Grade Inflation under the Threat of Students' Nuisance: Theory and Evidence*

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November 5, 2007

Abstract

This study examines a channel, students' nuisance, to explain grade inflation. "Students' nuisance" is defined by "students' pestering the professors for better grades." This paper contains two parts: the game theoretic model and the empirical tests. The model shows that the potential threat of students' nuisance can induce the professors to inflate grades. Ceteris paribus, a student is more likely to study little and to pester the professor for a better grade if: 1. the professor is lenient; 2. the studying cost is high; 3. the reward from pestering is high; 4. the cost of pestering is low.

My original survey data show that 70%+ of professors think that students' nuisance is "annoying" and "costly in terms of time, effort, and energy." Regression results indicate that the more the student values the grade, the higher the studying cost, and the more likely the student is to pester the professor.

JEL classification codes: D82, I20, I21

Keywords: grade inflation, grade exaggeration, students' nuisance

I Introduction

In the New Testament, Luke 18:2-5,

> In a certain town there was a judge who neither feared God nor cared about men.
>
> And there was a widow in that town who kept coming to him with the plea, 'Grant

*I am grateful to Marigee Bacolod, Dan Bogart, Michelle Garfinkel, Amihai Glazer, Igor Kopylov, and Michael McBride for their valuable comments. I am also thankful to the Office of Institutional Research at UC Irvine for compiling the data.

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> me justice against my adversary.' For some time he refused. But finally he said to himself, 'Even though I don't fear God or care about men, yet because this widow keeps bothering me, I will see that she gets justice, so that she won't eventually wear me out with her coming!'

Grade inflation adversely affects our society. Graduate schools and employers cannot make informed admission or hiring decisions because applicants' grade inflated transcripts are overdramatic. With different degrees of grade inflation existing across academic institutions, it is difficult for graduate schools and employers to evaluate and compare different applicants by merely reading their transcripts. Even ignoring this complication, grade inflation results in "grade compression" at the upper end, and truly outstanding students cannot distinguish themselves from second-best students who receive good grades through inflation (Sabot and Wakeman-Linn, 1991; Rosovsky and Hartley, 2002).

The causes of grade inflation are widely discussed among researchers and educators. Perhaps one of the most common explanations for grade inflation is that professors' attempt to "buy" good evaluations from students for tenure and promotion considerations. Grades directly affect students' well-being, so students rate professors according to the grades received. In order to get better evaluations from students, professors "bribe" students by giving easy A's and B's (McKenzie, 1975; Zangenehzadeh, 1988; Wallace and Wallace, 1998; Krautmann and Sander, 1999; Kanagaretnam et al, 2003).[1]

Of course, researchers might overemphasize the marginal importance of teaching evaluations in tenure and promotion considerations. That is to say, teaching evaluations might play a significant role in the personnel review process at academic institutions that place a relatively

[1]See the literature review in section II for other proposed explanations.

large weight on teaching over research. In research universities, however, research publications, rather than teaching evaluations, are essential in promotion considerations, given that the professor meets some minimum standard in teaching. Therefore, faculty members at such institutions would have a relatively small incentive to improve their teaching evaluations. Nevertheless, faculty members in research universities might inflate grades, not because they desire better teaching evaluations, but because they need more time and energy for research. By inflating grades, a professor can ensure few students will pester her for more points. This way, the professor is able to allocate more time to her own research, which is truly important for her promotion.

This study suggests that, in addition to the desire for a better teaching evaluation and other established causes, grade inflation also results from a potential *threat of students' nuisance*, especially in research universities. I define students' nuisance as "students' pestering the professors for better grades." Anecdotal evidence suggests that, unsatisfied with their grades, college students pester professors to obtain added points. College professors are frequently besieged by persistent students who request upward adjustments of their grades. In some cases, due to grading mistakes, students do have a legitimate reason to make such requests. Yet, there are many cases where the students do not deserve the points they request. Some students do not walk away until they get the points they want. These students are persistent, sending emails to the professor, trying to persuade the professor during class breaks, dropping by the professor's office, making the same requests, or repeatedly asking for regrading of their exams.[2] Nuisance is costly to the professors in terms of time and energy, especially to generally overwhelmed junior faculty who are striving hard for tenure in research universities. Instead of dealing with

[2]See Appendix E.1 for anecdotes collected from professors and TAs in the Department of Economics, UC Irvine.

students' requests, the professors could have invested the time in research, teaching preparation, and department service. To preempt students' nuisance, professors might inflate students' grades in the first place, so that there will be no or few students coming to pester them.

The term "grade inflation" is often referred to same quality students receiving higher grades today than those before; hence, there is a time dimension in that definition. In this paper, however, "grade inflation" is referred to static *"grade exaggeration;"* that is, professors or instructors set low standards and grade over-leniently.

While this paper focuses on students' pestering for better grades, the model has a broad scope. It can be applied to the scenarios with telemarketers, solicitors, salespeople, and stockbrokers who work hard to persuade potential customers to try or to buy their products and services. The nuisance might wear out some people that they end up buying the products and/or services they do not need, or donate funds they might not really care to donate.

After presenting a brief review of the grade inflation literature in section II, section III introduces a game theoretic model of one professor and n students. The model describes the dynamics between the students' pestering for added points and the professor's grading. Section III also discusses some real-world implications of the theoretical results, such as the types of students that are more likely to pester the professor, and some possible methods to reduce grade inflation due to students' nuisance. Section III.7 extends the model to include asymmetric information about the professor's types. Section IV utilizes four distinct data sets (two of which are from original surveys conducted by myself) to test empirically some important propositions in the model. Section V concludes.

II Literature Review

Many studies document grade inflation. In a survey of 180 colleges, Juola (1980) discovers a 0.432 grade point average (GPA) rise from 1960 to 1974. In a survey of 4,900 undergraduate students, Levine and Cureton (1998) find that from 1969 to 1993, the percentage of grades of A- or higher increased from 7 to 26 percent, while grades of C or below dropped from 25 to 9 percent. Kuh and Hu (1999) study 52,256 student surveys of two different periods, mid 1980s and mid 1990s, from the Colleges Students Experiences Questionnaire. They find that GPAs rose on average from 3.07 to 3.34 at various academic institutions. In a survey of seven Ontario universities for the period 1973-1974 and 1993-1994, Anglin and Meng (2000) find significant grade inflation in various Arts and Science programs. Cheong (2000) finds a trend of grade inflation for the past twelve years in the University of Hawaii at Manoa. Some suggest that students today are more intelligent than those a few decades ago, so students today deserve better grades. This argument, however, is contradicted by the fact that the trend of test scores (SATs, ACTs, and GREs) were declining from 1965 to 1980 (Wilson, 1999). As such, the real grade inflation could be more severe than nominal grade inflation.

The causes of grade inflation are widely discussed among researchers and educators. Rosovsky and Hartley (2002) summarize several causes of grade inflation, including the Vietnam War, the response to student diversity, student teaching evaluation, the idea of "students as customers," the watering down of course content at some academic institutions, and the role of adjuncts. McKenzie (1975), Zangenehzadeh (1988), Wallace and Wallace (1998), Krautmann and Sander (1999), and Kanagaretnam et al (2003) suggest that grade inflation is a by-product of teaching evaluations. Wallace and Wallace (1998) claim that the course workload and expected grades directly reflect students' happiness. To please students and thereby receive good evaluations, a professor reduces the workload and inflates grades. Kanagaretnam et al. suggest that the purpose of students' evaluation is to motivate the professors to exert high effort in teaching, thereby increasing the knowledge of students. Yet, professors could manipulate students into giving good teaching evaluations by lenient grading. McKenzie (1975) argues that, by inflating grades, the professor shifts students' constraints out, so that students enjoy better bundles of leisure time and grade. Hence, "the professor's rating will rise because of 'reduced standards' " (p. 101). Krautmann and Sander (1999) study the relationship between student evaluations and expected grades and other variables. Using graduate courses and core courses as instrumental variables for expected grade, they show that students' expected grades affect teaching evaluations. They conclude that faculty members can buy better evaluations by lowering grading standards. In a study of graduates from Swedish upper secondary schools, Wikstrom and Wikstrom (2005) argue that school competition results in modest grade inflation. Hernandez (2005) suggests merit based scholarships might induce grade inflation. Merit based scholarships require applicants to meet a minimum GPA requirement. The purpose of this requirement is to encourage students to study hard; yet, the requirement might induce instructors to lower grading standards. Bar et al. (2007) find that Cornell University's new policy to report course median grade online affects students' course selection and contributes to grade inflation. To my knowledge, no one has explored the idea of "student's nuisance" as a cause of grade inflation. This study aims to fill this void in the literature.

III The Game Theoretic Model

III.1 The Model

A professor p and n students ($i = 1, 2 \ldots n$) play the following game of complete information.

Figure 1: The Game Tree

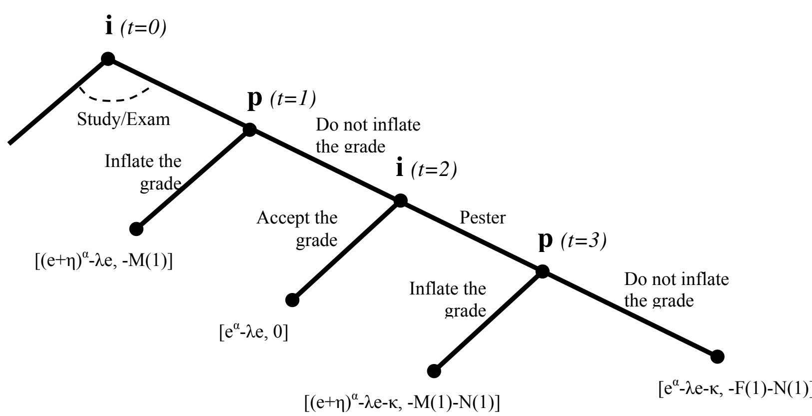


Figure 1 shows only one game tree between the professor and one student.
Keep in mind that the professor plays this game with n students simultaneously.

Sequence of Actions (see Figure 1)

1. Each student i independently and simultaneously chooses a studying effort level, $e_i \geq 0$,

prior to the exam, and then takes the exam.

2. The professor (p) determines whether to inflate each student i's grade, and the grade is revealed to each student i. If the professor inflates the grade of student i, the professor adds η extra points to student i's grade. The game ends with student i and his payoff is realized.
3. Each student i whose grade was not inflated at $t = 1$ independently and simultaneously chooses to pester the professor or to accept the uninflated grade. If student i accepts the grade, the game ends with him and his payoff is realized. For simplicity, assume students are unable to collude with one another.
4. If student i pesters the professor, she determines whether to inflate student i's grade or to reject his request. If the professor grants the request of student i, the professor adds η extra points to the student's grade. The professor's decision will be final.

