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Grades, Course Evaluations, and Academic Incentives

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We develop a model that identifies a range of new and somewhat counterintuitive results about how the incentives created by academic institutions affect student and faculty behavior. The model provides a theoretical basis for grade inflation and the behavioral response of students. Comparative statics are used to analyze the effects of institutional expectations placed on faculty. The results show that placing more emphasis on course evaluations exacerbates the problems of grade inflation and can even decrease a professor's teaching effort. Increased emphasis on research productivity also decreases teaching effort and provides a further incentive to inflate grades. We use the model to analyze how grade targets can control grade inflation and align professorial incentives with institutional objectives. We also discuss the implications of the model for hiring, promotion, and tenure.
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INTRODUCTION

At the end of an academic term, students fill out course evaluations and faculty assign grades. The proximity of these events makes it natural to wonder whether they are linked. In particular, can professors improve evaluations by grading more easily? And if so, what are the implications for students, faculty, and academic institutions? We address these questions in the context of a simple theoretical model and demonstrate that the link between grades and evaluations can lead to grade inflation, diminished student effort, and a disconnect between institutional expectations and faculty incentives.

We assume that students value the educational quality of their classes, in addition to time spent on other activities and future earnings. Professors, in turn, are assumed to value the education of students but also understand that tenure and promotion decisions are based on research output and course evaluations. We show that if evaluations reflect a broader measure of overall student welfare, which includes educational quality, leisure, and future income, lenient grading offers a low-cost means of boosting course evaluations without sacrificing time for research.

Beyond the basic setup of the model, our main contribution is to demonstrate how the interaction between students and professors can lead to a divergence between an institution's academic goals and the actual behaviors that its incentives induce. Academic institutions and individual departments create incentives for faculty by choosing how much emphasis to place on teaching and research in promotion and tenure decisions. Faculty, in turn, set incentives for students through designing the structure of a course and establishing grading standards. If instructors use grades to influence evaluations, the incentives become linked, creating the possibility for perverse responses to institutional policies.

We identify a range of new and seemingly counterintuitive insights about how an institution's promotion criteria may affect student and faculty behavior. First, we find that as institutions seek to improve teaching quality by placing more weight on course evaluations, professors respond by relaxing grading standards and possibly even teaching effort. Second, students react to the changes in grading policy and teaching effort by adjusting the time they spend studying. Interestingly, the adjustment of study effort to grade inflation need not be negative. In fact, under reasonable assumptions, students may actually increase their effort in response to grade inflation, a response that follows from the potential for more stringent grading to discourage students who have little to gain from higher grades. Third, increased emphasis on research also contributes to grade inflation, as it induces professors to allocate time away from teaching and to offset the resulting decline in course evaluations by raising grades.

These findings suggest that grade inflation can arise from an institution's efforts to improve teaching quality, research productivity, or both. This is not to suggest, however, that grade inflation is a necessary concomitant of an institution's efforts to improve quality. Grade targets, as we show, can effectively restrain grade inflation by aligning professorial incentives with institutional objectives.

Our final set of results relate to the implications of the model for hiring, promotion, and tenure. We show that professor heterogeneity provides one channel through which institutions can adjust research and teaching quality without exacerbating grade inflation. The model demonstrates the importance of recruiting faculty whose preferences for research and teaching are closely aligned with institutional goals. The alignment of professorial preferences with institutional goals also plays an important role in determining a professor's behavior after tenure. While the model demonstrates the possibility for enhanced or diminished teaching and research, a clear prediction is that we should expect more stringent grading.

BACKGROUND

Studies examining the time-series evolution of grades in US academic institutions find that inflation began in the 1960s and continued unabated through the 1990s (e.g., Levine and Cureton 1998; Kuh and Hu 1999). Average grades at Duke, Northwestern, and the University of North Carolina, for instance, increased 0.18–0.24 points per decade on a 4.0 scale (Rojstaczer 2005). Figure 1 plots the average GPAs over time for five representative institutions. With the exception of the University of Washington, all of the schools experienced substantial grade inflation during the 1990s, and those institutions with the highest grades exhibited the highest rates of inflation. The tendency for institutions with higher initial grades to experience higher inflation holds across a wider sample of schools and helps explain the widely reported statistic that 91 percent of Harvard undergraduates graduated with honors in 2001 (Healy 2001).

