NON-PROFITS AND PRICE-FIXING: THE CASE OF THE IVY LEAGUE

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Abstract: A number of private colleges choose not to use merit-based financial aid to compete for students, and until 1990 many of these collusively determined financial aid awards. I theoretically and empirically analyze the effects of different financial aid policies on average prices and tuition revenues. In a model of non-profit optimization, I assume that schools are altruistic in the sense that they derive utility by admitting (qualified) needy students. Nonetheless, utility increases with a reduction in price competition for these students. Using data from Peterson's Guides and the Department of Education, I find that a need-only financial aid policy significantly increases the price paid by non-needy students (tuition); increases the average price paid by students who receive financial aid; and substantially increases earnings from tuition. Thus, even though I assume that schools are non-profit optimizers, not competing with merit-based financial aid has the usual anti-competitive effects. Explicit coordination on financial aid awards increases prices and tuition earnings even more than does tacit collusion.

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In May 1991, the Department of Justice formally accused the Ivy Overlap Group of violating Section 1 of the Sherman Antitrust Act by conspiring to restrain trade through horizontal price-fixing. Participating schools cooperated on the criteria for awarding aid (need, not merit) and jointly determined a student's family contribution; financial aid awards were equal to the difference between the comprehensive fee (tuition, fees, and room and board) of the institution and the jointly determined family contribution.[1] Thus, needy students would face the same net price at all Overlap schools. Although the Ivy Overlap schools and Department of Justice ultimately settled out of court, the settlement allows schools to continue much of the contested behavior.[2]

Because the participants are non-profits, controversy surrounds the objective and effects of price-fixing.[3] The Department of Justice argued that the effect of the Overlap policy was "to restrain price competition among [Overlap members] for students receiving financial aid, resulting directly in higher family contributions for some financial aid recipients."[4] According to Bamberger and Carlton (1999), the Department of Justice further alleged that the "inevitable consequence of the collective behavior of the Overlap schools was to increase the schools' net tuition revenues." In contrast, the Overlap schools argued that the goal was "to advance educational access and socioeconomic diversity ... [the schools] neither sought nor obtained any financial or commercial benefit."[5] In addition, the Overlap schools argued that no antitrust harm was generated since tuition revenues did not increase under the Overlap process.

Schools that did not participate in the Overlap process adopted one of two other financial

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[1] This process is referred to as the Overlap process. *U.S.* v. *Brown University, et al.*, 805 F.Supp. 288, 1992, describes the Overlap process in detail.

[2] See Esposito and Esposito, 1995, for a description of the settlement terms.

[3] Several authors discuss the legal issues in applying antitrust law to the Overlap policy. See, for example, Carlson and Shepherd, 1992, Kreisler, 1991, Morrison, 1992, and Salop and White, 1991.

[4] Complaint for Equitable Relief for Violation of 15 U.S.C. § 1, Sherman Antitrust Act, Civil Action 91-CV-3274, U.S. District Court for the Eastern District of Pennsylvania, May 22, 1991, at 27.

[5] Bamberger and Carlton, 1999, p.271, quoting Massachusetts Institute of Technology's Brief in Opposition to the Antitrust Division's Motion for Summary Judgment. Carlton was an expert witness for MIT.

aid policies. Some schools adopted a need-only financial aid policy but did not participate in the types of coordination described above. Other schools offered merit-based as well as need-based financial aid. In essence, need-only schools, whether they implemented the policy independently or cooperatively, did not compete for meritorious students with price discounts,[6] while schools that offer merit-based aid were competing for these students with price discounts.[7]

I analyze how financial aid practices, including the Overlap process, affect the prices paid for higher education and tuition revenues earned. Carlton, Bamberger, and Epstein, 1995, empirically analyze the narrow question of the effect of the Overlap policy on average tuition revenue. I extend the analysis in two dimensions. First, I consider not only tuition revenue earnings per student, but also the prices charged to three groups of students – non-needy, needy, and financial aid recipients – to capture the distributional effects of different financial aid policies. Second, I consider not only the Overlap policy, but also non-collusive, independent adoption of a need-only policy. In so doing, I separate the effect of the Overlap policy into the effect of a need-only policy and the effect of explicit coordination.

The effects of financial aid policies on prices and tuition earnings are of interest for several reasons. First, price-fixing that succeeds in raising price is typically taken as evidence that the firms possess and exercise market power. Since the goal of a non-profit firm is something other than to increase profits, one might not expect non-profits to exercise market power. Second, the Overlap schools argued that the Overlap process does not increase tuition revenue while the Department of Justice argued that it did. Which of these hypotheses is consistent with the data is necessary in order to analyze the welfare effects of collusion by the Overlap members. Third, because the financial aid policies are a form of selective discounting, they might have socially significant distribution consequences. For example, prices may rise differentially for needy and non-needy students. Finally, whether the legal attack on Overlap collusion is worthwhile depends on the difference between the explicitly and tacitly collusive outcomes. If the non-cooperative outcome mirrors the collusive outcome, legal action will be ineffectual.

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[6] For expositional ease, throughout the paper I use the term meritorious to refer to students who would qualify for merit aid if it were offered.

[7] Schools compete for meritorious students because schools care to whom they sell. Talented students contribute to a school's prestige and may also contribute to a higher-quality education for all students. In addition, Carlson and Shepherd, 1992, argue that more talented students, who are more successful upon graduation, contribute more money. Thus, all else equal, schools prefer more talented to less talented students.

The central idea of the model and results is simple, though unfamiliar. Non-profit firms optimize some objective function, subject to a non-profit *constraint*; zero profit is not the objective. Given market power, whether obtained through collusion or other means, a non-profit firm will exercise that power to increase the value of its objective function. In the case of restrictive financial aid policies, two consequences of exercising market power are to raise average prices and revenues.

To obtain some insight into the effect of collusion on prices in a non-profit industry, Section II presents a model in which decision-makers maximize a utility function that increases in the number of (qualified) students receiving financial aid and in the quality of the school, subject to a zero-profit constraint. The model shows that collusion increases the prices paid by non-needy students as well as needy students, while the effect on tuition revenues earned per student is likely to be positive.[8] Section III motivates the empirical test of the predictions of the model. Four prices are considered: the price paid by students who do not receive any form of financial aid; the average price paid by needy students; the average price paid by students who receive any form of aid; and tuition revenue earned per student. Price is estimated as a function of the financial aid regime, the type of school, the quality of the school, and demand conditions. I describe the sample and data in Section IV.

I present the results in Section V, which reveal that adopting a need-only financial aid policy causes a school to charge about $900 higher tuition than do schools that offer merit-based aid, while explicit collusion increases tuition an additional $700. The financial aid policy does not affect the average price paid by students receiving need-based aid, but the price paid by students who would receive merit aid, were it available, pay substantially higher prices. The combined effects result in higher tuition revenue per student.[9] Schools that independently adopt a need-only financial aid policy obtain about $1,200 in higher tuition earnings, which increases to $2,000 for schools that colluded, relative to schools that offer merit-based aid.