The professor plays the same game with n students, while each student plays the same game independently and simultaneously with the professor.

The Payoff Functions: The professor's loss function can be expressed as follows:

$$L_p = N(x) + M(y) + F(z),$$

where $N(x)$ is the nuisance cost, $M(y)$ is the moral cost, and $F(z)$ is the sympathy cost. The professor incurs a nuisance cost $N(x)$, with $N(0) = 0$, $N' > 0$ and $N'' > 0$, if she is pestered, x being the number of pestering students. $N(x)$ captures the professor's opportunity cost and emotion cost when the students pester her. The convexity reflects an increasing marginal cost of nuisance. For example, dealing with the tenth pestering student is more costly than dealing with the second pestering student is, as each student's nuisance becomes more annoying as the number of pestering students increases.

The professor incurs a moral cost, $M(y)$, with $M(0) = 0$, $M' > 0$ and $M'' < 0$, when she inflates grades, y being the number of students who receive inflated grades. $M(y)$ captures the disutility the professor suffers from giving in to students' requests for added points. When not having inflated any grades, the cost of inflating one student's grade might be large. She feels guilty for unjustifiably increasing the student's grade and not fulfilling her responsibilities as a professor. When she inflates another student's grade, the added cost falls.

Finally, the professor incurs a sympathy cost $F(z)$, with $F(0) = 0$, $F' > 0$ and $F'' < 0$, if she rejects students' requests for added points, z being the number of students whose requests are turned down. The student might beg for a better grade, and the professor might feel guilty for turning the students away; the F function reflects this cost. The F function is concave: the added sympathy cost drops as the professor denies more requests, because the professor gets used to students' crying faces. The professor's objective is to minimize her loss. The professor is said to be "strict" if $\forall w$, $M(w) > F(w)$, w being any number of students; otherwise, the professor is "lenient." That is to say, the professor is "strict" if moral cost is greater than sympathy cost for any number of students; otherwise, the professor is "lenient."

The student's payoff function can be expressed as follows:

$$U_i = g_i^{\alpha_i} - \lambda_i \cdot e_i - \kappa \cdot m_i, \qquad g_i = e_i + I_i[\eta];$$

where g_i is the grade (which might be inflated or not) of student i, $\alpha_i \in (0, 1)$ is student i's value of the grade. $\lambda_i \in (0, \alpha)$ is student i's unit cost of studying, which captures his degree of laziness and the inverse of his effectiveness of effort in studying. λ_i is assumed to be less than α_i for each student, because a college student should not be too lazy or ineffective in studying; otherwise, they would not enter college in the first place. The professor knows the distribution of α_i and λ_i, but she does not know each student's α_i and λ_i. For instance, if the professor teaches an honor class, she knows students are relatively diligent; however, she cannot identify the diligent and lazy students. e_i is the chosen studying effort level; $m_i = 0$ or 1 is the number of times student i pesters the professor; and κ is the exogenous pestering cost, such as the time spent on sending emails to the professor or visiting the professor in person. I_i is the index function of grade inflation. If there is no grade inflation for student i, $I_i = 0$, and his grade is equal to the studying effort level, e_i. If there is grade inflation for student i, $I_i = 1$, and his grade is equal to the studying effort level e_i plus some exogenous grade inflation points, $\eta > 0$. Each student i's grade perfectly reflects his studying effort level if there is no grade inflation for him. Note that if the grade depends stochastically on the studying effort level, the main results of students' pestering behavior will not change, although they will exert higher studying effort due to their risk averse utility functions. Therefore, this study will focus on the special case where each student i' grade perfectly reflects his studying effort level in the absence of grade inflation.

The chosen studying effort level (e_i) enters student i's utility function through two channels. A higher studying effort level brings about a better grade, which increases student i's utility. However, studying is costly, so a higher studying effort level also lessens student i's utility. Student i may boost his grade by studying hard (choosing a higher e_i) *prior to* the exam, and/or by pestering the professor for added points *after* the exam. Assume that if student i is indifferent between pestering or not, he will choose not to pester the professor.

Strategies Since this is a dynamic game, a strategy is a plan of actions. The professor can choose to inflate the grade of each student i or not at $t = 1$ and $t = 3$. I will focus on the following three strategies, NI, PI, and D, where

- NI (No Grade Inflation): Never inflate any student's grade. In other words, the professor's action is "do not inflate grades" at $t = 1$ and $t = 3$.
- PI (Preemptive Grade Inflation): Inflate all students' grades at $t = 1$. That is, the professor inflates grades at $t = 1$ and $t = 3$.
- D (Delaying Grade Inflation): Do not inflate any student's grade at $t = 1$. At $t = 3$, inflate student i's grade if he pesters at $t = 2$.

Each student i's strategy is his studying effort level e_i prior to the exam, and a plan to pester the professor: $S_i = \{(e_i, A); (e_i, CP)\}$, where

- A (Accepting the grade): Accept the given grade and never pester the professor.
- CP (Conditional Pestering): Pester the professor if the grade is not inflated at $t = 1$.

III.2 Backward Induction

Using backward induction, it can be shown that there exist three subgame perfect equilibria.

Definition A professor is "strict" if $M(w) \geq F(w) \forall w$. That is, if w students pester the professor, the moral cost of inflating the grades for these w students is higher than the sympathy cost of not granting the requests of these w students. By contrast, a professor is "lenient" if $M(w) < F(w) \forall w$.

Proposition III.1 *(No Grade Inflation Equilibrium) If the professor is "strict" $\big(M(w) \geq F(w) \forall w$, w being any number of students$\big)$, there exists a subgame perfect equilibrium where the professor does not inflate grades, and all students accept the grades.*

Proposition III.2 *(Delaying Grade Inflation Equilibrium): If 1. the professor is "lenient"* $\big(M(w) < F(w) \forall w$, *$w$ being any number of students*$\big)$ *and 2. the distributions of students' α_i and λ_i are such that the proportion of potential pestering students is relatively small, then there exists a subgame perfect equilibrium where the professor delays grade inflation, n_1 students pester, and n_2 students accept the grades.*

Proposition III.3 *(Preemptive Grade Inflation Equilibrium): If 1. the professor is "lenient"* $\big(M(w) < F(w) \forall w$, *$w$ being any number of students*$\big)$ *and 2. the distributions of students' α_i and λ_i are such that the proportion of potential pestering students is relatively large, then there exists a subgame perfect equilibrium where the professor preemptively inflates the grades for all students at $t = 1$, and no student pesters the professor.*

Proof for Proposition III.1 Suppose $w \in [0, n]$ students pestered the professor at $t = 2$. At $t = 3$, if the professor inflates the grades for these w students, her loss will be $N(w) + M(w) + F(0) = N(w) + M(w)$. If she does not inflate the grades for the w students, her loss will be $N(w) + M(0) + F(w)$=$N(w) + F(w)$. Note that the nuisance cost is sunk at $t = 3$. If the professor is "strict," she will choose not to inflate the grades at $t = 3$, because $M(w) \geq F(w) \forall w$. Knowing this, all students will accept the grades at $t = 2$. Pestering costs κ, so there is no point to pester the professor if the professor does not change students' grades anyway. Knowing all students will accept the grades, the professor will not inflate grades at $t = 1$. Therefore, $\big(s_p = NI, s_i = A_{\forall i}\big)$ are mutually best responses. The utility function of the students can be expressed as follows:

$$U_i(e_i | s_p = NI, s_i = A) = e_i^{\alpha_i} - \lambda_i e_i$$

Differentiating U_i with respect to e_i to find the first order condition, one can easily verify

$$e^*_{i,NI,A} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}}. \tag{1}$$

$\blacksquare$

Proof for Propositions III.2 and III.3 Suppose $w \in [0, n]$ students pestered the professor at $t = 2$. At $t = 3$, if the professor inflates the grades for these w students, her loss will be $N(w) + M(w) + F(0) = N(w) + M(w)$. If she does not inflate the grades for the w students, her loss will be $N(w) + M(0) + F(w)$=$N(w) + F(w)$. Again, the nuisance cost is sunk at $t = 3$. If the professor is "lenient," she will inflate the grades at $t = 3$, because $M(w) < F(w) \forall w$. Given the professor's strategy, student i's best response is to pester the professor if $(e_i + \eta)^{\alpha_i} - \lambda_i e_i - \kappa > e_i^{\alpha_i} - \lambda_i e_i$; otherwise, he will accept the grade. That is to say, student i will pester if his chosen effort level e_i is less than a threshold effort level $e_{i,0}$, where

$$(e_{i,0} + \eta)^{\alpha_i} - \lambda_i \cdot e_{i,0} - \kappa = e_{i,0}^{\alpha_i} - \lambda_i \cdot e_{i,0}.$$

The left hand side of the equation represents the utility of student i if he pesters the professor. This utility is evaluated at any studying effort level e_i. Student i receives some added points, η, by bearing the pestering cost, κ. The right hand side of the equation represents the utility of the student if he accepts the grade. Rearranging, we have

$$(e_{i,0} + \eta)^{\alpha_i} - e_{i,0}^{\alpha_i} = \kappa. \tag{2}$$

The left hand side of the equation represents the discrete difference in utility for pestering, and the right hand side of the equation represents the cost of pestering. At $e_i = e_{i,0}$, the marginal benefit is equal to the marginal cost of pestering, given the professor delays grade inflation. If equation (2) holds, the student is indifferent between pestering and accepting the grade. It can be shown that[3]

$$(e_i+\eta)^{\alpha_i} - e^{\alpha_i} \le \kappa \qquad \forall e_i \ge e_{i,0}; \tag{3}$$

$$(e_i+\eta)^{\alpha_i} - e^{\alpha_i} > \kappa \qquad \forall e_i < e_{i,0}. \tag{4}$$

Therefore, if the optimally chosen studying effort satisfies inequality (3), the student has no incentive to pester the professor, for the possibility of adding η points to his grade does not induce this student to pester his professor. By contrast, if the optimally chosen effort level satisfies inequality (4), the student will pester the professor.