Grade inflation is considered problematic because it leads to grade compression at the upper end of the distribution. As grades become more compressed, they lose their usefulness as a signal of effort and ability, both in terms of an external signal to employers and graduate schools, and as an internal signal to the students themselves. Chan et al. (2002) examine the role of grade as an external signal and

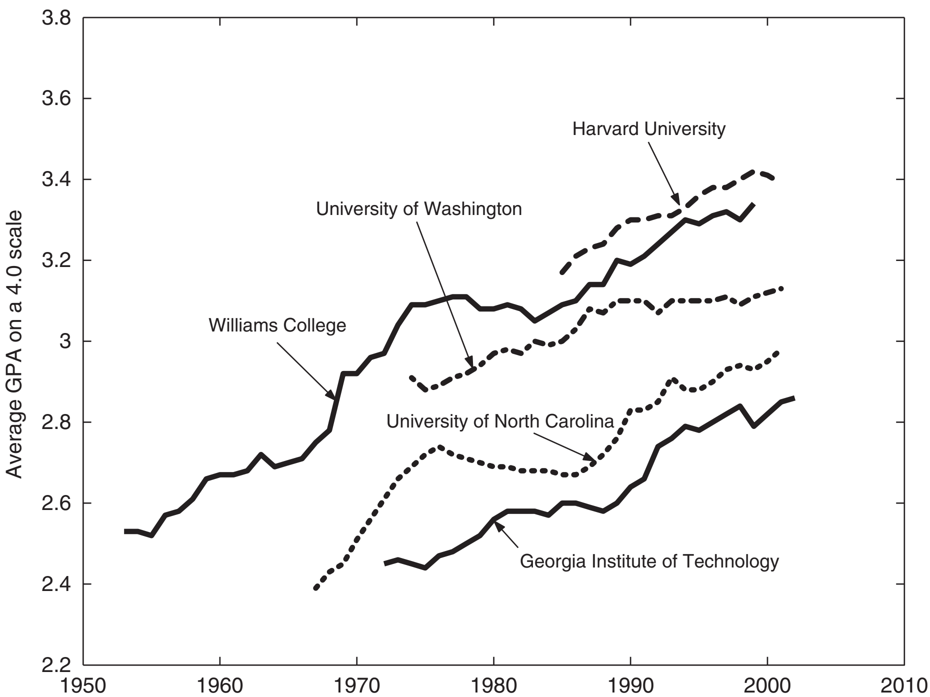

Figure 1. Grade inflation trends for selected schools. Data taken from Rojstaczer (2005).

argue that grade inflation arises as universities exploit the noisiness of the signal to improve the job prospects of weaker students. The role of grades as an internal signal is highlighted in a study by Sabot and Wakeman-Linn (1991), which finds that differential grading distorts the allocation of students across courses and disciplines. Bar et al. (2006) find that this tendency for students to locate in easier courses leads to compositional grade inflation as less stringent courses account for a larger share of enrollments.

Grades are the means by which teachers evaluate students, but students also evaluate teachers. Studies investigating the validity and biases of student evaluations of teachers (SETs) abound in the education literature, with most finding a strong, positive correlation between grades and student ratings.[1] While many researchers accept the evidence on correlation, some are skeptical that it represents a bias. Instead, these researchers appeal to one of several theories positing a third intervening variable that affects the other two. These theories typically involve some variation of the teacher effectiveness theory (e.g., Costin et al. 1971; McKeachie 1997), which argues that students learn more from effective teachers and are deservedly rewarded with higher grades.

Although the teacher effectiveness theory may explain some of the correlation between grades and SETs, it does not explain all of it.[2] An alternative theory that is consistent with much of the empirical evidence is the grade-leniency theory, which posits that students reward professors who reward them with easier grades (McKenzie 1975). A less cynical interpretation of the relationship between expected grades and SETs, but one that derives fundamentally similar implications, invokes attribution bias — the tendency to attribute success to ourselves but failure to others. Both the grade-leniency and attribution-bias theories receive empirical support in Johnson's (2003) exhaustive study of grade inflation. Overall, the empirical evidence clearly suggests that grade inflation exists and that grades influence SETs.