I conclude in Section VI. Collusion on financial aid awards has the standard anti-competitive effect of raising prices even for non-profit firms. To do a complete welfare analysis, we need to consider to additional effects. First, was there an "output" effect (fewer students)? This was neither

[8] Following Simpson's paradox, if the composition of students changes sufficiently, the average price may fall even though the prices to needy and non-needy students both rise.

[9] Carlton, Bamberger, and Epstein find that neither Overlap group earns higher tuition revenues per student. However, I have found several data and method problems in their analysis. When I use their data but correct the problems, I confirm my finding of a significant positive effect. See Section V for the details.

alleged nor supported by the evidence. Second, the non-profit constraint on the schools requires that increased revenues from higher prices be "spent" in some way. The theoretical model predicts that the increased revenues will be spent on increasing quality, which in turn may increase welfare.

II. Theoretical Motivation

Non-profit sectors are difficult to analyze because there is no obvious objective function. Some plausible suggested non-profit objective functions nest profit-maximization.[10] For example, Shepherd (1995) suggests that colleges and universities maximize net revenues from education as an intermediate step towards maximizing an objective function that increases in prestige and in benefits to faculty and administrators. Then collusion has the usual anti-competitive effects: prices rise since schools have an incentive to increase profits from tuition by reducing competition for students. In Carlson's model, the increase in tuition net revenues is then used to invest in prestige and in benefits to faculty and administrators.

However, suppose that a more benign view is held towards colleges and universities. That is, suppose that colleges and universities really do wish to provide access to needy students, as the Overlap schools argued in their defense. Under a plausible objective function that increases in the number of needy students admitted, do schools still have an incentive to raise prices if they cooperate in setting prices? The Overlap schools argue that they simply re-allocate financial aid monies (discounts) without increasing tuition revenue earnings. As illustrated by the model, this is unlikely to be true if the school also derives utility in other dimensions.

The goal of the theoretical analysis is to analyze the effect of cooperation on prices in a situation where firms have a beneficent objective function. I formally model schools that care about access and quality using a two-stage model of university decision-makers who maximize utility subject to a zero-profit constraint.[11] This objective function is chosen as tractable yet largely consistent with the stated objective of the Overlap schools – to provide more access to needy

[10] If schools maximized tuition revenues, conditional on quality, for equally qualified applicants they would admit the one with lower need. Instead, most schools do not even consider a student's financial situation in granting admissions. The National Association of College Admission Counselors reports that, in 1994, 91% of surveyed colleges and universities report that the institution is 100 percent need-blind until May 1, and 86% report that they are need-blind after May 1.

[11] This is an extension of the model in James, 1983. James's one-stage model assumes that firms choose quantities, are competitive (price-takers), and behave non-cooperatively. The model here assumes that firms choose prices and quality and that they have market power, and examines both the non-cooperative and cooperative situations.

students – and with the obvious objective of elite colleges and universities – to maintain a high quality reputation.[12]

Model Set-Up

The formal model considers schools that choose three parameters: the price charged to non-needy students, the price charged to needy students, and investments in quality. As such, it is a model of schools that offer only need-based aid; students are charged different prices depending only on their financial need.[13] I analyze two settings: one in which all choice variables are chosen independently, and one in which the price to needy students is chosen cooperatively while the price to non-needy students and the investment in quality are chosen non-cooperatively. In the final subsection, I discuss the implications of incorporating merit-based financial aid.

One complication of a model of college and university behavior is that students are both consumers and inputs into production; that is, schools care to whom they sell. In particular, the quality of the student body increases the quality of the school. Because quality of the school positively enters the utility function, schools will not be willing to sell to any student, regardless of quality, who is willing to pay. To capture this effect, assume that in the first-stage, schools choose a threshold level of quality that a student must reach in order to be considered acceptable to the school. The applicant pool is determined by the intersection of demand by students and demand for students by the school. In the interests of tractability, I assume that once this minimum level of quality of the student is set, the school desires to enroll all acceptable students equally within each class of students.[14]

Within the set of acceptable potential students, I assume that demand by students of either type is decreasing in the price of attending school i, increasing in the price of attending alternative schools $-i$, increasing in the quality of school i, and decreasing in the quality of alternative schools.[15,16] Let T_i denote the tuition level at school i, which is the price paid by non-needy

[12] The model could be extended to allow schools to derive utility in other dimensions. The qualitative implications of the model would be unchanged, as discussed below.

[13] The financial aid award is the difference between the price paid by non-needy students and the price paid by needy students.

[14] See footnote 10 above; the vast majority of schools admit students without regard to their financial status.

[15] In addition, demand is a function of other variables outside the control of the school, such as income levels. For expositional and notational ease, I suppress these other variables from the discussion of the model. They are incorporated into the empirical estimation.

[16] Demand may depend on the make-up of the student body as well. I do not incorporate such interactions for two reasons. First,

students; D_i the average discounted price paid by needy students (tuition less the average financial aid award); Q the number of non-needy students; N the number of needy students; and K the quality of the school. Then the demand functions are given by $Q = Q(T_i, T_{-i}, K_i, K_{-i})$ and $N = N(D_i, D_{-i}, K_i, K_{-i})$.[17,18]

Utility is a function of the number of needy (qualified) students and the quality of the school: $U = U(N, K)$. For simplicity and without loss of generality, assume that the utility functions are identical across schools, and assume that the utility function has standard properties: $U_N > 0$, $U_K > 0$, $U_{NN} < 0$, $U_{KK} < 0$, and $U_{NK} > 0$. Assume that total costs are a function of the total number of students ($S = Q + N$) and the quality of the school, $C = C(S, K)$, with standard properties: C_S, C_K, C_{SS}, C_{SK}, and $C_{KK} > 0$.

Non-Cooperative Solution

Assume that schools act as Nash oligopolists, so that they conjecture that their rivals will not react to their choices.[19] Dropping the non-choice parameters and the i subscript for notational ease, the maximization problem is given by

$$\max_{T,D,K} \; U\Big(N(D,K), K\Big)$$

$$s.t. \;\; \Pi \equiv TQ(T,K) + DN(D,K) - C(Q(T,K) + N(D,K), K) = 0.$$

The first-order conditions for the choice variables are given by[20]

$$\mathcal{L}_T^{nc} = Q + TQ_T - C_S Q_T = 0 \tag{1}$$

$$\mathcal{L}_D^{nc} = U_N N_D - \lambda N - \lambda D N_D + \lambda C_S N_D = 0 \tag{2}$$

$$\mathcal{L}_K^{nc} = U_N N_K + U_K - \lambda T Q_K - \lambda D N_K + \lambda C_S Q_K + \lambda C_S N_K + \lambda C_K = 0 \tag{3}$$

such interactions lead to second-order effects, changing the quantitative but not qualitative results. Second, the direction of these interactions is unknown. For example, demand by non-needy students may increase in the number of needy students if needy students contribute to a quality education via diversity. On the other hand, it may decrease in the number of needy students if non-needy students use college to search for a mate.