Suppose the distribution of α_i and λ_i is such that, given the professor delays grade inflation, n_1 students pester, and n_2 $(= n - n_1)$ students accept the grade $\big((s_p = D, s_i = CP, s_j = A)_{i\in n_1, j\in n_2}\big)$. The utility functions of each student can be expressed as follows:

$$U_i(e_i|s_p = D, s_i = CP) = (e_i+\eta)^{\alpha_i} - \lambda_i e_i - \kappa;$$

$$U_j(e_j|s_p = D, s_j = A) = e_j^{\alpha_j} - \lambda_j e_j.$$

Differentiating U_i with respect to e_i and U_j with respect to e_j to find the first order condition, one can easily verify

$$e^*_{i,D,CP} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}} - \eta < e_{i,0} \tag{5}$$

$$e^*_{j,D,A} = (\frac{\alpha_j}{\lambda_j})^{\frac{1}{1-\alpha_j}} \ge e_{j,0}. \tag{6}$$

Call the n_1 students "potential pestering students." Let q be the proportion of potential pestering students ($q = \frac{n_1}{n}$). If the professor delays grade inflation, her loss will be

$$L_p(D,q) = N(qn) + M(qn) + F(0), \tag{7}$$

[3]See Appendix A.1.

since qn students pester the professor, and she gives in to those students' requests. If the professor preemptively inflates students' grades, her loss will be

$$L_p(PI, q) = M(n) + F(0), \tag{8}$$

since the game ends after she inflates all students' grades at $t = 1$, and no students will pester her. It can be shown[4] that for all n, there exists only one $q^* \in (0, 1)$ such that

$$N(q^*n) + M(q^*n) = M(n), \tag{9}$$

where

$$N(qn) + M(qn) < M(n) \qquad \forall q < q^*, \tag{10}$$

$$N(qn) + M(qn) > M(n) \qquad \forall q > q^*. \tag{11}$$

q^* can be viewed as the threshold proportion of potential pestering students. Recall that q is the actual proportion of potential pestering students. If the proportion of potential pestering students is relatively small ($q < q^*$), the professor prefers delaying grade inflation (D) over preemptive grade inflation (PI) according to equation (10). By contrast, if $q > q^*$, the professor prefers to preemptively inflates grades at $t = 1$, because she does not want so many students to pester her. If the distribution of α_i and λ_i is such that $q < q^*$, the professor prefers to delay grade inflation over preemptive grade inflation. If the professor is "lenient," and the proportion of potential pestering students is relatively large ($q > q^*$), the professor prefers preemptive grade inflation (PI) over delaying grade inflation (D) $\big($see equation (11)$\big)$. Given the professor preemptively inflates grades, n_1 students pester if grade is not inflated at $t = 1$, and n_2 students accept the grades $\big((s_p = PI, s_i = CP, s_j = A)_{i \in n_1, j \in n_2}\big)$, the utility functions of the students can

[4]See Appendix B.1.

be expressed as follows:

$$U_i(e_i|s_p = PI, s_i = CP) = (e_i + \eta)^{\alpha_i} - \lambda_i e_i$$

$$U_j(e_j|s_p = PI, s_j = A) = (e_j + \eta)^{\alpha_j} - \lambda_j e_j.$$

Differentiating U_i with respect to e_i and U_j with respect to e_j to find the first order condition, one can easily verify

$$e^*_{i,PI,CP} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}} - \eta < e_{i,0} \quad (12)$$

$$e^*_{j,PI,A} = (\frac{\alpha_j}{\lambda_j})^{\frac{1}{1-\alpha_j}} - \eta \geq e_{j,0}. \quad (13)$$

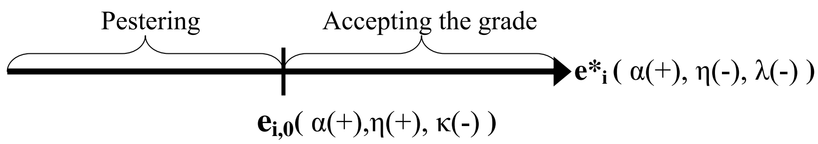
■

Note that equations (1), (5), (6) (12), and (13) show that all optimal studying effort levels are increasing in the value of the grade (α_i) and decreasing in the unit cost of studying (λ_i) (see Appendix A.3 for proof). Moreover, each student's optimal studying effort level is higher when there is no grade inflation than when there is preemptive grade inflation $\big($see equations (1), (12), and (13)$\big)$.

Proposition III.4 *The equilibrium optimal studying effort level is increasing in the student's value of the grade (α_i) and decreasing in the student's unit cost of studying (λ_i).*

Proposition III.5 *Each student's optimal studying effort level is relatively lower when the professor preemptively inflates grades ($s_p = PI$) than the optimal studying effort level when the professor does not inflate grades ($s_p = NI$).*

Figure 2: Decision to Pester when the Professor is "Lenient"



III.3 Decision to Pester

Each student i's decision to pester depends on the professor's strategy, the student's own threshold effort level $e_{i,0}$ and his optimally chosen studying effort level, e_i^*. $e_{i,0}$ and e_i^* depend on the value of the grade (α_i), studying cost (λ_i), added points (η) and pestering cost (κ). Recall that $e_{i,0}$ is the threshold studying effort level that student i is indifferent between pestering the professor or not, given the professor delays grade inflation $\big($see equation (2)$\big)$. The student will pester the professor if $e_i^* < e_{i,0}$, but to accept the grade otherwise $\big($see Figure 2$\big)$.

It can be shown that $e_{i,0}$, $e^*_{i,D,CP}$, and $e^*_{j,D,A}$ are functions of α_i, η, λ_i and κ (see Appendix A.2 and A.3).

$$e_{i,0} = \Omega\Big(\alpha_i(+), \eta(+), \kappa(-)\Big), \tag{14}$$

$$e^*_{i,D,CP} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}} - \eta = \Psi\Big(\alpha_i(+), \lambda_i(-), \eta(-)\Big) < e_{i,0}, \tag{15}$$

$$e^*_{j,D,A} = (\frac{\alpha_j}{\lambda_j})^{\frac{1}{1-\alpha_j}} = \Phi\Big(\alpha_j(+), \lambda_j(-)\Big) \geq e_{j,0}. \tag{16}$$

Value of the Grade Equation (14) suggests that given any chosen studying effort level, the more the student values his grade (a large α_i), the more likely the student is to pester the professor for a better grade *after* the exam. Figure 2 shows that, as α_i increases, $e_{i,0}$ moves to the right; hence, it is easier for any studying effort level to fall into the "pestering" region. However, equations (15) and (16) suggest that the optimal studying effort level is increasing in α_i. Figure 2 shows that, as α_i grows, e_i^* moves to the right, away from the pestering region. In other words, a high value of the grade α_i makes a student more likely to pester *after the exam*, according to equation (14); however, a high α_i also induces a student to study harder *before the exam*, making pestering unworthy $\big($see equation (3)$\big)$. Therefore, the relationship between the value of the grade α_i and the decision to pester is ambiguous. In Figure 2, as α_i increases, both $e_{i,0}$ and e_i^* move to the right. If the nuisance threshold $e_{i,0}$ rises faster than the optimal effort level e_i^* does, the marginal benefit of pestering is higher than the marginal benefit of studying. As a result, the student is more likely to pester the professor. Yet, if the optimal studying effort level e_i^* rises faster than the nuisance threshold $e_{i,0}$ does, the marginal benefit of studying is higher than the marginal benefit of nuisance. Consequently, the student will study hard before the exam and not to pester after the exam.

Proposition III.6 *The relationship between the value of the grade (α_i) and the likelihood of pestering is ambiguous.*

Studying Cost An increase in unit cost of studying λ_i does not affect the threshold $e_{i,0}$, but brings down the optimal studying effort level, e_i^*. Figure 2 shows that a lower optimal effort level is more likely to fall into the "pestering" region. Therefore, a student with high studying cost is likely to study a little before the exam, and to pester the professor for added points after the exam. By contrast, a student with a low studying cost is more likely to exert a high studying effort prior to the exam and not to pester the professor afterwards. Thus, studying and pestering are partial substitutes.

Proposition III.7 *An increase in the unit cost of studying (λ_i) increases the likelihood of pestering. Studying and pestering are partial substitutes.*

Reward and Cost of Pestering An increase in the reward of pestering η increases the likelihood to pester. As shown in Figure 2, an increase in η shifts the threshold point $e_{i,0}$ to the right, making students more likely to pester. Likewise, a decrease in pestering cost κ moves the threshold $e_{i,0}$ to the right: any studying effort level e_i is more likely to fall into the "pestering" region. Hence, decreasing pestering cost encourages students to pester the professor.

Proposition III.8 *Other things being equal, students are more likely to pester the professor if the reward of pestering (η) is high and/or the cost of pestering (κ) is low.*

Class Size So far, I have assumed a fixed class size. The analysis will allow n to vary. It can be shown that (see Appendix B.2.)

$$\frac{\partial q^*}{\partial n} < 0. \tag{17}$$

That is, the larger the size of the class, the smaller the threshold proportion of potential pestering students (q^*) that the professor is indifferent between preemptive grade inflation and delaying grade inflation. In other words, if the proportion of potential pestering student (q) is fixed, the larger the class size, the more likely the professor prefers preemptive grade inflation over delaying grade inflation $\big($see inequality (11)$\big)$.

Proposition III.9 *if the professor is "lenient" and the distributions of α_i and λ_i are fixed, ceteris paribus, the larger the class size, the more likely one observes preemptive grade inflation.*

III.4 Class Policy Implications

Obviously, there would be no grade inflation equilibrium if the reward of pestering (η) is equal to zero. In fact, lowering the reward of pestering discourages students from pestering. For instance, a professor can re-grade the whole exam if a student asks for grade adjustments. The student is told that his grade "might go up as well as go down" after the re-grading. The uncertainty reduces the net reward of pestering, deterring students from pestering.

Given any studying effort level, a student is less likely to pester the professor if the pestering cost (κ) is high $\big($see equation (3)$\big)$. The emergence of emails drastically decreased students' pestering cost, thereby increasing students' nuisance. To avoid students' pestering, the professor might refuse to read students' emails about grading issues. For example, a professor might announce to her students that she will not respond to email messages regarding grading. If students have questions about their grades, they are required to visit the professor during her office hours. Visiting the professor is more costly than merely sending an email, especially for shy students. Furthermore, a professor could require the student to submit a report of justification if he wishes to request added points for an assignment. Such a requirement also raises the cost of pestering. For instance, before I passed back a midterm exam, I announced to my students that I would adhere to the following policy: whoever requested re-grading would have to submit a report of justification, and I would re-grade the whole, rather than a part, of the exam. Students looked very disappointed; eventually, only one of the 60+ students asked for re-grading; a much smaller figure than usual.