The literature on academic standards identifies future wages as an important channel through which grades might directly affect student welfare and thereby influence evaluations. The translation of a student's study effort into higher future wages depends fundamentally on the standards set by the educational institution. How these standards are set, however, depends on the institution's objective function. Costrell (1994) uses a theoretical model to demonstrate that institutions seeking to promote greater equality will tend to promote laxer standards than those that attempt to maximize aggregate income. Betts (1994) shows, however, that this result does not necessarily hold in a world of heterogeneous ability. When abilities differ, tighter standards can actually improve the labor market outcomes of both the most- and the least-qualified individuals who continue to meet the threshold standard.

In the model that follows, we refrain from specifying the institution's objective function and instead focus on the effect of an institution's policies on academic incentives. We assume that institutions value some combination of teaching and research, that students value grades because of their correlation with future wages, and that professors take account of both the incentives created by their institutions and the behavioral responses of their students. The setup of our model is most similar to that in Kanagaretnam et al. (2003). The main difference is that their paper focuses on the normative aspects of course evaluations, while our paper focuses on behavioral interactions between students, professors, and institutions. Moreover, a distinguishing feature of our model, which is important for the results, is that professors are treated as more than just teachers in that they face demands on their time due to research expectations.

THE MODEL

We model the interaction between a representative student and his professor. The student allocates time between studying and other activities to maximize utility, which is a function of future wages, leisure, and the quality of instruction. We assume that future wages are a function of grades so that the professor's grading standard enters implicitly into the student's problem. The professor recognizes that more lenient grading might improve course evaluations and therefore prospects of tenure and promotion. But she also cares about the student's effort, which may or may not be increasing in the ease of her grading. The professor maximizes her own utility by choosing a grading standard and an allocation of time spent teaching and doing research. The framework is meant to be the simplest possible to demonstrate the important interactions between students, professors, and, as we show in the next section, academic institutions.

The student

The student has preferences over his future earnings, the time available for other activities, and the quality of the professor's instruction. We assume that future earnings w are an increasing function of the student's grades g, so that we have the function $w(g)$. Grades are determined by two factors: the amount of time t he spends studying, and the professor's grading ease, measured by a variable $\bar{g}$, which lies in the interval $[0, 1]$. We write the student's grade g as a function of these two arguments:

$$g = g(\bar{g}, t) \tag{1}$$

where g is strictly increasing, concave, and additively separable.[3] The other activities that the student values include other courses, athletics, or simply leisure. We denote time spent on all other activities as l. Normalizing the time available to the student to 1 yields the constraint $t + l = 1$.

The student's preferences are represented by a utility function of the form

$$u^s = u^s(w, l, e) \tag{2}$$

where e is the quality of the professor's instruction (or educational quality) measured in terms of the professor's preparation effort. We assume that u^s is strictly increasing, strictly concave, and additively separable.[4] The inclusion of e in the student's utility function captures the uncontroversial notion that, all else constant, the student prefers to be taught by a more prepared professor. The student's utility maximization problem can be written as

$$\max_{0 \leqslant t \leqslant 1} u^s(w(g(\bar{g}, t)), 1 - t, e) \tag{3}$$

To focus on the interesting results, we assume this maximization problem is globally concave and that we have an interior solution. The first-order condition can be written as

$$u^s_w w_g g_t = u^s_l \tag{4}$$

where subscripts denote partial derivatives. This expression implies that the student splits time between studying and other activities so that the marginal benefit from increasing his grade, and therefore his earnings, equals the marginal opportunity cost of time spent on other activities. The unique solution can be written as a function of the professor's grading ease:

$$t^* = t(\bar{g}) \tag{5}$$

It follows, using the implicit function theorem, that changes in the professor's grading ease will affect the student's study time according to

$$t^*_{\bar{g}} = -g_{\bar{g}} g_t (u^s_{ww} w_g^2 + u^s_w w_{gg}) \Theta \tag{6}$$

where $\Theta < 0$ is the inverse of the second-order condition. The sign of the overall expression will be the same as the sign of the sum in parentheses. The only term with an indeterminate sign is w_{gg}. If it is negative, so that the wage function is concave, the overall expression is negative, and study time is a decreasing function of $\bar{g}$. The intuition for this result is that a boost to the student's grade substitutes for study time, causing a shift toward other activities. An important implication of this, which we revisit later, is that grade inflation can cause a reduction in the student's time spent studying.