17 For simplicity and without loss of generality, I assume that the demand function is the same for all schools.

18 The model could be relaxed to allow schools to have an "endowment" of quality, K_{i0}, that also increases demand. Then the quality K chosen each period would be an addition to the stock of quality. This endowed quality differential would then lead to an asymmetric equilibrium. However, the qualitative predictions of the model would be unchanged.

19 That is, $dX_{-i}/dY_i = 0$, $X, Y = D, T, K$.

20 Given the assumption that the firms behave as Nash oligopolists, the first-order equations implicitly define the school's best-response function for each of its choice variables as a function of the choices of its rivals. For notational ease, these parameters have been suppressed.

To interpret the model, note that one can solve (2) and (3) to obtain the standard equilibrium condition that the marginal utility per dollar spent on quality and spent on admitting needy students be equal. That is, schools behave as in a standard utility-maximization setting; the only difference is that the school measures the "price" of each product based on its marginal effect on profits.

Consider how a constrained utility-maximizing agent sets T, D, and K relative to the levels that would be chosen by a profit-maximizing agent. The first-order condition for tuition is the standard marginal revenue equal marginal cost condition, leading to the profit-maximizing tuition.[21] The constrained first-order conditions for the price charged to needy students and for the level of quality show that the optimal levels depend not only on marginal revenue and marginal cost with respect to those variables, but also on marginal utility. That is, a utility-maximizing agent will balance marginal revenue *and* marginal utility against marginal cost. Marginal utility from quality is positive; therefore the utility-maximizing manager will choose a level of quality that is above the profit-maximizing level.[22] Marginal utility from the average needy price is negative, so the price charged to needy students by a utility-maximizing agent will be below the profit-maximizing level.[23]

Cooperative Solution

Now suppose that the schools agree to jointly determine the average price paid by needy students while continuing to non-cooperatively set the price paid by non-needy students and the quality level. Intuitively, when the decision-maker considers decreasing the needy price in a non-cooperative situation, utility increases because the quantity of needy students will increase, but profits from needy students decline, tightening the zero-profit constraint. In a cooperative setting, the decision-maker must consider two additional effects: the effect on its rival's utility and the effect on its rival's zero-profit constraint.

More formally, consider for simplicity that there are two schools (i and j) cooperating and that the schools choose the price for needy students to maximize the sum of their utilities. The schools independently choose the values of T and K. Rewriting the cooperative maximization

[21] This comparison is conditional on the level of quality.

[22] Hence, Π_K is negative at the optimum, a fact that will be useful for signing comparative statics effects.

[23] Hence, Π_D is positive at the optimum.

problem as a function of the choice variables, D_i and D_j, and suppressing many parameters for notational ease, the maximization problem can be written as

$$\begin{aligned} \underset{D_i, D_j}{max} \;\; & U\Big(N(D_i, D_j), K_i\Big) + U\Big(N(D_j, D_i), K_j\Big) \\ s.t. \quad & \Pi_i = T_i Q(T_i, T_j) + D_i N(D_i, D_j) - C(Q(T_i, T_j) + N(D_i, D_j), K_i) = 0. \\ & \Pi_j = T_j Q(T_j, T_i) + D_j N(D_j, D_i) - C(Q(T_j, T_i) + N(D_j, D_i), K_j) = 0. \end{aligned}$$

The first order conditions for the choice variables are given by

$$\mathcal{L}^c_{D_i} = U_N N_1 + U_N N_2 - \lambda_i[N + D_i N_1 - C_S N_1] - \lambda_j[D_j N_2 - C_S N_2] = 0$$

$$\mathcal{L}^c_{D_j} = U_N N_1 + U_N N_2 - \lambda_i[D_i N_2 - C_S N_2] - \lambda_j[N + D_j N_2 - C_S N_2] = 0,$$

where λ_i and λ_j are the Lagrange multipliers for the zero-profit constraint for each school.[24] For simplicity and without loss of generality, assume that the schools are identical. Then the first-order equations are identical and can be written as

$$\mathcal{L}^c_D = U_N N_1 + U_N N_2 - \lambda[N + DN_1 + DN_2 - C_S N_1 - C_S N_2] = 0. \tag{4}$$

The Nash equilibrium obtains when the cooperative FOC for the price to needy students (equation (4)), the non-cooperative FOCs for the price to non-needy students and the level of quality (equations (1) and (3), respectively) for each school, and the non-profit constraints for each school hold simultaneously.

To compare the cooperatively chosen needy price, D^c, to the non-cooperative outcome, D^{nc}, I evaluate the first-order equation for D^c at the level D^{nc}. From equation (2), $U_N N_1 - \lambda[N + DN_1 - C_S N_1]$ is equal to zero at the non-cooperative price charged to needy students, so

$$\mathcal{L}^c_D \,|_{D=D^{nc}} \;=\; U_N N_2 - \lambda N_2[D - C_S] = N_2[U_N - \lambda(D - C_S)]. \tag{5}$$

The sign of equation (5) depends on the term in brackets, since demand by needy students increases in the rival's price. The term in brackets is positive, as shown by rewriting a school's first-order equation for the needy price evaluated at the non-cooperative level (equation (2)) as[25]

$$U_N - \lambda[D - C_S] = \lambda \frac{N}{N_D} > 0.$$

[24] I have altered notation to differentiate between the effect of the own price and the rival's price. N_1 refers to the derivative of the quantity of needy students with respect to own price, while N_2 refers to the derivative with respect to the rival's price.

[25] The inequality follows because $\lambda < 0$, N is of course positive, and $N_D < 0$.

Beginning at each school's non-cooperative level of the needy price, the cooperative first-order condition is positive, indicating that the needy price should be increased relative to the non-cooperative level. Thus, collusion in a non-profit setting where decision-makers gain utility from the number of needy students leads to a higher price, as would occur if the schools maximized profits. However, as in the non-cooperative setting, the needy price will not rise so far as the profit-maximizing price, because the schools will again face a trade-off between an increase in profits from needy students and a decline in utility as the number of needy students declines.

The Impact of an Increase in the Price Paid by Needy Students on the Optimal Tuition and Quality Choices

What happens to the price charged to non-needy students and to expenditures on quality when the price charged to needy students is chosen cooperatively? To obtain dT/dD and dK/dD, I differentiate the first-order conditions with respect to D; total derivatives can then be obtained using Cramer's rule.[26]

The derivative of quality with respect to a change in the price charged to needy students is positive. Intuitively, when the needy price is increased relative to the non-cooperative level, profits from needy students increase, loosening the zero-profit constraint. Decision-makers adjust to the higher profits by increasing quality, which increases utility directly as well as indirectly by attracting more needy students.