Proposition III.9 suggests that, if the professor is "lenient," other things being equal, the larger the class size, the more likely the professor is to inflate grades preemptively. This is in-

Table 1: Four Types of Students

	Value of Grades α_i	**Studying Cost** λ_i	**Proportion**	**Number if** $n = 40$	**Number if** $n = 160$
Type ①	0.5	0.125	0.10	4	16
Type ②	0.5	0.25	0.05	2	8
Type ③	0.25	0.125	0.75	30	120
Type ④	0.25	0.25	0.10	4	16

tuitive: if ten percent of the students pester the professor in a class of 40, that would be four pestering students. In a class of 160, the number would jump to 16. The marginal cost of students' nuisance is increasing in the number of pestering students, so the professor prefers to preemptively inflate the grades of all students to avoid students' nuisance. Thus, reducing class sizes could reduce possible preemptive grade inflation.

III.5 A Numeric Example

Suppose there is one professor and 40 students of four types, ①, ②, ③, ④ (see Table 1). Type ① and type ② students both highly value their grades, but the studying cost of type ① students is lower than that of type ② students. Perhaps type ① students are smarter and/or more diligent than type ② students are. The value of the grade is relatively lower for type ③ and type ④ students, and the studying cost of type ③ students is lower than that of type ④ students.

The reward of pestering $\eta = 0.75$ [5], and the pestering cost $\kappa = 0.125$. The professor's nuisance cost, moral cost, and sympathy cost functions are as follows: $N(x) = x^{1.5}; M(y) = y^{0.8}; F(z) = z^{0.9}$. Note that the professor is "lenient." It can be shown that there exists a subgame perfect equilibrium where the professor delays grade inflation, type ① and type ③ students accept the

[5] Keep in mind that the added points η is not necessarily out of one hundred.

Table 2: Optimal Studying Effort Level

	$e^*_{D,A} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}}$	$e^*_{D,CP} = (\frac{\alpha_i}{\lambda_i})^{\frac{1}{1-\alpha_i}} - \eta$	$e_{i,0}$	**Proportion**	**Action**
Type ①	16*	15.25	8.6289	0.10	Accept
Type ②	4	3.25*	8.6289	0.05	Pester
Type ③	2.52*	1.77	1.3659	0.75	Accept
Type ④	1	0.25*	1.3659	0.10	Pester

grades, whereas type and ② and type ④ students pester the professor.

Given the professor delays grade inflation, the students' optimal effort level is $e^*_{i,D,CP} < e_{i,0}$ if they pester the professor, and $e^*_{i,D,A} \geq e_{i,0}$ otherwise $\big($see equations (5) and (6)$\big)$. Table 2 shows that the two type ② and four type ④ students choose effort level $e_2 = 3.25$ and $e_4 = 0.25$ and pester the professor, while the four type ① and thirty type ③ students choose $e_1 = 16$ and $e_3 = 2.52$ and to accept the grades. Hence, six students pester, and thirty four students accept the grade.

The professor's loss functions can now be expressed as follows:

$$L(D) = N(6) + M(6) = 6^{1.5} + 6^{0.8} = 18.89; \qquad L(PI) = M(40) = 40^{0.8} = 19.13.$$

Delaying grade inflation provides a lower cost to the professor.

Class Size If the distributions of α and λ are fixed, but the class size jumps from 40 to 160,

$$L(D) = N(24) + M(24) = 24^{1.5} + 24^{0.8} = 130.29; \qquad L(PI) = M(160) = 160^{0.8} = 57.98.$$

Preemptive grade inflation is less costly than delaying grade inflation.

Positive Externality From this numeric example, one observes that when class size is small, the professor inflates the grades of the potential pestering students. By contrast, when the class

Table 3: Grades

	Large Class	Small Class
Professor's Strategy	Preemptive Grade Inflation	Delaying Grade Inflation
Potential Pestering Students	Inflated Grades	Inflated Grades
Students who Never Pester	Inflated Grades	Deserved Grades

size is large, the professor undiscriminatingly inflates grades for all students. That is to say, when the class size is large, students who never pester can enjoy the positive externality from the threat of nuisance of potential pestering students. Potential pestering students receive inflated grades regardless of class size, but students who do not pester receive inflated grades only if the class size is large, given that the professor is lenient (see Table 3).

III.6 Who Pesters After All?

Anecdotal evidence collected from professors and TAs in the Department of Economics at UC Irvine suggests that pestering students can be diligent or lazy. Once a hardworking student (who received a B+) emailed me to ask for an A-: "I tried VERY hard to ensure I would pass this class with an A-…I put in numerous hours each day, making sure all the notes were clear and mastered…that I would get a high grade which would allow me to get an A-." A TA told me that his student complained to him: "I have been a straight A student. I *have to* have an A." By contrast, a lazy student skipped classes and studied little. One of my students was about to fail the class, he begged "I will not be able to graduate on time if I do not pass this class with a minimum C-." One might picture the diligent pestering students as type ② students in section III.5. They study hard ($e_2 = 3.25$ is the second highest studying effort level), and they highly value their grades ($\alpha = 0.5$). Yet, their studying cost is high ($\lambda = 0.25$). Perhaps they are not as intelligent as type ① students are, who have the same value of the grade but a smaller studying cost. Since type ② students have a higher studying cost than type ① students do, type ② students have a comparative advantage in pestering; therefore, it makes sense for type ② to study less and pester the professor after the exam.

One might picture the lazy pestering students as type ④ students. They do not care so much about their grades ($\alpha = 0.25$) and they are too lazy to study ($\lambda = 0.25$). Their effort level $e_4 = 0.25$ is the lowest among the class. When they are about to fail the class, they beg the professor to pass them so that they might be able to graduate.

A professor might also encounter a student who highly values academic performance and studies diligently, but he does not pester the professor. He is a typical type ① student, who has a high value of the grade ($\alpha = 0.5$) but a relatively low cost of studying ($\lambda = 0.125$), because he is hard working and intelligent. Since the studying cost is low, the cost of pestering is relatively high. Therefore, it makes sense for him to study hard and not to pester the professor.

III.7 Asymmetric Information

So far, due to the assumption of perfect information of professor's type (lenient or strict), rejection from the professor does not occur. This section explains why in the real world, one observes professors turning down students' requests for better grades.

Suppose the professor is "strict." By backward induction, in the final stage, she will deny students' requests for added points. However, the students are unaware of the professor's type; hence, each student i assigns a prior that

$$Prob\big(F(w) > M(w)\forall w\big) = \pi_i \qquad Prob\big(M(w) \geq F(w)\forall w\big) = 1 - \pi_i.$$

With prior π_i, the professor is lenient; but with prior $1 - \pi_i$, the professor is strict. Given any studying effort level, student i is indifferent between pestering and accepting the grade if

$$\pi_i(e_i + \eta)^{\alpha_i} + (1 - \pi_i)e_i^{\alpha_i} - \lambda_i e_i - \kappa = e_i^{\alpha_i} - \lambda_i e_i.$$

The left hand side of the equation represents the expected utility (evaluated at any studying effort level e_i) if student i pesters the professor. With prior π_i, student i receives some added points, η,by incurring the pestering cost, κ. Yet, with prior $1 - \pi_i$, his grade remains the same. The right hand side of the equation represents the utility of the student if he accepts the grade. Rearranging,

$$\pi_i\Big((e_i + \eta)^{\alpha_i} - e_i^{\alpha_i}\Big) = \kappa. \tag{18}$$

Let threshold $e_{i,\pi,0}$ be the solution to equation (18). It can be shown that (see Appendix C.1)

$$\pi_i\Big((e_i + \eta)^{\alpha_i} - e_i^{\alpha_i}\Big) \leq \kappa \qquad \forall e_i \geq e_{i,\pi,0} \tag{19}$$

$$\pi_i\Big((e_i + \eta)^{\alpha_i} - e_i^{\alpha_i}\Big) > \kappa \qquad \forall e_i < e_{i,\pi,0}. \tag{20}$$

If the optimally chosen studying effort satisfies inequality (19), the student will not pester. By contrast, if the optimally chosen effort level satisfies inequality (20), the student will pester. Note that inequality (20) holds if student i strongly believes that the professor is "lenient" (a high π_i), if the studying cost is high (a high λ_i), if the points sought are high (a high η), and if the cost of pestering is low (a low κ). Again, one cannot tell whether an increase in the value of the grade (α_i) increases the likelihood that the student pesters the professor.

Given a prior π_i, if student i is to pester the professor, his utility function can be expressed as follows:

$$U_i(e_i|\pi_i, s_i = CP) = \pi_i(e_i + \eta)^{\alpha_i} + (1 - \pi_i)e_i^{\alpha_i} - \lambda_i e_i - \kappa.$$

Given a prior π_j, if student j accepts the grade, his utility function can be expressed as follows:

$$U_j(e_j|\pi_j, s_j = A) = e_j^{\alpha_j} - \lambda_j e_j.$$

Differentiating U_i with respect to e_i and U_j with respect to e_j to find the first order condition, one can verify that (see Appendix C.2)

$$e^*_{i,\pi_i,CP} = \phi\Big(\alpha_i(+), \lambda(-), \eta(-), \pi_i(-)\Big) < e_{i,\pi,0}\Big(\alpha_i(+), \eta(+), \kappa(-), \pi_i(+)\Big) \tag{21}$$

$$e^*_{j,\pi_j,A} = (\frac{\alpha_j}{\lambda_j})^{\frac{1}{1-\alpha_j}} \geq e_{j,\pi,0}\Big(\alpha_j(+), \eta(+), \kappa(-), \pi_j(+)\Big). \tag{22}$$

Equations (21) and (22) suggest that the higher the prior π_i, the higher the studying cost λ_i, the higher the reward from pestering η, the lower the pestering cost κ, and the more likely the student is to choose a low studying effort level e_i and to pester the professor.

Proposition III.10 *If there is asymmetric information and the professor is "strict," there exists a subgame perfect equilibrium such that students who assign a high prior that the professor is "lenient" (high π_i students) pester the professor, students who assign a low prior that the professor is "lenient" (low π_i students) accept the grades, and the professor denies the requests of the pestering students.*

If the game is repeated, and the professor's type does not change, students should update their priors and the equilibrium rejection would not exist. For example, after the professor rejects student i's request, he will update his prior π_i from some positive number to zero. The equilibrium in the repeated game will be the same as that in section III.2, "no grade inflation equilibrium." In the real world, however, one does observe equilibrium rejection from the professor because the game is not repeated, or because the professor's type changes.