If, on the other hand, the wage function is sufficiently convex, expression (6) will be positive. For this to happen, future income must exhibit increasing returns over some range of grades. This would occur, for example, in cases where the chance of receiving a particular job offer (or admission to graduate school) depends on having near-perfect grades, as in many high-paying professions such as investment banking, corporate law, or medicine. In such cases, a student whose grades are near the threshold would have an incentive to put even more effort into a course in which grading is comparatively lenient, as the cost of crossing the threshold becomes lower. The flip side of this result — discouragement in the face of tougher grading practices — is also of interest. When grade ease pushes students further from the threshold, they might simply give up and spend less time on their studies.

The professor

The professor has preferences over her course evaluation, research productivity, and concern for the student's education. The professor can influence the student's learning investment (measured in terms of study time) with her choice of $\bar{g}$, as shown in equation (6). She also knows that her choice of $\bar{g}$ as well as e will affect the student's level of satisfaction and therefore her course evaluation. We assume the student's course evaluation is determined by a function

$$v = v(\bar{g}, e) \tag{7}$$

that is strictly increasing, concave, and additively separable. This function can be thought of simply as the indirect utility function of the student, where well-being depends on the given levels of $\bar{g}$ and e. The specification of the evaluation function is consistent with either of the two competing theories of grade inflation discussed above: the grade attribution theory, in which students interpret good grades as a reflection of their own performance but attribute bad grades to poor instruction, and the grade leniency theory, in which students reward easier professors with good evaluations.

Beyond the professor's interaction with the student, she also cares about her research productivity, denoted r. There is a tradeoff between the professor's time spent on research and time spent on course preparation. Normalizing the professor's time to one, she faces the time constraint $e + r = 1$.

The professor's preferences are represented by a utility function of the form

$$u^p = u^p(v, r, t; \alpha, \beta) \tag{8}$$

which we assume is strictly increasing, strictly concave, and additively separable in v, r, and t. The inclusion of t in the professor's utility function recognizes that the professor enjoys teaching a harder-working student.[5] The parameters α and β characterize the institution where the professor is employed. Specifically, α is an indicator of the institution's teaching expectations, and β is an indicator of the institution's research expectations. We specify the relationship between the institution's expectations and the professor's preferences as follows: $u^p_{v\alpha} > 0$ and $u^p_{r\beta} > 0$. If the professor is at an institution with higher teaching expectations, her marginal utility from the course evaluation is greater. In a parallel manner, if the professor is at an institution with higher research expectations, her marginal utility from research productivity is greater. Note that differences in both α and β can be used to characterize institutions along two dimensions: the relative expectations of teaching and research (i.e., the ratio α/β), and the combined expectations of both. We will exploit this feature of the model after considering the professor's problem.[6]

Nesting the student's problem within the professor's utility maximization problem yields

$$\max_{0 \leqslant \bar{g}, e \leqslant 1} u^p(v(\bar{g}, e), 1 - e, t^*(\bar{g}); \alpha, \beta) \tag{9}$$

Letting μ and φ denote the multipliers associated with the Lagrangian L, the Kuhn–Tucker first-order conditions can be written as

$$\begin{aligned}
&\frac{\partial L}{\partial \bar{g}} = u_v^p v_{\bar{g}} + u_t^p t_{\bar{g}}^* - \mu \leqslant 0, && \bar{g} \geqslant 0, && \bar{g}\frac{\partial L}{\partial \bar{g}} = 0\\
&\frac{\partial L}{\partial e} = u_v^p v_e - u_r^p - \varphi \leqslant 0, && e \geqslant 0, && e\frac{\partial L}{\partial e} = 0\\
&1 - \bar{g} \geqslant 0, && \mu \geqslant 0, && \mu(1 - \bar{g}) = 0\\
&1 - e \geqslant 0, && \varphi \geqslant 0, && \varphi(1 - e) = 0
\end{aligned} \tag{10}$$