The derivative of the price to non-needy students with respect to a change in the price charged to needy students depends on the parameters of the profit function. Intuitively, the optimal non-needy price changes because changes in quality lead to a shift in demand by non-needy students and changes in the number of needy students and in quality shift the marginal cost of non-needy students curve. The direct effect of an increase in the price to needy students is to lead to a reduction in tuition; this arises because costs fall given the smaller number of needy students. However, the effects of the increase in quality imply that the price to non-needy students should increase. An increase in quality increases demand by non-needy students and increases costs; costs increase both directly due to the increase in quality and indirectly since the increase in quality leads to a larger number of non-needy and needy students at given prices. Both of these effects – the increase

[26] See the appendix for details.

in demand and the increase in costs – lead to an increase in tuition. If the effect of the increase in quality offsets the effect of the increase in the price to needy students (*i.e.*, if Π_{TK} is sufficiently positive[27]), then tuition rises when firms cooperatively increase the price to needy students.

Earnings from Tuition

There is one other term that is of interest: tuition revenue earned per student (that is, the price averaged across all students). This term is of interest given the conflicting arguments put forth by MIT and the Ivy League and the Department of Justice: the Overlap schools argued that cooperating in setting financial aid awards did not increase tuition revenues, while the Department of Justice argued that it did. Without making additional assumptions regarding the functional forms of demand, the effect is theoretically ambiguous. That both prices increase suggests that the average price increased, but it is theoretically possible that the number of needy students increases sufficiently relative to the number of non-needy students such that the average price falls. However, that seems unlikely to occur in this situation. For both types of students, the increase in quality shifts the demand curve out, while the increase in price reduces the number of students. It seems reasonable to assume that both types of students respond similarly to the change in quality, so that the relative mix of needy to non-needy students would be essentially unchanged due to the increase in quality. It seems plausible to assume that needy students have a more elastic demand than non-needy students, given the differences in wealth and income across the two types of students, in which case it is more likely that the number of needy students will decline relative to the number of non-needy students given the increase in price. If true, tuition revenue earned per student will increase. One thing we can infer from the model, however, is that it is unlikely that revenues per student are unchanged, as claimed by the Overlap schools. That would require a delicate balance in which the mix of students changed just enough so that the increase in revenues from higher prices is exactly offset by a reduction in the number of non-needy students and an increase in the number of needy students. Nonetheless, the effect of cooperation in setting the average price charged to needy students on tuition revenue earned per students remains an empirical issue.

[27] Specifically, if $\Pi_{TK} > \left(\Pi_K \Pi_{TD}\right)/\Pi_D$, then dT/dD is positive.

Extensions and Summary

The model has been developed in the simplest case that is descriptive of the Overlap process in order to illustrate the effects of cooperation in setting financial aid. The formal model illustrates the effect of collusion when schools gain utility in two dimensions, quality and the number of needy students, and when the only form of financial aid is based on a student's need. The effects of incorporating a variety of complicating aspects of the higher education market can be intuited from the simple model analysis. In all cases, the qualitative implication remains: collusion leads to higher prices.

First, while the schools in question obviously require some minimum level of student quality, schools do have preferences over those students meeting the minimum quality standard. One way of attracting the better students is to offer merit-based financial aid, and indeed many schools do. To incorporate merit-based aid, assume that utility depends not only on the number of needy students and quality, but also on the number of meritorious students. There are now four types of students – needy meritorious, needy "average," non-needy meritorious, and non-needy average.[28] With price competition for all types of students, the price to needy, meritorious students would be lowest, since these students increase utility in two dimensions. The price to non-needy, average students would be the highest (at the profit-maximizing level), as these students contribute to utility only indirectly by giving the school the resources to attract needy and/or meritorious students and to increase quality. The price for needy, average and non-needy, meritorious students would be in the middle; which price would be lower depends on the marginal utility of an additional meritorious student relative to the marginal utility of an additional needy student.

The Overlap policy consists not only of cooperatively setting the price to needy students, but also of agreeing not to offer merit-based aid. Thus, the prices charged by Overlap schools can be compared to the prices charged by two other types of schools: schools that also eschew price-competition for meritorious students but that independently implement a need-only policy, which is the comparison made in the formal model above, and schools that offer merit-based aid. Based on the intuition above, if a school eliminated merit-based aid, the price to meritorious students rise, regardless of whether they are needy or non-needy; need-only schools are not willing

[28] Average is used simply to differentiate between the best (meritorious) students and the very good (average) students.

to reduce price as a means to attract meritorious students. The effect on needy and non-needy average students is less clear. They are now grouped with a larger group of students; whether this causes their price to rise or fall depends on the demand curves of the average and meritorious students that are being combined. As in a standard price discrimination model, a consumer prefers to be (not to be) categorized with other consumers if they have lower (higher) demand, as the average price will fall (rise). If demand by meritorious students does not systematically differ from demand by average students, prices to needy and non-needy students may be unchanged when a school does not offer merit aid. Finally, the effect of not using merit aid should increase tuition revenues earned per student, as these students are no longer granted a discount.

Second, the model could be extended to incorporate more arguments into the utility function. For example, Shepherd suggests that schools also care about benefits to administrators and faculty. Benefits to administrators are analogous to increases in quality – by increasing the price to needy students, resources are generated that can be used to invest in benefits. Carlton, *et al.*, suggest that colleges care about the welfare of their students, and so may have a preference for keeping price low.[29] As modeled, the schools' utility function does place a weight on keeping the price to needy students low, since an increase in the price causes the number of needy students to decline. Suppose the schools also derive utility from keeping the price to non-needy students low. In both a non-cooperative and cooperative setting, the price to non-needy students will now be below the profit-maximizing price as the schools set price so that marginal revenue is equal to marginal cost and marginal disutility. Nonetheless, tuition will still rise when the price to needy students is increased under collusion, because the same effects obtain: demand and costs change in such a way as to lead to a higher price to non-needy students. Thus, the qualitative predictions of the model remain: schools will raise the price to needy students if they cooperate, which in turn will lead to higher tuition and higher expenditures on the other arguments in the utility function.

Finally, consider the fact that, unlike the static nature of the model presented, schools are repeating their interactions. The qualitative effect of cooperation remains: explicit cooperation leads to higher prices. What equilibrium obtains for schools that adopt a need-only financial aid

[29] MIT argued that the Overlap process was beneficial because, even though it eliminated price competition for needy students, it encouraged competition among participants in amenities (*U.S.* v. *Brown University, et al.*, 805 F.Supp. 288, 1992, p.304). Thus, caring about student welfare does not necessarily imply that schools will keep prices low; the schools may believe that student welfare lies elsewhere.

policy, but that implement the policy non-cooperatively? Friedman (1971) demonstrated that, in an infinitely repeated game, any outcome between the competitive and monopoly outcome could be sustained. The question then becomes, which of the many possible equilibrium is the most likely to occur? Here, the Federal financial aid program may facilitate tacit (non-cooperative) collusion by providing a focal point. The Federal government requires students wishing to obtain federally-funded financial aid to submit information from which the Department of Education calculates the contribution to be made to education by a student and her or his family; this information is distributed to the student and to all schools to which the student has applied. Thus, all schools competing for this student are provided with a "suggested" price. The existence of such a focal point and the repeated nature of the game may allow the schools to achieve a non-competitive price, even though the schools are behaving non-cooperatively.