IV Empirical Tests

This section tests various propositions of the model using four distinct data sets. Two of the data sets come from original surveys conducted by myself. The first data set comes from a survey for professors and instructors of the Department of Economics, UC Irvine. The second data set comes from a survey for students in the Department of Economics, UC Irvine. The third data set records the ranking of students who actually pestered the professors. The fourth data set is the restricted academic records complied by the Office of Institutional Research, UC Irvine. Unfortunately, not all propositions are testable due to the lack of data.

IV.1 The Cost of Nuisance: Professors' Viewpoints (Data Set 1)

How costly and annoying is students' nuisance to professors? To answer this question, I conducted a survey to assess the cost of nuisance to professors. All professors and instructors who taught from spring 2006 to winter 2007 (including summer) in the Department of Economics, UC Irvine, were solicited for this survey. 22 out of 48 professors/instructors responded, a 45.8% response rate. The survey includes responses from four tenured faculty members, nine tenure-track junior faculty members, and nine non-tenure-track instructors. Among these professors, nine of them are female, and thirteen are male (see Table 4).

In this survey, the professors are asked to indicate whether they "strongly agree," "agree," "have no opinion," "disagree," or "strongly disagree" to the following two statements:

- *"Responding to or acting on students' complaints about grades or requests for more points is COSTLY in terms of my time, effort, and/or energy."*
- *"Students' complaints about grades/requests for more points are ANNOYING."*

Table 4: Professor Survey Data

Tenure Level		Gender	
Senior Professor	4 (18.2%)	Male	13 (59.1%)
Junior Professor	9 (40.9%)	Female	9 (40.9%)
Instructors	9 (40.9%)		
Total	22 (100%)	Total	22(100%)

Table 5: Professor Survey Results

	Students' Nuisance is COSTLY	**Students' Nuisance is ANNOYING**
Strongly Agree	3 (13.6%)	2 (9.1%)
Agree	14 (63.6%)	14 (63.6%)
No Opinion	1 (4.5%)	0 (0%)
Disagree	3 (13.6%)	4 (18.2%)
Strongly Disagree	0 (0%)	0 (0%)
No Response	1 (4.5%)	1 (4.5%)
Agree or Strongly Agree	**17 (77.3%)**	**16 (72.7%)**
Disagree or Strongly Disagree	**3 (13.6%)**	**4 (18.2%)**
Total	22 (100%)	22 (100%)

Table 6: Descriptive Statistics: Professor Survey Data

Variable	**Obs**	**Mean**	**Std. Dev**	**Min**	**Max**
Annoying	21	3.714	0.902	2	5
Costly	21	3.810	0.873	2	5
Female	22	0.409	0.409	0	1
Tenure	22	0.182	0.395	0	1

Table 7: Professor Survey: Correlation Coefficients

	Annoying	Costly	Female	Tenure
Annoying	1.0000			
Costly	0.5083	1.0000		
Female	0.4523	0.5385	1.0000	
Tenure	0.1231	-0.1721	-0.1531	1.0000

No professor responded “I strongly disagree” to either question. Table 5 shows that the majority of professors and instructors agree or strongly agree that students’ nuisance is costly and/or annoying. Table 6 summarizes the descriptive statistics of the data. Answer “I strongly agree” is coded “5” in both questions; “I agree,” 4; “No opinion,” 3; “I disagree,” 2. “Tenure” and “Female” are dummy variables.

Table 7 displays the correlation coefficients of “Annoying,” “Costly,” “Female,” and “Tenure.” It shows a moderate positive correlation between Annoying and Female (0.4523), and between “Costly” and “Female” (0.5385). This could be an indication that female professors/instructors are more sensitive to students’ nuisance. Alternatively, female professors might be pestered more often. There is a small positive association between “Annoying” and “Tenure.” Perhaps tenured professors have been teaching for a longer period of time than untenured professors have, thus, tenured professor experienced more students’ nuisance, which might cause the small positive association between “Annoying” and “Tenure.” Not surprisingly, there is a moderate negative association between “Tenure” and “Costly.” First, tenured professors are in general more experienced with students’ nuisance; therefore, dealing with students’ nuisance is probably not that costly to them. Moreover, tenured professors are not under tremendous publication stress as junior professors are. Tenured professors also have less teaching responsibilities than instructors do. Consequently, dealing with students' nuisance is not that costly to tenured professors.

IV.2 Value of the Grade and Cost of Studying

Utilizing a student survey, this section tests several hypotheses from the game theoretic model, in particular, propositions III.6 and III.7.

Proposition III.6 suggests that a higher value of the grade (α_i) does not necessarily make the student more likely to pester the professor. On the one hand, as the value of the grade increases, the optimal studying effort level *prior to the exam* increases, making pestering unnecessarily. On the other hand, given any chosen studying effort level, a greater value of the grade makes the student more likely to pester the professor *after* the exam. Therefore, the relationship between the value of the grade and the likelihood of pestering is ambiguous.

Proposition III.7 suggests that a higher cost of studying reduces the optimal studying effort level and increases the likelihood of pestering.

IV.2.1 Student Survey Data

To test proposition III.7, a survey was given to all students who took ECON 20A (Basic Economics) and ECON 116 (Game Theory) in UC Irvine, Summer Session 1, 2007. 203 out of 239 students responded the survey, a rate of 85.0%. In this survey, students indicated whether they "strongly agree," "agree," "have no opinion," "disagree," or "strongly disagree" to the following two statements:

- *Grades (academic performance) are important to me.*
- *To me, studying takes a lot of time and effort.*

The students' response to the first statement indicated their value of the grade. For example, a student who responded "I strongly agree" values his or her grade higher than a student who responded "I agree," and so on. The second statement measures the cost of studying of the student. For example, a student who responded "I strongly agree" has a higher studying cost than a student who responded "I agree," and so on. No one responded "I strongly disagree" to either statement. "I disagree" is coded as 0, "No opinion," 1; "I agree," 2; and "I strongly agree," 3. Note that every student agrees or strongly agrees that grades are important. Students have more varied answers regarding the cost of studying, although an average student agrees that studying is "costly" in terms of his or her time and effort (see Table 8).

I also surveyed students' history of pestering (variable $Nuisance$) by asking the following question:

- *In your college life, have you ever ask your professors/TAs to adjust up your grades in any assignment, including homework, quiz, exam, extra credit assignment and other?*

A "yes" answer is coded as 1, and "no," 0. The appropriate interpretation of the responses to this question might be debatable, because students might have asked the professor(s) to correct grading mistakes. In an attempt to remove such ambiguity, I included an open-ended question that students explain why they requested for more points. Not surprisingly, few students requested more points due to grading mistakes, while a great majority requested for more points without justification. For example, students asked for upward adjustment of their grades when their scores are close to the next higher rung. Alternatively, students "spent plenty of time, energy, and thoughts" on assignments, for which they "feel that they deserve better grades." Some students asked for better grades to avoid being dismissed from the university. Hence, "requesting for upward adjustment of the grade" is a reasonable, though not perfect, measurement of

Table 8: Descriptive Statistics: Student Survey Data

Variable	Obs	Mean	Std. Dev	Min	Max
Nuisance	203	0.389	0.489	0	1
Value	202	0.653	0.477	2	3
Cost	203	2.138	0.856	0	3
GPA	164	3.002	0.438	1.909	3.91
Senior	202	0.579	0.495	0	1
Major	203	0.355	0.480	0	1

students' nuisance (see Appendix E.2).

Finally, students report their college GPA and their year in school: freshman, sophomore, junior, senior, or graduate. Students in their junior year and above are labeled as "Senior." Note that although 203 students responded the survey, only 164 students reported their GPAs (see Table 8). Perhaps students feel less comfortable report their GPAs. Therefore, in the following regression, the number of observation is 162, a much smaller number than the number of students who responded the survey.

IV.2.2 Regression Model

Proposition III.6 suggests that the relationship between $Value$ and $Nuisance$ is ambiguous, while a higher cost of studying makes the student more likely to pester the professor. The linear probability model can be expressed as the following:

$$Nuisance = \delta_0 + \delta_1 Value + \delta_2 Cost + \delta_3 Senior + \delta_4 GPA + \delta_5 Major + \epsilon, \tag{23}$$

where $Nuisance$ indicates whether the student has pestered any professor before, $Value$ is the value of the grade, $Cost$ is the studying cost, $Senior$ indicates students academic status in school (freshman and sophomore=0; junior, senior, and graduate=1), and GPA is students' self reported college GPA. $Senior$, GPA and $Major$ are control variables. Naturally, juniors, seniors and graduate students are more likely to have pestered a professor than freshmen and sophomores are. GPA might affect the student's incentive to pester the professor; for example, students with lower GPAs might have more incentive to pester the professor, because a minimum GPA is required to graduate in most departments of most universities. Finally, $Major$ controls for the diversified backgrounds of the students: $Major = 1$ if the student is an econ major; otherwise, $Major = 0$. Students who have not selected their majors are considered "non-major."

The major weakness of the linear probability model is that the estimated probability could go above one or below zero. Notwithstanding this drawback, the coefficients of the linear probability model are easy to interpret. As an alternative specification, I also estimate a probit model to check for robustness. Details are provided in Appendix D.

IV.2.3 Regression Results

OLS regression results are shown in Table 9. I first discuss the variables of interest, and I analyze control variables.

$Value$ Although proposition III.6 suggests that the relationship is ambiguous between $Nuisance$ and $Value$, the regression results demonstrate a positive association between the two. The result is statistically significant at the ten percent level. On average, a unit increase in $Value$ raises $Nuisance$ by 0.1471. In words, a unit increase of the value of the grade raises the probability that the student pesters the professor by 0.1471. One possible explanation for this result is that, as described in proposition III.6, as the value of the grade increases, the nuisance threshold $e_{i,0}$ rises faster than the optimal studying effort level e_i^* does (see Figure 2). Therefore, the increase

Table 9: Regression Results: Student Survey Data

Nuisance	Expected Sign	Coef. (Std. Err.)
Value	?	0.1471
		(1.73)*
Cost	+	0.0683
		(1.48)
Senior	+	0.1958
		(2.42)**
GPA	?	-0.0575
		(0.61)
Major	?	0.0541
		(0.66)
Observations		162
R-Squared		0.07

Absolute t values are in parentheses.
** significant at the 5% level; * significant at the 10% level.

of $Value$ causes students' optimal studying effort level to fall into the "pestering region." As a result, there is a positive association between $Nuisance$ and $Value$.

$Cost$ There is a positive association between $Cost$ and $Nuisance$, as predicted by proposition III.7. On average, one unit increase of studying cost raises $Nuisance$ by 0.068. That is, the probability the student pesters the professor is 0.068 higher with a unit increase of studying cost. The result is almost significant at the ten percent level (P-Value=0.141).