These conditions provide some intuition for the possible corner solutions. If the constraint on the upper bound for $\bar{g}$ is binding (i.e., $\mu > 0$), then $\bar{g} = 1$, which can arise for two different reasons. If $t_{\bar{g}}^* < 0$, the marginal benefit of an increase in the professor's evaluation can be greater than the marginal cost associated with a reduction in the student's effort. Alternatively, if $t_{\bar{g}}^* > 0$, there is simply no cost to the professor of laxer grading. If the time constraint is binding (i.e., $\varphi > 0$), the professor spends all her time preparing for class because the marginal benefit from increasing her course evaluation is greater than the marginal opportunity cost of doing research. In contrast, if the professor spends no time on course preparation, then $\varphi = 0$, and the marginal benefit of an improved course evaluation will generally be less than the marginal opportunity cost of doing research.

For the case of interior solutions, which require $t_{\bar{g}}^* < 0$, the professor chooses $\bar{g}$ to equate the marginal benefit of an improved course evaluation with the marginal cost of diminishing the student's incentive to work. Moreover, the professor chooses her level of teaching preparation to equate the marginal benefit of an improved course evaluation with the marginal cost of lower research productivity. We assume the Hessian matrix associated with this problem is negative definite, which guarantees that the first-order conditions define a unique $\bar{g}^*$ and e^* that maximize (9). Together, these conditions implicitly define the professor's optimal choices as a function of the exogenous institutional parameters:

$$\bar{g}^* = \bar{g}(\alpha, \beta) \quad \text{and} \quad e^* = e(\alpha, \beta) \tag{11}$$

INSTITUTIONAL EFFECTS

In this section, we analyze the comparative static properties of the model to show how changes in institutional policies affect the behavior of students and professors. We begin by considering how the professor's optimal behavior depends on institutional teaching expectations. A change in α will affect the professor's choice of $\bar{g}$ such that

$$\frac{\partial \bar{g}^*}{\partial \alpha} = u_{v\alpha}^p v_{\bar{g}} (u_v^p v_{ee} + u_{rr}^p) \Omega \geqslant 0 \tag{12}$$

where $\Omega = -1/(\det H)$ and H is the Hessian matrix of the professor's optimization problem. The sign of this expression is positive since $u_{v\alpha}^p v_{\bar{g}} > 0$, both terms in the parentheses are negative, and $\Omega < 0$ by the negative definiteness of the Hessian matrix. An increase in institutional teaching expectations therefore provides an incentive for the professor to inflate grades. The weak inequality accounts for the possibility that the professor is already at the corner of a solution where grades cannot be further increased.

What about the effect of increased teaching expectations on the professor's teaching effort? Intuition would suggest that the professor would spend more time preparing. While this may in fact occur, it is interesting to note that it need not be the case. Consider the comparative static

$$\frac{\partial e^*}{\partial \alpha} = u^p_{v\alpha} v_e (u^p_v v_{\bar{g}\bar{g}} + u^p_{tt} t^{*2}_{\bar{g}} + u^p_t t^*_{\bar{g}\bar{g}}) \Omega \tag{13}$$

The sign of all terms is known except for $t^*_{\bar{g}\bar{g}}$. The sign of equation (13) will be unambiguously positive if $t^*_{\bar{g}\bar{g}} \leqslant 0$. This is the intuitive case, whereby an increase in teaching expectations increases the professor's teaching effort. But if $t^*_{\bar{g}\bar{g}} > 0$, and the magnitude is sufficiently large, the sign of the overall expression will be negative. Although this is admittedly an extreme case, it is nevertheless possible and generates a counterintuitive result: increasing institutional teaching expectations can actually decrease the professor's teaching effort.

The reasoning behind this counterintuitive result is the following. We have already established that the professor will increase grades in response to an increase in teaching expectations. The utility cost to her of doing so may be that the student spends less time studying. Yet if the change in the student's study time is decreasing at a decreasing rate (i.e., $t^*_{\bar{g}\bar{g}} > 0$), this utility cost is getting smaller on the margin, creating a further incentive for her to increase grades. If this effect is sufficiently large, the professor will take advantage of the boost in her evaluation from the higher grade by reducing teaching effort to create more time for research.