To summarize, the model shows that an agreement among schools to collude on the average price paid by needy students increases that price, increases tuition, and increases expenditures on quality. The effect on revenue raised by way of tuition is ambiguous, but likely to be positive. These results arise in a model that assumes that decision-makers gain utility by providing access to needy students, as argued by the Overlap schools, and in which decision-makers are constrained from distributing earnings to "owners" of the firm. The qualitative implications remain when the model is extended in several ways. Note that these qualitative predictions are exactly those that would arise in a model of profit-maximization. The fact that firms are non-profits and that decision-makers gain utility from enrolling needy students does not protect students from the use of market power.

III. Empirical Set-Up and Methodology

I now empirically analyze the effect of a school's financial aid policy on the prices paid by students who receive aid and those who do not and the average revenue earned per student. The first-order equations show that tuition and the average discounted price are functions of marginal utility, demand conditions, marginal cost, and the level of quality of the school. The equation for the average tuition revenue earned per student is a function of the same variables.

The estimating equations are assumed to take the following form:

$$P_{it} = \alpha + F_i\gamma + U_i\beta + D_{it}\delta + Q_{it}\xi + \mu_i + \nu_{it},$$

where P_{it} represents the price charged by school i at time t. The F matrix represents variables that indicate the financial aid regime; the U matrix contains variables that may indicate structural differences in utility functions; the D matrix variables representing demand conditions; and the Q matrix factors that indicate the quality of the school. I assume an error-component model, where μ_i represents the school-specific random error and ν_{it} a white noise error varying across schools and time.

Four prices are considered: the average price paid by students who do not receive financial aid of any kind; the average price paid by students who receive need-based financial aid; the average price paid by students who receive need-based or merit-based financial aid; and tuition revenue earned per student. These prices are analyzed in order to gain insight into the distributional effects as well as the effect on tuition revenues of different financial aid regimes. The price paid by non-needy students is measured as tuition plus mandatory fees.[30,31] The average price paid by needy students is measured as tuition plus mandatory fees less the average scholarship received by needy students. The average scholarship (grant aid) includes awards for which the school chooses the recipient and uses funds under its control. The average price paid by students who receive any type of aid is measured as tuition and fees less grant aid administered by the school per student who receives financial aid. Finally, tuition revenue earned per student is given by out-of-state tuition plus mandatory fees less total grant aid administered by the school divided by the total number of students.

Grant aid includes awards to undergraduate and graduate students. Thus, even though the Overlap process applied only to undergraduates, the appropriate denominator in calculating the average grant award includes graduate students as well. The resulting bias in the measure of average grant aid will be larger the larger the proportion of graduate students. To control for this

[30] For public schools, this variable is measured as a weighted average of in-state and out-of-state tuition, where the weight is the proportion of the student body that are in-state residents. The results are unchanged if out-of-state tuition or if public schools are omitted.

[31] For schools that have mandatory fees but that do not report the level of fees, I impute fees. Because fees were relatively stable during the initial years of the sample, I assume that the fees in 1982-83 are equal to the 1983-84 fees when 1982-83 fees are missing (Bryn Mawr, Claremont, Columbia, University of Pennsylvania, and St. John's). For those schools for which fees are zero for either all observed years or for the initial years of the sample, I assume that fees missing in 1982-83 and/or 1983-84 are equal to zero (Colorado, Dartmouth, Hamilton, Michigan, MIT, Northwestern, Occidental, Princeton, St. Olaf, Smith, Stanford, William and Mary, Wisconsin, and Yale). For Cornell and Earlham I assume that fees in 1983-84 are equal to the average of 1982-83 and 1984-85. Finally, I assume that fees for Georgetown in 1982-83 and 1983-84 are equal to the average fees for 1984-85 and 1985-86. Several other schools had missing values for fees, but sufficiently many observations were missing or fees sufficiently variable that I did not impute these values. The results are not sensitive to the presence of the observations with imputed values.

effect, the regressions for the average price paid by financial aid recipients and tuition revenue earned per student also include as a regressor the proportion of the student body that is graduate students. If graduate students on average receive larger grant awards than do undergraduates, which might be expected since an Overlap process is not applied to graduate students, then average grant aid per student will be overstated relative to its true value for undergraduates. Then the coefficient on the proportion of students who are graduate students would be negative. On the other hand, schools often support most graduate students via employment (teaching or research assistantships). Then, though the average graduate student, conditional on receiving financial aid, receives a higher award than undergraduates, the average across all graduate students will be lower than the average for undergraduates. In this case, the higher the proportion of graduate students, the more that the average grant award is understated, in which case the coefficient would be positive.

Inclusion of the two discounted prices allows two comparisons to be made. The first discounted price allows comparisons of the price paid by needy students at schools with different types of financial aid policies. The model suggests that the price to needy students at Overlap schools is higher than the price at need-only schools that implement the policy independently, conditional on the success of tacit collusion. The relationship between the price charged by need-only schools relative to schools that offer merit-based aid is unknown. The Ivy League argued in its defense that it was transferring financial aid from meritorious, non-needy students to needy students in order to maintain its policy of need-blind admissions and financial aid sufficient to meet the full need of admitted students. If so, then the price paid by needy students at need-only schools and schools that offer merit-based aid should be the same. The second discounted price allows a comparison of the price that financial aid recipients pay at need-only schools relative to the price financial aid recipients pay at schools that also offer merit-based aid. For schools that offer merit-based aid, this discounted price is based on the average scholarship award to students receiving need- or merit-based aid.[32] Several of the schools that were charged or investigated argued that the elimination of the Overlap process would lead to a bidding war, reallocating limited financial aid monies to attract a small number of meritorious students. If this is true, then we should expect to see schools that compete for meritorious students by offering merit-based aid to charge financial aid recipients a lower price than do need-only schools.

[32] Data limitations prevent a comparison of the price paid by meritorious students.

A measurement issue arises with respect to the two discounted prices and the tuition revenue earned per student. A student's financial need depends on the tuition level. The higher is tuition, the more students who qualify for aid, but they are wealthier (or they would have qualified for aid at a lower tuition level) and so qualify for lower levels of financial aid. It is then possible that the average price paid by needy students will be higher the higher is tuition.[33] In order to control, at least partially, for this effect, the regressions for discounted prices and for tuition revenue earnings include as a regressor the proportion of the undergraduate student body that receives financial aid at any level.