$Senior$ Naturally, the longer a student stays in the university, the more likely he has pestered a professor at some point. Not surprisingly, $Senior$ is positively associated with $Nuisance$. One unit increase of $Senior$ is associated with 0.1958 unit increase of $Nuisance$. In other words, the probability that juniors, seniors, and graduate students pester their professors is 0.1958 higher than freshmen and sophomores do, other things being equal. The coefficient is statistically significant at the five percent level.

GPA and $Major$ Neither GPA nor $Major$ is statistically associated with $Nuisance$. The sign of GPA's coefficient is negative; perhaps good students have less incentive to pester their professors.[6] $Major$ is positive but statistically insignificant, suggesting that econ majors are not more likely to pester professors than non-majors are.

IV.3 The Rankings of Pestering Students (Data Set 3)

Anecdotal evidence suggests that most pestering students have low rankings in classes. To tell the rankings of pestering students, I collect data from six UC Irvine econ professors/instructors about the rankings of pestering students in the classes they taught in spring 2006 and summer 2007. Each professor taught exactly one class during this period. The professors recorded the final ranking (in percentiles) of each pestering student. For instance, if there are 200 students in a class, and the pestering student is ranked 198 in that class, his or her ranking is 99%. Students are considered "pestering" the professor if they asked for upward adjustment of their grades without justification. Tables 10 and 11 show the distribution of these pestering students.

Table 11 shows that there are more pestering students that come from the bottom than from the top of the distribution. For instance, there are 15 pestering students that come from bottom 10% (ranking$>90\%$), but only 6 pestering students that come from top 10% (ranking$<10\%$). There are 25 pestering students that come from bottom 20% (ranking$>80\%$), but only 16 pestering students that come from top 20% (ranking$<20\%$). Table 11 demonstrate that more pestering students come from the bottom rather than the top of the class.

[6] There could be endogeneity between $Nuisance$ and GPA. However, the regression results without GPA is similar to the regression results reported here.

Table 10: Pestering Students Ranking Data

Ranking (Percentile)	Count	Percentage
0-10	6	5.22%
10-20	10	8.70%
20-30	11	9.57%
30-40	13	11.30%
40-50	11	9.57%
50-60	14	12.17%
60-70	9	7.83%
70-80	16	13.91%
80-90	10	8.70%
90-100	15	13.04%
Total	115	100%

Table 11: Pestering Students Ranking Data

Ranking Percentile	Count	Percentage	Ranking Percentile	Count	Percentage
< 10	6	5.22%	> 90	15	13.04%
< 20	16	13.91%	> 80	25	21.74%
< 30	27	23.48%	> 70	41	35.65%
< 40	40	34.78%	> 60	50	43.48%
< 50	51	44.35%	> 50	64	55.65%

IV.4 Class Size (Data Set 4)

Proposition III.9 suggests that, if the professor is "lenient," and the proportion of pestering students is fixed, other things being equal, the larger the class size, the more likely one observes preemptive grade inflation. This section utilizes data collected from UC Irvine Registrar and Office of Institutional Research (OIR) to test the effect of class size on grade inflation.

The data include nearly all students who entered UC Irvine as freshmen and have taken intermediate micro and macroeconomics (ECON 100A, B, C) from fall 2001 to spring 2006 (summer 2005 excluded) and their grades in those classes. 100A is the prerequisite of 100B and 100C, and 100B is the prerequisite of 100C. The data also include class enrollments and each student's UCI grade point average (GPA), high school GPA, SAT math and verbal scores, and major (exclusively economics or not).

There are several drawbacks of the data. First, data on students' types (potential pestering students or not) are unavailable. Utilizing the results from section IV.3, I approximate pestering students by poor performers. Additionally, there are only a few observations in this data set, because not many non-majors take these upper level economics classes: there are merely 1605 observations in 100A, 1470 in 100B, and 1225 in 100C.[7]

The major shortcoming of this data is that, in compliance with Family Educational Rights and Privacy Act (FERPA)[8], OIR cannot provide the detailed data I requested. OIR worries that complete records of students' course grades, SAT scores, UCI GPAs, and high school GPAs could make students identifiable and thus violate FERPA. Hence, OIR could only release the

[7] The reason for the descending number is that OIR include 100B students only if they already took 100A, and 100C students only if they already took 100A and 100B.

[8] As recorded from ed.gov, "The Family Educational Rights and Privacy Act (FERPA) is a Federal law that protects the privacy of student education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education." For details, see http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html.

de-identified and additionally restricted data. Rather than reporting raw grades, OIR labels A+, A and A- as A; B+, B, and B- as B; C+, C and C- as C; D+, D and D- as D; F and incomplete grades as "O." I transformed the letter grades into numbered grades: "A" as "4", "B," "3;" "C," "2;" "D," 1; "O," 0. If a student takes a class multiple times, only the first grade is included in the sample. This is to maintain the consistency of students' grades and ability, as it is presumably easier to perform well in a class when taken the second time.

Data on students' UCI GPAs are also restricted: OIR aggregated GPAs into several bands, and I took the mid point of the band as the student's GPA. For example, if the student's GPA is 2.47, OIR labels it as "2.41-2.50," and I took the midpoint 2.45 as the student's GPA. GPAs below 1.9 are labeled as 1.85.

OIR is also unable to provide data of each student's SAT scores and high school GPA separately. Rather, the SAT scores and high school GPA are combined to make an admission "$Index$." The formula for $Index$ is 400 times high school GPA, plus the sum of SAT math and verbal scores. OIR further restricts this number into several bands, and the midpoints of each band is taken as the $Index$ of the student. Finally, OIR provides a major dummy variable that indicates whether students are econ majors or not. Unfortunately, OIR wrongly labeled double major in econ as "non-major," so this variable could be uninformative. The data might be somewhat noisy because of the restriction of FERPA.

Instructors' Information I gather instructors' information from UC Irvine Searchable Schedule of Classes (WebSOC), a web tool offered by the UC Irvine registrar. WebSOC preserves class information such as instructors' names and enrollments of all UC Irvine classes offered in the most recent five years. I matched instructors' names offered by WebSOC and the class size in-

Table 12: Descriptive Statistics

	100A	**100B**	**100C**
	Mean (SD)	Mean (SD)	Mean (SD)
Grade	2.86 (0.84)	2.56 (0.92)	2.56 (1.02)
Size	267.38 (96.32)	259.09 (87.56)	270.17 (74.23)
GPA	3.06 (0.41)	3.07 (0.41)	3.08 (0.40)
Index	2643.84 (201.53)	2644.49 (201.01)	2639.53 (204.84)
Number of Classes	11	1	11
Number of Senior Professors	2	1	0
Number of Junior Professors	3	2	4
Number of Instructors	1	1	3

formation provided by OIR to determine the instructor of each class.

Season is the main cause of the variation in class sizes (see Table 12). 100A is offered in fall and winter; 100B, winter and spring; 100C, spring and fall. Students usually take 100A in fall, 100B in winter, and 100C in spring. Those who fail to take 100A in fall take it in the following winter, and 100B, C in spring and fall, respectively. Hence, 100A has larger class sizes in fall than in winter; 100B has larger class sizes in winter than in spring, and 100C has larger class sizes in spring than in fall.

A small number of students added or dropped classes in the end of the quarter. As a result, there could be a small gap between the records of WebSOC and those provided by OIR. For instance, for a specific class, the enrollment records of WebSOC on several quarters were 367, 197, 272, 100, and 246, respectively. Except for one class that has the perfect match in enrollment, every class has a small gap (one to five students) between the records from WebSOC and OIR. Fortunately, different classes have large variations in sizes, so I was able to match most classes and the instructors.

IV.4.1 The Ordinary Least Squares Model

The model seeks to explain grade inflation by students' nuisance, which can be affected by class size. The grade for ECON 100 series is the dependent variable.

$$\begin{aligned} Grade = \beta_0 + \beta_1 Size + \beta_2 Size * GPA + \beta_3 Assist + \beta_4 Full \\ + \beta_5 GPA + \beta_6 Log\_Index + \beta_7 Major + \beta_8 Class + \beta_9 Prereq + \epsilon, \end{aligned} \quad (24)$$

where $Grade$ is the course grade, $Size$ is the class enrollment, $Size * GPA$ is the interaction of GPA and $Size$. According to proposition III.9, β_1 is expected to be positive, because a professor is more likely to preemptively inflate grades when the class size is large. β_2 is expected to be positive, because good students enjoy positive externality from poor performers' threat of nuisance; hence, good students receive better grades in larger classes than they would receive in small classes, other things being equal.

$Assist$ and $Full$ are dummy variables of assistant professors and full professors, respectively. Adjunct professors are the baseline teachers; there are no associate professors in the data set. No full professors or associate professors taught 100C in the sample period. UC Irvine is a research university, where research publications are important in tenure decisions. Because assistant professors have more incentive to inflate grades to avoid students' nuisance and to focus on their own research, β_3 is expected to be positive. According to "buy good teaching evaluation" theory, adjuncts need good teaching evaluations to renew contracts with the school; hence, β_4 is expected to be negative.

GPA is the student's cumulative UCI GPA before he took any 100 class; Log_Index is the log of $Index$; $Major$ is the major code, with 1 representing exclusively major in econ and 0 otherwise. These variables control for students' discipline, aptitudes, and human capital. β_5 and β_6 are expected to be positive, but the sign of β_7 is unknown. Although econ majors often outperform non-majors in learning economics, exclusive econ majors are not necessarily better than those who double major in econ. $Class$ is the class dummy variable that controls for different ECON 100 classes in the pooled data.

Finally, $Prereq$ is the grade earned on prerequisite econ 100 series classes. For example, grades earned for 100A and 100B are included as control variables for 100C regression. Grade earned for 100A is a control variable for 100B regression. Because the three classes are designed to be taken in sequence, grades earned for prerequisites could be good indications for the performance of subsequent 100 series classes. ϵ is the residual.

IV.4.2 Regression Results

Table (13) shows the results of the linear regression for 100A, 100B, 100C, and the pooled data.

Class Size Proposition III.9 suggests that the larger the class size, the more likely one observes preemptive grade inflation. Contrary to the prediction, class size is negatively associated with grades for all regressions, with 100A an exception after controlling for $Size * GPA$. The magnitude of the coefficient is small, however: for instance, for the pooled data, an increase of 100 students in the class lowers the student's grade by a fifth letter grade (coefficient $= -0.002$). There could be several reasons for the negative association. First, proposition III.9 assumes that the proportion of pestering students does not change among different classes. This assumption might not hold, as the proportion of pestering students might change in the sample period.