Now consider changes in the institution's research expectations. A change in β will affect the professor's choice of the grading variable and teaching effort such that

$$\frac{\partial \bar{g}^*}{\partial \beta} = u^p_{r\beta} u^p_{vv} v_e v_{\bar{g}} \Omega \geqslant 0 \tag{14}$$

and

$$\frac{\partial e^*}{\partial \beta} = -u^p_{r\beta} (u^p_{vv} v^2_{\bar{g}} + u^p_v v_{\bar{g}\bar{g}} + u^p_{tt} t^{*2}_{\bar{g}} + u^p_t t^*_{\bar{g}\bar{g}}) \Omega \leqslant 0 \tag{15}$$

where the sign of equation (14) follows from the concavity assumptions, and the sign of equation (15) follows from negative definiteness of the Hessian matrix. The intuition is straightforward. In response to greater research expectations, the professor wants to spend more time doing research. The only way she can accomplish this is by spending less time on teaching preparation. As a result, she increases grades to compensate for the negative effect of diminished teaching effort on her course evaluation. These results indicate that, in addition to higher teaching expectations, higher research expectations also contribute to grade inflation. Holding teaching expectations constant, institutions with greater research expectations will generate both more research and more grade inflation.

Now consider how changes in an institution's teaching and research expectations will affect the student's behavior. Referring back to the student's problem, we established that the student's choice of t^* will depend on the grading ease. But as

Table 1 Institutional effects on professor and student behavior

Institutional policy	*Professor*		*Student*
	Grade variable ($\bar{g}$*)	*Teaching effort* (*e**)	*Study time* (*t**)
Teaching emphasis (α)	+	+ or –	+ or –
Research emphasis (β)	+	–	+ or –

the professor's choice of $\bar{g}$ will depend on the institutional parameters α and β, the student's choice of t^* is an implicit function of these parameters as well:

$$t^* = t(\bar{g}^*(\alpha, \beta)) \tag{16}$$

We can differentiate this expression to determine how the student's optimal study time changes with the institutional parameters. First consider a change in α:

$$\frac{\partial t^*}{\partial \alpha} = t^*_{\bar{g}^*} \frac{\partial \bar{g}^*}{\partial \alpha} \tag{17}$$

We have shown how increasing teaching expectations induce the professor to inflate grades, but the sign of $t^*_{\bar{g}^*}$ can be either positive or negative. Thus, an increase in teaching expectations can either increase or decrease student effort. The result of a change in β follows a similar pattern:

$$\frac{\partial t^*}{\partial \beta} = t^*_{\bar{g}^*} \frac{\partial \bar{g}^*}{\partial \beta} \tag{18}$$

The professor responds to increased research expectations by shifting more time away from teaching and toward research, causing a decline in evaluations. In order to compensate for this effect, the professor inflates grades, but the effect on student effort once again depends on the sign of $t^*_{\bar{g}^*}$.

Table 1 summarizes the comparative static results that we have shown thus far. We see that increasing institutional expectations of either type will always result in higher grades. But the effect on student effort can go either way and will depend on properties of the wage function. Cases in which higher grades decrease student effort provide a theoretical basis for the following description of the student-professor relationship:

> Richard H. Hersh, former president of Trinity College and Hobart and William Smith Colleges, refers to this situation as a "mutual nonaggression pact." Professors see teaching as a requirement they have to fulfill to do the research they prefer, he says, "so the professor goes into class and doesn't ask much of students, who in return don't ask much of the professor. The professor gives out reasonably high grades as a way of camouflaging that this bargain has been struck, his evaluations will be satisfactory, and students don't complain about grades or about whether they've learned much" (Merrow, 2005).

A further result that is particularly counterintuitive is that an increase in the emphasis on course evaluations can potentially *decrease* teaching effort. Presumably, the primary motivation for institutions placing greater emphasis on course evaluations is to improve teaching quality for their students. Despite this intent, our results suggest that the opposite may occur, because of the added incentive for grade inflation.