Several time-invariant financial aid regime variables are used. The first approach includes three dummy variables indicating: (1) schools that independently offer financial aid on a need-only basis; (2) schools that were part of the Pentagonal/Sisters Overlap group; and (3) schools that were part of the Ivy Overlap group. In a dynamic setting, non-cooperative (tacit) collusion may arise. However, without explicit coordination, these schools may be less effective at reducing price competition for meritorious students. Therefore, independent need-only schools are identified separately. If the magnitude of the independent coefficient is the same size as the Overlap coefficients, then there is some evidence that annual meetings are unnecessary to reduce such price competition. Ivy and Pentagonal/Sisters Overlap schools are identified separately because, although both groups were investigated by the Department of Justice, only the Ivy Overlap group was charged. This may imply that the Pentagonal/Sisters schools were not successful in reducing competition for meritorious students, so I allow for the potential of different effects for the two Overlap groups.[34]

Three alternative specifications are considered. First, it may be that all schools that adopt a need-only policy have similar prices; that is, tacit collusion may be as effective as explicit collusion. I therefore estimate the price equations including a dummy variable indicating a need-only policy, regardless of how the policy is implemented. Second, only Overlap schools are explicitly cooperating. It is of interest to see whether their pricing policies differ from schools that behave non-cooperatively, whether these schools offer merit-based aid or not. This hypothesis

[33] However, the average fraction of the undergraduate student body that receives financial aid is virtually identical across different groups of schools, even though their tuition levels vary. The fraction of financial aid recipients is 54%, 49%, 52%, and 53% at Ivy Overlap, Pentagonal/Sisters Overlap, independent need-only, and merit schools. As shown in Table 2 below, tuition is significantly higher at the Overlap schools than the other types of schools, and is higher at independent need-only schools than at merit schools.

[34] Alternatively, it could be that Justice did not feel that it had adequate evidence against these schools, or that Justice felt a more limited case would be as effective as a broader case.

is tested by including a variable indicating membership in an Overlap group. Finally, I include indicator variables for a need-only policy and for participation in an Overlap group. Inclusion of both variables allows each policy to have a separate effect, allowing a test of the hypothesis that the Overlap process is not any more effective than non-cooperatively refraining from competing in the price dimension for meritorious students.

Two variables are included in the U matrix: indicator variables for liberal arts schools and for public schools. These variables are included to capture the fact that different types of schools may have different objective functions, since different types of schools clearly have different missions. It is expected that universities will behave differently than liberal arts schools, if for no other reason than a tendency for the former to emphasize the physical sciences over the liberal arts and research over teaching. Liberal arts schools are known for their small size, overall and within the classroom, and their excellent learning environment. This reputation may enable them to command a price premium.[35] Thus, the coefficient on liberal arts schools is expected to be positive, driven both by reputation for excellent teaching and because the marginal cost of teaching at liberal arts schools is expected to be higher given lower class sizes and reliance on faculty rather than graduate students for teaching. Public schools are likewise expected to have different utility functions than private schools; state schools are typically legislatively limited in the amount of discretion they have over setting prices. In addition, public schools may offer a lower quality good, through larger classes, higher student-faculty ratios, limited space in required courses, *etc.* While variables measuring the quality of the school are included, they may not be sufficient to capture the full quality effect. Thus, the coefficient on the public dummy variable may pick up a quality effect as well as any differences in utility-functions. All effects suggest a negative coefficient.

One variable is included to measure demand conditions, indicated by D. It is the average of national and a school's state real median income, weighted by the proportion of in-state students. The expectation is that higher incomes lead to higher prices. A weighted average is used because, though the schools in the sample draw from students nationwide, all schools have higher proportions of state residents. Thus, demand for a school will be affected both by the national income as well as by regional incomes.

[35] Including a variable directly measuring enrollment or the student/faculty ratio does not change the results, and neither is significant. Data on average classroom size are not available.

The variables in the Q matrix are designed to proxy for the quality of the institution. The quality of a school, in part, is reflected in and is a positive function of high quality students. Four student-quality variables are included: the proportion of incoming students with verbal (math) SAT scores between 600 and 700 and the proportion with verbal (math) SAT scores above 700. This specification allows a non-linear effect of SAT scores on quality. Four other variables control for quality: the number of volumes in the library, the proportion of graduates who pursue further studies, the proportion of faculty members holding doctorates, and the proportion of the student body that is African-American. The latter is included given the arguments presented by the Overlap members that one benefit of the Overlap process was to lead to a more diverse student body which in turn led to a higher quality educational experience.[36] It is expected that the higher the quality of the school, the higher will be the price; thus, all coefficients are expected to be positive.

In applying the model to competition between schools in a dynamic setting, one must consider quality as analogous to a capital investment. That is, a school's quality level today depends not only on expenditures on quality this period, but also on past expenditures on quality. To take this into account and to eliminate the simultaneity between prices and expenditures on quality this period, I use qualitative measures to proxy for the total stock of quality, not measures of this period's investment in quality. This approach eliminates correlation between the quality regressors and the white noise error that arises under simultaneity.[37]

As discussed in the next section, the data form a panel covering 67 schools over ten years. The normal panel data estimation techniques are infeasible or inappropriate. Fixed effects estimation cannot be used because it does not identify the coefficients on the time-invariant variables, which in this case are the variables of interest. Between and random effects estimation gives inconsistent estimates since a Hausman specification test (reported in Table 4 below) indicates that an assumption that the regressors are uncorrelated with the school specific error is highly untenable.

It is the quality regressors that are correlated with the school-specific error. The school-specific error can be assumed to capture two factors: unobserved quality characteristics and unobserved utility characteristics. If schools have different utility functions, and hence different goals with regard to admitting students, then the school-specific error will be correlated with

[36] Due to data limitations, the inclusion of other ethnic groups is infeasible.

[37] Below I discuss the likely correlation between the quality regressors and the school-specific error term.

measures of the quality of the student body. Unobserved quality characteristics captured in the school-specific error term will be correlated with all the quality variables. While the dummy variables indicating the financial aid regime are not in the set of endogenous regressors, not controlling for the endogeneity of quality is likely to lead to inconsistent estimates on the financial aid parameters because the Overlap dummies are highly correlated with the endogenous variables.

To control for endogeneity, the equations are estimated using the Hausman-Taylor (1981) technique. This approach is an instrumental variables random effects estimator, where the instruments include the exogenous variables, deviations from the time-mean for the time-varying variables, and the time mean of the exogenous time-varying variables. The correlation between regressors and the unobserved school-specific (time-invariant) effects can be eliminated by removing the time-invariant component of the endogenous, time-varying, regressors. Thus, transforming the endogenous regressors into deviations from their time-means provide natural instruments. This ability to obtain instruments from "inside" the system is important in this application. No outside instruments that are correlated with the measured quality of the school but not correlated with the unobserved quality of the school, captured in the school-specific error, seem likely to exist.

The Hausman-Taylor random effects estimator is a weighted average of two consistent estimators, one of which is based on time-variation and the other on cross-sectional variation. Any weight results in consistent estimates. As the weight on the estimate based on cross-sectional information increases, the coefficients on all variables are largely unchanged, but the standard errors on the time-varying regressors increase while the standard errors on the time-invariant regressors decrease. A consistent between estimator is based completely on cross-sectional information. Carlton, *et al.* argue that, because the time-varying regressors change slowly over time, that analyzing the data using the cross-sectional variation is a reasonable way to proceed. Although this produces the most significant results for the variables of interest, the time-varying regressors are not identified. Therefore, I present results based on a weight equal to 0.25, which seems to approximately best identify both the time-varying and time-invariant variables.

