

	Undergraduate courses taught Fall 1992					Annual salary and benefits*.5		Avg. cost of demand per course unit = (total salary and benefits)/ additional course demand
		Additional demand						
Unit	FT Tenured/ Tenure-track	Non-tenured faculty (instr)	Teaching assistants	Total	Demand as % of total	Non-tenured[a]	TA's[b]	
Agriculture	52.3	3.7	0.6	56.6	7.6%	$47,233	$4,690	$12,004
Arts	114.6	39.0	17.3	170.9	32.9%	$316,395	$129,756	$7,924
Business	72.2	25.0	6.1	103.3	30.1%	$256,742	$46,103	$9,723
Education	51.6	19.3	12.6	83.5	38.2%	$346,934	$94,309	$13,843
Engineering	129.2	15.8	3.0	148.0	12.7%	$211,781	$22,441	$12,464
Humanities	178.8	86.9	60.3	326.0	45.2%	$641,567	$452,320	$7,431
Math & CS	82.9	16.3	15.6	114.8	27.8%	$170,214	$116,780	$9,005
Nat'l Sciences	128.1	10.2	3.9	142.2	9.9%	$197,985	$29,159	$16,123
Social Sciences	188.1	16.4	18.5	223.0	15.6%	$363,968	$138,498	$14,411
All other fields	91.5	30.4	9.2	131.1	30.2%	$391,388	$69,001	$11,626
University	1,089.2	263.0	147.1	1,499.3	27.4%	$2,944,206	$1,103,057	$9,870

[a]Sum of annualized salary for non-tenured instructional faculty from 1993 NSOPF data, plus an additional 15% for benefits.
[b]Calculated as $15,000*number of teaching assistants.

Table 5. Course Demand Met and Personnel Savings With Mandatory Workload

Unit	Demand[a]	Additional courses taught[b]	Demand met		Course over/ under supply		Cost savings (demand met*avg salary and benefits per course[a])
			N	%	N	%	
Agriculture	4.3	177.1	4.3	100.0%	172.8	3994%	$51,924
Arts	56.3	41.3	41.3	73.4%	-15.0	-27%	$327,279
Business	31.1	52.7	31.1	100.0%	21.6	69%	$302,844
Education	31.9	58.8	31.9	100.0%	26.9	84%	$441,242
Engineering	18.8	133.8	18.8	100.0%	115.0	612%	$234,221
Humanities	147.2	128.0	128.0	87.0%	-19.2	-13%	$951,145
Math & CS	31.9	87.8	31.9	100.0%	55.9	175%	$286,995
Nat'l Sciences	14.1	297.0	14.1	100.0%	282.9	2008%	$227,144
Social Sciences	34.9	145.3	34.9	100.0%	110.4	317%	$502,465
All other fields	39.6	98.1	39.6	100.0%	58.5	148%	$460,389
University	410.1	1,220.0	375.9	91.7%	844.1	206%	$3,709,623

[a]From Table 4.
[b]From Table 3.

Table 6. Overall Impact of Mandatory Workload Policy

Unit	Budgetary impact			Other effects	
	Loss in grant dollars[a]	Cost savings in courses taught[b]	Revenue outcome	Loss in articles published[a]	Over-/under-supply of courses[b]
Agriculture	-$5,934,469	$51,924	-$5,882,545	3	173
Arts	-$92,972	$327,279	$234,307	-3	0
Business	-$2,482,397	$302,844	-$2,179,553	-6	22
Education	-$1,056,171	$441,242	-$614,929	-9	27
Engineering	-$15,248,905	$234,221	-$15,014,683	-16	115
Humanities	-$275,808	$951,145	$675,337	-10	0
Math & CS	-$1,714,581	$286,995	-$1,427,586	-5	56
Nat'l Sciences	-$16,886,897	$227,144	-$16,659,753	-66	283
Social Sciences	-$4,456,454	$502,465	-$3,953,989	-18	110
All other fields	-$4,626,928	$460,389	-$4,166,539	-3	58
University	-$52,775,580	$3,709,623	-$49,065,957	-133	844

[a]From Table 3.
[b]From Table 5.