GRADE TARGETS

We now consider a straightforward extension of the model to account for grade targets, which is one mechanism that some institutions use to address grade inflation. Grade targets are designed to suggest — or even require — grade distributions for individual classes. Consider the actual policy for an institution that we leave unnamed:

> In 2000, the faculty passed legislation mandating regular reporting to the faculty of the mean grades in their courses. In consequence, at the end of the semester, every faculty member receives from the Registrar a grade-distribution report for each course he or she has taught. This report places the mean grade for each course in the context of a set of suggested maximum mean grades: 100-level courses, 3.2; 200-level courses, 3.3; 300-level courses, 3.4; 400-level courses, 3.5; where A = 4.0, B = 3.0, C = 2.0, D = 1.0. These suggested **maximum** mean grades reflect the averages that prevailed at [institution name] during the mid-1990s. The intent of the guidelines is to recommend **upper** limits for average grades, so that faculty can aim to avoid grade inflation in the normal course of their grading.

How do such grade targets affect the results of the model? Assuming the policy is binding, the professor's choice of the grading variable must equal the target. We write this constraint as $\bar{g} = \bar{g}^T$. Rewriting the professors problem in equation (9) with this constraint yields

$$\max_{e} \; u^p(v(\bar{g}^T, e), 1 - e, t^*(\bar{g}^T); \alpha, \beta) \tag{19}$$

Now the professor has lost a degree of freedom and must maximize utility by choosing only her level of teaching effort. Assuming an interior solution, the optimal level of effort continues to satisfy the same first-order condition, but the solution is conditional on the grade target $\bar{g}^T$. The professor's choice of teaching effort now depends on three exogenous parameters:

$$e^* = e(\alpha, \beta, \bar{g}^T) \tag{20}$$

With this function, we can analyze the effects of changing the institutional parameters α, β, and $\bar{g}^T$. Applying the implicit function theorem, we have the following results:

$$\frac{\partial e^*}{\partial \alpha} = u^p_{v\alpha} v_e \Phi > 0, \quad \frac{\partial e^*}{\partial \beta} = -u^p_{r\beta} \Phi < 0, \quad \text{and} \quad \frac{\partial e^*}{\partial \bar{g}^T} = u^p_{vv} v_g v_e \Phi < 0 \tag{21}$$

where $\Phi = -(u^p_{vv} v_e^2 + u^p_v v_{ee} + u^p_{rr})^{-1} > 0$. These results are all intuitive. Increasing teaching expectations increases teaching effort. Increasing research expectations increases research effort at the expense of teaching effort. Finally, relaxing the grade-target constraint enables the professor to inflate grades to keep evaluations high, while spending more time on research and less time on teaching. These results differ qualitatively from those we encountered previously. The effect of a change in α is now unambiguously positive; that is, with grade targets in place, the institution can unambiguously increase the professor's teaching effort by increasing its emphasis on course evaluations.

Grade targeting also has implications for student behavior. The student's problem remains unchanged, as study time is still a function of only the grading variable. But this variable is now determined by the grade target, so $t^* = t(\bar{g}^T)$. Thus, the institution determines the student's study time with its choice of the grade target. It also follows that with a grade target in place $\frac{\partial t^*}{\partial \alpha} = \frac{\partial t^*}{\partial \beta} = 0$.These results imply that an institution can affect the professor's allocation of time, while leaving the student's allocation of time unchanged. It seems, therefore, that grade targeting is potentially an effective policy. It not only limits grade inflation, but also enables institutions to improve teaching and research productivity without sacrificing student effort.

PROFESSOR HETEROGENEITY

Thus far we have considered heterogeneity regarding institutions, but not regarding professors. Just as institutions vary in the emphases they place on teaching and research, so too do the faculty across these institutions differ in their preferences for teaching, research, and student education. These differences may arise through sorting during faculty recruitment or selection during promotion. In either case, it is straightforward to reinterpret the model to account for both institutional and professorial heterogeneity.