IV. Data

Ideally, the empirical analysis would use time-series data across the Ivy Overlap, Pentagonal/Sisters Overlap, and independent need-only schools before and after they adopted their financial

Table 1: Sample of Schools[1]

Ivy Overlap[2]	Pent./Sisters Overlap[2]	Independent Need-Only[3]	Merit-Based Aid[3]	
Brown	Amherst^L	Bates^L	Caltech	North Carolina
Columbia	Barnard^L	Colgate^L	Carleton^L	Oberlin^L
Cornell	Bowdoin^L	Georgetown	Carnegie-Mellon	Occidental^L
Dartmouth	Bryn Mawr^L	Hamilton^L	Centre College^L	Rice
Harvard	Colby^L	Haverford^L	Chicago	Rochester
MIT	Middlebury^L	Lafayette^L	Claremont McKenna^L	St. Olaf^L
Princeton	Mt. Holyoke^L	Northwestern	C. of the Holy Cross^L	Swarthmore^L
Pennsylvania	Smith^L	Notre Dame	Colorado College^L	Texas at Austin
Yale	Trinity^L	Pomona^L	Davidson^L	UC Berkeley
	Tufts^L	Reed^L	Duke	UCLA
	Vassar^L	St. John's^L	Earlham^L	Vanderbilt
	Wellesley^L	Stanford	Emory	Virginia
	Wesleyan^L		Grinnell^L	Washington & Lee^L
	Williams^L		Illinois	Washington U
			Johns Hopkins	William & Mary
			Michigan	Wisconsin

^{L}Liberal arts college.
[1]Derived from *U.S. News and World Report* annual rankings of colleges and universities.
[2]As listed in *U.S.* v. *Brown University, et al.*, 805 F.Supp. 288 1992.
[3]Derived from *Peterson's Guides*.

aid policies in order to most accurately control for school-specific characteristics. However, the Overlap process extends back to the 1950s, and data are not available that far back. While the Overlap meetings ended in the 1991-1992 academic year, the settlement and the Need-Based Educational Aid Antitrust Protection Act of 1997 allowed the schools to continue most of the contested behavior. Thus, the approach taken is to assemble a set of schools that are competitive with the Ivy Overlap schools. Following Masten (1995), the sample consists of any school named as one of the top 25 national universities or the top 25 national liberal arts colleges from the annual *U.S. News and World Report* surveys on colleges in any year since 1981. The schools included in the sample are listed in Table 1, which classifies the schools according to their financial aid policy. I categorize schools into independent need-only and merit-based depending on whether merit-based aid is not or is available in most of the years in the sample. That is, I examine the availability of merit-based aid in all periods as reported in Peterson's Guides. If a school generally offers merit-based aid, then it is characterized as a merit school in all periods. If a school generally does not offer merit-based

aid and is not one of the Overlap participants, it is designated as an independent need-only school in all periods.[38] The sample covers the school years 1981-82 through 1990-91.[39]

Much of the data are from Peterson's *Competitive Colleges*. The variables used to calculate prices include: tuition, mandatory fees, the average need-based scholarship, the proportion of students receiving financial aid, whether merit-based aid is available, undergraduate and total enrollment, and the proportion of in-state students. School characteristics include: whether a school is public or private, the number of volumes in the library, the proportion of faculty with Ph.D.s, the proportion of the graduating class that pursues further study, the proportion of the student body that is African-American, the percentage of the freshman class that have verbal and math SAT scores over 600 and the percentage over 700. Data on total grant aid expenditures are from the Higher Education General Information Survey (HEGIS) and the Integrated Postsecondary Education Data System (IPEDS), which supercedes the HEGIS, which is a survey conducted by the Department of Education. All financial data are deflated using the Higher Education Price Index to 1987 real dollars. Real U.S. and state median income is from the Economic Report of the President. Descriptive statistics are presented in Table 2.[40]

Table 3 presents descriptive statistics on prices and financial aid by type of school. The two measures of the average price paid by students receiving need-based aid and those receiving any type of aid (rows 2 and 3) bear comment. Theoretically, these numbers should be identical for the three groups of schools that adopt a need-only financial aid policy. In practice, this average price may differ for two reasons. First, I am using different data sources for financial aid awards. For the average price paid by students receiving need-based aid, data on the average need-based scholarship are from Peterson's Guides. The average price paid by students receiving any type of aid is calculated using data on grant aid from the Department of Education. Second, need-only schools sometimes offer merit-based financial aid. Average grant aid will be larger by the amount of merit awards than average need scholarships. The difference between the two discounted prices at need-only schools is small and only statistically significantly so for the Pentagonal/Sisters Overlap

[38] As reported in Peterson's Guides, schools that I designate as independent need-only do not offer merit-based aid 87% of the time, while schools that I designate as merit schools offer merit-based aid 98% of the time.

[39] The initial year is chosen as the year when Peterson's, the primary data source, began publishing college guides. It is also the year that U.S. News and World Report began ranking colleges and universities. The final year is the last year that the Overlap schools met.

[40] The minimum average price paid by students receiving any form of financial aid is negative, indicating that these students receive grant aid in excess of tuition and mandatory fees.

Table 2: Descriptive Statistics

	Mean	Std. Dev.	Minimum	Maximum
Tuition & Fees*	$10,242	$2,439	$1,383	$15,802
Avg. Price for Needy*	$4,780	$1,425	$418	$9,802
Avg. Price for Students w/Aid*	$4,958	$1,993	–$743	$9,982
Tuition Rev./Student*	$7,380	$2,083	$469	$13,391
Independent Need-Only	18%		0	1
Pent./Sisters Overlap	26%		0	1
Ivy Overlap	11%		0	1
Liberal Arts	60%		0	1
Public	7%		0	1
Income†	$15,260	$1,386	$11,429	$18,511
% Students Receive Aid	53%	14	19%	86%
% Graduate Students	19%	22	0	84%
Volumes in Library	1,666,439	1,982,790	75,000	10,000,000
Further Study	40%	15	13%	80%
% Faculty w/Ph.D.	90%	8	50%	100%
African-American	5%	2	1%	11%
Verbal SAT 600-700	39%	11	9%	64%
Verbal SAT $>$ 700	11%	9	1%	37%
Math SAT 600-700	44%	8	4%	60%
Math SAT $>$ 700	24%	17	1%	96%

*Deflated by the Higher Education Price Index to 1987 constant dollars.
†In 1987 constant dollars.

schools. For schools that offer merit-based aid, the difference is more substantial (and statistically significantly so), as expected, with the average price paid by students receiving need-based aid higher than the average price paid by students receiving any type of aid. This suggests that, on average, students who receive merit-based aid receive grant aid in excess of the calculated need of the student's family.[41]

With one exception, price variables for any type of need-only school are statistically sig-

[41] Federal financial aid is subject to the restriction that any student who receives even one dollar of federally-funded financial aid, in any form, must not receive a total financial aid award, from all sources, in excess of the student's financial need. Thus, a financial aid award in excess of need is funded totally by the school, and the distinction between the "need" and "merit" portions of the award are meaningless since the money is fungible.