Second, one complicating factor not considered in the theoretic framework is that professor's sympathy cost might change with different class sizes. As the class size grows, the professor becomes relatively distant from each student in the class. Consequently, the sympathy cost might change: it might be relatively easier for the professor to fail some anonymous students in a large class at the cost of possible students' nuisance. The game theoretic model does not reflect this change in sympathy cost. Third, the model does not incorporate a possible learning effect in class size. It could be easier for the professor to control a small class than a large class, thereby improving students' performance. The "distance effect" and "learning effect" work in the opposite direction of nuisance effect, causing class size to have a negative sign. In fact, nuisance effect might explain why researchers have difficulties finding "size effect" empirically (Lazear 2001). Finally, if professors are "strict," they will not inflate grades; consequently, grade inflation does not occur, and the class size does not affect grade inflation.

Interaction $Size * GPA$ captures the positive externality that good students enjoy from the nuisance effect. $Size * GPA$ is positive and significant at the 5% level for 100B, but statistically insignificant for 100A, 100C, and the pooled data. In particular, $Size * GPA$ has a wrong sign for 100A, although it is statistically insignificant. 100A has the most full professor teaching the class. Full professors are less likely to preemptively inflate grades because they do not have tenure pressure; perhaps this is why there is no "positive externality" in 100A.

Tenure Status Assistant professors give higher grades than adjunct professors and full professors, with 100B being an exception. However, there is only one full professor in 100B in the sampled period, so one cannot tell whether that full professor gives higher grades because of his or her tenure status or personality. In 100A, 100C, and the pooled data, students who were taught by assistant professors did better than those taught by full professors or adjunct professors, other things being equal. In 100A, a student scored about one third letter grade higher (0.33) if he or she took the class from an assistant professor rather than from a full professor. In 100C, a student scored about one-fourth letter grade higher (0.24) if he or she took the class from an assistant professor rather than from an adjunct professor. In general (in the pooled data), a student scored higher (0.18) if he or she took the class from an assistant professor rather than from a full professor or an adjunct professor, other things being equal.

There are several possible explanations for these results. First, assistant professors might be better teachers than full professors and adjunct professors are. This is not very convincing, though, because there are nine different assistant professors in the data set, and it is unlikely that they are all better teachers. Another explanation, as suggested by several researchers such as Moore and Trahan (1998) and Sonner (2000), is that assistant professors attempt to "buy tenure." This explanation, however, is hardly plausible, because research (rather than teaching) determines tenure decision in the Department of Economics, UC Irvine. As long as the faculty member's teaching evaluation meets some minimum standards, teaching evaluation is of marginal importance in tenure and promotion decisions.

Another explanation is that assistant professor grade leniently to preempt students' nuisance. In a research university such as UC Irvine, assistant professors undergo tremendous stress from demanding research publication requirements, and the opportunity cost of not doing research is prohibitively high. Instead of dealing with pestering students' requests for added points, assistant professors inflate grades to prevent students' nuisance.

Contrary to the findings of Moore and Trahan (1998) and Sonner (2000), I do not find evidence that adjunct professors give higher grades than tenure track faculties do. Grades are negatively associated with adjunct faculties at the one percent level, with 100A as an exception, though there is only one adjunct faculty member teaching 100A and 100B in the sampled period. This finding casts some doubt on the "buying good teaching evaluation" theory.

Control Variables GPA is a strong predictor of grades. One letter grade advantage in GPA is associated with a higher letter grade in all 100 series classes; the coefficients of GPA for regressions are statistically significant at the one percent level. A high GPA suggests good learning ability and discipline; therefore, students with higher GPAs perform better in 100 series classes.

For 100A, 100C and the pooled data, there exists a positive and statistically significant association between grades and Log_Index, although the marginal effect of $Index$ on grades is minimal. No positive association is found between grades earned in 100B and Log_Index. The results are similar to the findings of Butler et al. (1998), who find no significant association between SAT verbal score and the grades of intermediate micro- or macroeconomics, and no association between SAT math score and grade in intermediate macroeconomics.

In none of 100A, B, C is there any significant association between $Major$ and grades, although $Major$ is negatively associated with grades in the pooled data at the 5% level. While econ majors are expected to perform better than non-econ students do, students who major exclusively in econ do not necessarily outperform those who double major in econ. Moreover, a non-major (for example, an engineering major) is not necessarily worse in math than an econ major is, and math skill is crucial for good performance in ECON 100 series. All these factors could explain why there is a perverted, though mostly insignificant, association between $Major$ and grades.

Table 13: OLS Regression, ECON 100 Grades

Variable	Expected Sign	100A		100B		100C		ECON 100 Pooled	
		(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
Size	+	-0.001	0.001	-0.001	-0.005	-0.001	-0.001	-0.001	-0.002
		(3.35)***	(0.47)	(4.03)***	(2.95)***	(4.13)***	(0.29)	(7.14)***	(1.69)*
Size*GPA	+		-0.000		0.001		-0.000		0.000
			(0.98)		(2.39)**		(0.26)		(0.72)
Assist Prof	+	0.372	0.363	0.174	0.177	0.242	0.242	0.262	0.263
		(3.74)***	(3.62)***	(3.79)***	(3.87)**	(4.67)***	(4.65)***	(6.69)***	(6.70)***
Full Prof	?	0.044	0.034	0.346	0.351			0.199	0.200
		(0.43)	(0.33)	(3.90)***	(3.96)***			(4.14)***	(4.17)***
GPA	+	1.018	1.139	1.404	1.072	1.009	1.064	1.307	1.243
		(21.21)***	(8.57)***	(24.15)***	(7.13)***	(13.06)***	(4.72)***	(41.76)***	(13.33)***
Log_Index	+	0.972	0.969	-0.313	-0.340	0.677	0.680	0.458	0.455
		(4.12)***	(4.10)***	(1.21)	(1.32)	(2.29)**	(2.30)**	(2.91)***	(2.90)***
Major	?	-0.056	-0.055	-0.028	-0.029	-0.028	-0.028	-0.072	-0.072
		(1.30)	(1.27)	(0.59)	(0.61)	(0.50)	(0.50)	(2.51)**	(2.52)**
100A Grade (Prereq)	+			0.171	0.171	0.069	0.069		
				(6.39)***	(6.42)***	(2.28)**	(2.29)**		
100B Grade (Prereq)	+					0.201	0.201		
						(7.10)***	(7.10)***		
Class Effect 100A	?							-0.055	-0.056
								(1.01)	(1.03)
Class Effect 100B	?							-0.096	-0.096
								(2.08)**	(2.07)**
Observations		1605	1605	1470	1470	1225	1225	4318	4318
R-squared		0.287	0.287	0.426	0.428	0.359	0.359	0.323	0.323

Absolute t values are in parentheses. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

The grade earned in 100A and 100B are positively and significantly associated with grades earned in the following 100 series classes at the 1% and 5% level. One letter grade advantage of 100A is associated with an improvement of one-sixth (0.17) of a letter grade in 100B and one-fourteenth (0.07) of a letter grade in 100C. One letter grade advantage of 100B is associated with an improvement of one fifth (0.2) of a letter grade in 100C. This is not surprising, because of the course design that the three classes are to be taken in sequence. The knowledge obtained in 100A is crucial in learning 100B, and so on. Moreover, there could be a screening effect. Poor performers in 100A or 100B might not complete the sequence; that is why enrollment dropped on average over the sequence.

V Conclusions and Comments

In this paper, I presented a game theoretic model to show how the threat of students' nuisance can induce professors to inflate grades. The model suggests that students are more likely to pester the professor if the professor is "lenient," the unit cost of studying is high, the reward of pestering is high, the cost of pestering is low, and when information is asymmetric students assign high priors that the professor is "lenient." Moreover, students with a high value of the grade might or might not be more likely to pester the professor. A student who values his grade more highly is more likely to pester the professor after the exam; however, the student will exert more effort in studying before the exam, making pestering unnecessary. A student with a high cost of studying is more likely to pester the professor. Finally, if the professor is "lenient" and the proportion of pestering students is fixed, other things being equal, the larger the class size, and the more likely one observes preemptive grade inflation in larger classes.

The empirical tests weakly support parts of the game theoretic model. About three quarters of the surveyed professors/instructors agree or strongly agree that "students' nuisance is annoying" and "costly in terms of time, effort and energy." Students' value of the grade is positively associated with nuisance; the coefficient is statistically significant at the ten percent level. Students' cost of studying is positively associated with nuisance, although the effect is not statistically significant ($P - Value = 0.14$). A majority of pestering students are composed of poor performers. The empirical tests show no evidence of preemptive grade inflation.

Researchers have discussed possible causes of grade inflation. Yet, they neglect students' nuisance as an alternative explanation for grade inflation, probably because they themselves, as professors, are so used to students' complaints and nuisance. The main contribution of this paper is that it brings our attention to the costly nuisance that not only aggravates grade inflation but also hinders professors from research, teaching preparation, and department service.

For simplicity, the game assumes that students are unable to collude with one another. In real life, however, one does observe students colluding with one another to exchange information about the grading of specific professors. Information exchange websites such as ratemyprofessors.com greatly facilitate communication among students. Sharing information helps to eliminate asymmetric information. For example, one would observe fewer rejections from the professor if more students are aware that the professor is "strict." Although this paper does not discuss delaying grade inflation under asymmetric information, the reader should be able to picture such a case. Suppose the professor delays grade inflation. Student i has a low π_i, so he accepts the grade. However, once his classmates tell him that the professor delays grade inflation, he will pester the professor if inequality (4) holds. If many students behave the same way as student i does, the professor might switch her strategy from delaying grade inflation to preemptive grade inflation.

This paper assumes numerical grades. In the real life, however, grades can be given in alphabetical letters or numeric numbers. If grades are given in alphabetical letters, the utility functions of students will be step functions. In that case, students whose grades are close to the next higher rung (a high payoff of pestering) are more likely to pester the professor than are those students whose grades are further away from the next higher rung, other things being equal.

While this paper focuses on students' nuisance, this study has a broad perspective. Future research will extend the model to describe and analyze the behavior of persistent telemarketers, salespeople, and solicitors who try hard to win potential subscribers, customers, and donors.

A Threshold Studying Effort Level e_0

A.1 Proof of Equations (3) and (4)

Define $E(e_i)$ as the following:

$$E(e_i) = (e_i + \eta)^{\alpha_i} - e_i^{\alpha_i} - \kappa$$

$$\frac{\partial E}{\partial e_i} = \alpha_i \Big(\frac{1}{(e_i + \eta)^{1-\alpha_i}} - \frac{1}{(e_i)^{1-\alpha_i}} \Big) < 0.$$

E is monotonically decreasing in e_i. Since $E(e_{i,0})$ is equal to zero, it follows that equations (3) and (4) hold.