To accomplish this, we need only reinterpret the parameters α and β as functions of institutional expectations and the professor's preferences. Specifically, we can define $\alpha = \max\{\alpha_I, \alpha_p\}$ and $\beta = \max\{\beta_I, \beta_p\}$, where parameters subscripted with I denote the institution's preferences and those with p denote the professor's preferences. This formulation demonstrates that if the institutional expectations exceed the professor's preferences, the institution will influence behavior; otherwise, behavior is determined by the professor's preferences alone. For example, a professor for whom $\alpha_I \leqslant \alpha_p$ and $\beta_I \leqslant \beta_p$ will feel no external pressure to improve her course evaluation or to increase her research productivity.

The specified relationship between institutional expectations and faculty preferences provides two further insights of the model. The first relates to faculty recruitment. While individual departments may have little influence on their institution's overall expectations, they have greater control over their hiring decisions. Accordingly, they can affect teaching and research productivity by recruiting candidates according to α_p and β_p. Although in practice there is a problem of asymmetric information, the institutional expectations of α_I and β_I provide insurance in the form of a lower bound for promotion and tenure.

The second insight that comes from modeling professor heterogeneity relates to the effect of promotion and tenure. To the extent that being promoted or receiving tenure makes a professor less concerned with institutional expectations, we can think of these changes as causing a reduction in α_I, β_I, or both. It follows that in the case where $\alpha_I \leqslant \alpha_p$ and $\beta_I \leqslant \beta_p$, promotion or tenure will have no effect on the professor's behavior, as her own expectations equal or exceed those of the institution. If, however, either of these inequalities do not hold — in which case $\alpha = \alpha_I$, $\beta = \beta_I$, or both — then promotion or tenure will influence behavior. While it is unclear whether we would expect better teaching or more research, it is clear that we would expect more stringent grading.

CONCLUSION

This paper identifies a range of new and somewhat counterintuitive results about how the incentives created by academic institutions can affect student and faculty behavior. The model provides a theoretical basis for grade inflation and shows how an important consequence may be diminished student effort. The results show that increased institutional emphasis on teaching evaluations can exacerbate the problems of grade inflation and inadvertently lower faculty teaching effort. It is also the case that increased emphasis on research productivity decreases teaching effort and provides a further incentive for grade inflation. We find that grade targets can be an effective policy not only because they limit grade inflation, but also because institutions can set expectations to improve teaching and research productivity without affecting student effort. These same objectives can be accomplished with careful attention to hiring, promotion, and tenure decisions. The model generates several predictions that are consistent with the existing empirical literature and that we hope will motivate further empirical studies.

Finally, although this paper is useful for understanding behavioral responses to institutional incentives, it is important to recognize that the normative questions remain unanswered. As institutions change their expectations, we can use the model to predict how students and faculty will respond. But how should institutions set their expectations? Why should some institutions emphasize teaching while others emphasize research? What, if any, are the consequences of emphasizing one or the other? How might competition between institutions affect their choice of grade targets? Such questions get at the important issue of how to define an institution's objective function. Although this topic is well beyond the scope of this paper, an improved understanding of student and faculty behavior is essential for evaluating the tradeoffs that are inherent in the mission of academic institutions.

Notes

1. Detailed surveys of this literature can be found in Feldman (1976), Stumpf and Freedman (1979), Greenwald and Gillmore (1997), and Johnson (2003).
2. Several studies present evidence that is inconsistent with the theory. For examples, see Holmes (1972), Worthington and Wong (1979), Chacko (1983), Nelson and Lynch (1984), Zangenehzadeh (1988), Gigliotti and Buchtel (1990), Greenwald and Gillmore (1997), and Isely and Singh (2005).
3. While grades are often based on a discrete scale, the continuity assumption is not restrictive, as we could reinterpret the grade function to represent a student's expected, rather than actual, grade. In this case, the grade function would characterize probabilities such that more study effort increases the likelihood that a student will achieve a higher grade.
4. We assume additive separability of all functions throughout the paper. We make this assumption because, first, we want to focus primarily on the direct (first-order) effects, and second, because in most cases there is no clear intuition for whether the cross-partial derivatives should be positive or negative.
5. A technical reason for including t in the professor's utility function and e in the student's utility function is that without these assumptions, we would immediately obtain the uninteresting result that the professor chooses the maximum allowable grade and the student expends no effort.
6. Later in the paper we extend the model and discuss the implications of interpreting α and β as representing professorial heterogeneity, in addition to institutional expectations.

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