A.2 Proof of Equation (14)

Define Γ as the following:

$$\Gamma = (e_{i,0} + \eta)^{\alpha_i} - e_{i,0}^{\alpha_i} - \kappa = 0.$$

Using implicit function theorem, one can easily verify

$$\frac{\partial e_{i,0}}{\partial \eta} = -\frac{\partial \Gamma/\partial \eta}{\partial \Gamma/\partial e_{i,0}} = \frac{\frac{1}{(e_{i,0}+\eta)^{1-\alpha_i}}}{\frac{1}{e_{i,0}^{1-\alpha_i}} - \frac{1}{(e_{i,0}+\eta)^{1-\alpha_i}}} > 0 \tag{25}$$

$$\frac{\partial e_{i,0}}{\partial \kappa} = -\frac{\partial \Gamma/\partial \kappa}{\partial \Gamma/\partial e_{i,0}} = \frac{1}{\alpha_i\Big(\frac{1}{(e_{i,0}+\eta)^{1-\alpha_i}} - \frac{1}{e_{i,0}^{1-\alpha_i}}\Big)} < 0 \tag{26}$$

$$\frac{\partial e_{i,0}}{\partial \alpha_i} = -\frac{\partial \Gamma/\partial \alpha_i}{\partial \Gamma/\partial e_{i,0}} = \frac{[\ln(e_{i,0}+\eta)](e_{i,0}+\eta)^{\alpha_i} - [\ln(e_{i,0})e^{\alpha_i}]}{\alpha_i[\frac{1}{e_{i,0}^{1-\alpha_i}} - \frac{1}{(e_{i,0}+\eta)^{1-\alpha_i}}]} > 0. \tag{27}$$

Equation (27) holds if $e_{i,0} \geq 1$.

A.3 Proof of Equations (15) and (16)

This section shows that optimal studying effort levels for potential pestering students ($e^*_{D,CP}$) and that of the students who accept the grades ($e^*_{D,A}$) are increasing in the value of the grade, α, and decreasing in the cost of studying, λ. Additionally, $e^*_{D,CP}$ is decreasing in the reward of pestering, η.

$$\frac{\partial e^*_{NI,A}}{\partial \alpha} = \frac{\partial e^*_{D,CP}}{\partial \alpha} = \frac{\partial e^*_{D,A}}{\partial \alpha} = \frac{\partial}{\partial \alpha}\Big((\frac{\alpha}{\lambda})^{\frac{1}{1-\alpha}}\Big) = (\frac{\alpha}{\lambda})^{\frac{1}{1-\alpha}}\frac{1}{(1-\alpha)^2}\Big(\frac{1}{\alpha} - 1 + \ln\alpha - \ln\lambda\Big) > 0 \tag{28}$$

$$\frac{\partial e^*_{NI,A}}{\partial \lambda} = \frac{\partial e^*_{D,CP}}{\partial \lambda} = \frac{\partial e^*_{D,A}}{\partial \lambda} = \frac{\partial}{\partial \lambda}\Big((\frac{\alpha}{\lambda})^{\frac{1}{1-\alpha}}\Big) = (-\frac{1}{1-\alpha})\lambda^{-\frac{2-\alpha}{1-\alpha}}\alpha^{\frac{1}{1-\alpha}} < 0 \tag{29}$$

$$\frac{\partial e^*_{D,CP}}{\partial \eta}\Big((\frac{\alpha}{\lambda})^{\frac{1}{1-\alpha}} - \eta\Big) = -1 < 0. \tag{30}$$

B The Proportion of Pestering Students, q

B.1 The Threshold Proportion of Pestering Students, q^*

This section shows that for all n, there exists only one q^* such that

$$M(n) = M(q^*n) + N(q^*n).$$

PROOF: Suppose there exist two numbers, $\bar{q} \neq \underline{q}$, such that the above equation holds. Without lost of generality, assume that $\bar{q} > \underline{q}$. It follows that

$$M(n) = M(\bar{q}n) + N(\bar{q}n)$$

$$M(n) = M(\underline{q}n) + N(\underline{q}n),$$

which implies

$$N(\bar{q}n) - N(\underline{q}n) = M(\underline{q}n) - M(\bar{q}n).$$

Recall that $N(\cdot)$ and $M(\cdot)$ are monotonically increasing, and that $\bar{q} > \underline{q}$. Therefore, the left hand side of the equation above is positive, but the right hand side of the equation is negative. Thus, there is a contradiction. $\square$

B.2 Proof of Equation (17)

This section shows that given a concave moral cost function $M(\cdot)$ and a convex nuisance cost function $N(\cdot)$, the larger the number of students n, the smaller the threshold proportion of potential pestering students (q^*) that the professor is indifferent between preemptive grade inflation (PI) and delaying grade inflation (D).

$$M(n) = M(q^*n) + N(q^*n).$$

Differentiating both sides of the equation with respect to q^*, one can find

$$0 = nM'(q^*n) + nN'(q^*n).$$

Dividing both sides of the equation by n, one can find

$$0 = M'(q^*n) + N'(q^*n).$$

Let G be the sum of the above equation,

$$G = M'(q^*n) + N'(q^*n) = 0.$$

Using implicit function theorem, one can easily verify that

$$\frac{\partial q^*}{\partial n} = (-1)\frac{\partial G/\partial n}{\partial G/\partial q^*} = (-1)\frac{q^*[M''(q^*n) + N''(q^*n)]}{n[M''(q^*n) + N''(q^*n)]} = (-1)\frac{q^*}{n} < 0.$$

Therefore, the greater n, the smaller q^*. $\square$

C Student i's Prior, π_i

C.1 Proof of Inequalities (19) and (20)

Define $H(e_i)$ as

$$H(e_i) = \pi_i\Big((e_i + \eta)^{\alpha_i} - e_i^{\alpha_i}\Big) - \kappa.$$

Take the derivative with respect to e_i, it can be easily verified that

$$\frac{\partial H(e_i)}{\partial e_i} = \pi_i\alpha_i[\frac{1}{(e_i + \eta)^{1-\alpha_i}} - \frac{1}{e_i^{1-\alpha_i}}] < 0.$$

$H(e_i)$ is monotonically decreasing in e_i, and $H(e_{i,\pi,0})$ is equal to zero. It follows that inequalities (19) and (20) hold.

C.2 Proof of Equations (21) and (22)

$$U_i(e_i|\pi_i, s_i = CP) = \pi_i(e_i + \eta) + (1 - \pi_i)e_i^{\alpha_i} - \lambda_i e_i - \kappa.$$

Table 14: Probit Regression Results: Student Survey Data

Nuisance	Expected Sign	Coef. (Std. Err.)
Value	?	0.4053*
		(0.2347)
Cost	+	0.1998
		(0.1291)
Senior	+	0.5409**
		(0.2217)
GPA	-	-0.1673
		(0.2608)
Major	?	0.1533
		(0.2196)
Cons	?	-1.6971
		(0.9514)

Log Likelihood=-102.25325. Number of observations: 162. Standard deviation are in parentheses.
** significant at the 5% level; * significant at the 10% level.

Differentiating U_i with respect to e_i to find the first order condition,

$$\Theta = \frac{\partial U_i}{\partial e_i} = \pi_i \alpha_i (e_i + \eta)^{\alpha_i - 1} + \alpha_i (1 - \pi_i) e^{\alpha_i - 1} - \lambda_i = 0.$$

Using implicit function theorem, one can easily verify

$$\frac{\partial e^*_{i,\pi,p}}{\partial \pi_i} = -\frac{\partial \Theta / \partial \pi_i}{\partial \Theta / \partial e_i} = (-1) \frac{(e_i + \eta)^{\alpha_i - 1} - e_i^{\alpha_i - 1}}{\pi_i (\alpha_i - 1)[(e_i + \eta)^{\alpha_i - 2} + e_i^{\alpha_i - 2}]} < 0.$$

D The Probit Model

Table 14 shows the probit regression results. The results of the probit model are similar to those in the linear probability model (LPM). The signs of the coefficients are the same as those in the LPM. $Value$ is positive and significant at the ten percent level. $Senior$ is positive and significant at the five percent level. The probit model suggests that the higher the value of the grade, the more likely the student is to pester the professor. Furthermore, juniors, seniors, and graduate students are more likely to have pestered their professors than freshmen and sophomores, as predicted in the LPM.

E Students' Nuisance

E.1 Professors' and TAs' Stories

I collected the following anecdotes from professors and TAs in the Department of Economics, UC Irvine. They describe cases where students pester them for added points.

- A student received a B+ and her grade was close to an A-. She emailed the professor and asked the professor to raise her grade up, saying: "I am sure that in my homework, quizzes, or exams, I will be able to find a small grading mistake that can pump my grade up to an A-. To save your time, why don't you just give me an A-."
- A student went to a TA to ask for more points for a quiz. The TA rejected the request, because he did not think that the student had a case. Yet, the persistent student started to cry, so the TA gave up: "OK, I will just give you the points to get rid of you."
- A student asked for more points on the final exam in order to get an A. The TA did not grant the points because the student's answer was wrong. The student replied: "But *I have to* have an A; I have never received anything worse than that." The TA was so annoyed, so he gave the points.
- A student received a D and asked the professor to give him a C-, because that was the last class he took, and he already received a job offer. The professor felt sorry for this student and passed him.

- A student wrote a 470-word email to a professor explaining why she could not accept the grade she received, and that she needed an appointment with the professor to check if she received proper credit for every single assignment and the final exam. The student also asked the professor to reply "ASAP."

E.2 Students' Students' Viewpoints

The survey asks students to describe the cases where they requested upward adjustments of their grades from professors/TAs. Here are several responses.

- The student feels that he/she deserves more points.
- The student was "just one point away" from an A-, so he/she asked for a grade raise.
- The student received a low grade for a research paper assignment in which the overall grade depended only on the one midterm exam, the research paper, and the final exam. The student thinks he/she spent plenty of time, energy, and thought on the assignment and has never received a grade that low for a paper. After emailing the TA to reconsider his/her case, the TA replied in a mass email to the students that she would not be changing any grades for any reason, and that she would not be available to set up any meetings to even discuss the subject in person.
- Some students asked for more points because of grading mistakes.
- A student asked for an adjustment on a final exam so that he/she would not "get kicked out of college."
- A student said "I just basically emailed the professor to bump me up a letter grade. I tried to be nice when I complain[ed]."

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