Table 3: Descriptive Statistics[1]
(Standard deviations in parantheses)

	Ivy Overlap	Pent./Sisters Overlap	Independent Need-Only	Merit Schools
Tuition + Mandatory Fees	$11,941†‡* (852)	$11,513‡* (1,093)	$10,809* (1,047)	$8,584 (2,593)
Tuition – Avg. Need Scholar.[2]	$5,359†* (1,112)	$4,888‡ (1,365)	$5,270* (1,025)	$4,761 (1,370)
Tuition – Avg. Scholar., Need or Merit[3]	$5,559* (1,609)	$5,370* (1,648)	$5,320* (1,726)	$3,465 (2,625)
Tuition Revenue per Student	$7,847†* (1,529)	$8,605‡* (1,492)	$8,031* (1,366)	$5,486 (2,957)
Cheating Incidents[4]	3%	16%	13%	—
Number of Schools Ever Cheating	6	8	9	—
Number of Schools	9	14	12	32

† Statistically different from Pentagonal/Sisters Overlap schools at the 5% level, based on a t-test of independent means. Results are the same whether assuming that the variance is the same or allowing the variance to differ across samples.

‡ Statistically different from the independent need-only schools at the 5% level.

* Statistically different from the schools that offer merit-based aid at the 5% level.

[1] Over the sample 1981-82 through 1990-91. Dollar values deflated by the Higher Education Price Index, 1987 constant dollars.

[2] Tuition + mandatory fees less the average financial aid award based on need.

[3] Calculated as tuition revenue per student less financial aid of any type per student receiving aid, regardless of whether aid awarded on the basis of need or merit.

[4] The proportion of school-year observations where cheating (merit aid was offered) occurred.

nificantly higher than the prices at merit schools. In addition, differences exist among the different types of schools that adopt a need-only policy. Both Overlap groups have statistically significantly higher tuition and fees (the non-needy price) than do schools that adopt a need-only policy independently. All need-only schools earn higher average tuition revenue than do schools that offer merit-based aid. Thus, the descriptive statistics suggest that prices and tuition revenue earned per student differ depending on a school's financial aid policy.

Given the three different groups – one Overlap group against whom charges were brought, one Overlap group that did not face charges, and a group that behaves non-cooperatively – one might expect different levels of "cheating," that is deviations from a stated policy of awarding only need-based financial aid. Cases of cheating are compiled as instances where Peterson's Guides published that merit-based aid was available in a given year for any school that generally has a need-only policy.[42] In a traditional, for-profit cartel, a firm deviating from the cartel agreement

[42] Schools self-report whether merit-based aid is available. If schools offered merit-based aid and did not report this policy to

would not announce that they were cheating. Why might we expect different behavior here? Offering merit-based aid can have two effects for a school: first, it may expand the applicant pool, attracting higher quality students to the school, and second, of those students whom the schools have admitted, merit-based aid may induce the student to matriculate rather than attending a rival school. The first effect requires that students know that the school is offering merit-based aid. In fact, if the primary goal is to improve the applicant pool, the school may report that they are offering merit-based aid, even if they do not.

A substantial number of schools in all three need-only groups deviate from the need-only policy: approximately 60% or more of the schools in each group offer merit-based aid at least once over the sample period. Self-reported cheating as a proportion of school-year observations is quite a bit lower among the Ivy Overlap schools than among the Pentagonal/Sisters Overlap and the independent need-only schools. Furthermore, the latter two groups are subject to cheating in every time-period. The Ivy League, on the other hand, was subject to cheating in only two years, 1987-88 and 1988-89. Thus, based on self-reported offers of merit-based aid, the Ivy League appears to be a more stable cartel. While the schools in this group may have higher prices in part because they have faced fewer deviations from a need-only policy, the data on cheating is so noisy that nothing conclusive can be inferred.

While these statistics are suggestive that tacit and explicit collusion significantly raise prices relative to those charged by schools that offer merit-based aid, consideration must be given to possible differences in quality and characteristics of the school. Regression analysis is used to control for these variables, as well as to examine the possibly differential effect of a need-only policy and an Overlap policy.

V. Results

Table 4 presents the results for the Hausman-Taylor random effects estimates controlling for the endogeneity of variables measuring quality. The results of the Hausman specification tests, reported at the bottom of the table, indicate that the hypothesis that all of the regressors are not correlated with the unobserved school effect is rejected for all except the non-needy price (tuition); for that price, the null hypothesis of exogeneity is rejected at the 28% level. The Hausman

Peterson's, the cheating would not show up here.

Table 4: Hausman-Taylor Random Effects Estimates

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Independent	827.07***	108.49	986.33***	1085.08***
	(294.47)	(510.88)	(406.37)	(338.62)
Pent./Sisters Overlap	1421.10***	–373.80	580.19*	932.76***
	(285.15)	(498.69)	(393.42)	(331.03)
Ivy Overlap	1463.35**	246.24	3973.72***	3358.33***
	(665.66)	(1165.84)	(734.37)	(649.55)
Liberal Arts	379.46	470.72	2028.39***	2665.67***
	(463.39)	(748.58)	(632.87)	(513.15)
Public	–6298.34***	–3454.33***	132.83	–2711.67***
	(544.48)	(916.65)	(761.85)	(627.33)
Income	689.46***	4.30	225.14***	446.10***
	(34.07)	(60.96)	(46.68)	(39.29)
Volumes in Library	34.20	74.26	–850.57***	–426.41**
	(205.19)	(306.01)	(206.48)	(172.14)
Further Study	7.56**	4.04	7.55	6.74
	(3.70)	(7.13)	(5.03)	(4.24)
% Faculty w/Ph.D.	6.65	22.44**	–8.36	2.24
	(6.44)	(11.25)	(9.89)	(7.40)
African-American	27.68	–17.34	64.16	83.93**
	(34.83)	(60.87)	(48.43)	(40.46)
Verbal SAT 600-700	–20.80**	–0.23	11.00	–9.79
	(8.26)	(14.21)	(11.26)	(9.50)
Verbal SAT $>$ 700	–17.08	–43.84*	–36.58*	–48.65***
	(13.29)	(23.59)	(18.61)	(15.21)
Math SAT 600-700	14.14*	30.20	–0.70	10.40
	(8.47)	(14.61)	(11.51)	(9.70)
Math SAT $>$ 700	35.03***	25.09	14.13	30.57***
	(9.41)	(16.42)	(12.87)	(10.74)
% Graduate Students			62.47***	55.42***
			(10.83)	(9.03)
% Receive Fin. Aid		0.44	93.23***	–8.27*
		(7.38)	(6.04)	(4.90)
Constant	–2317.99***	1015.66	–5540.32***	–2738.50***
	(819.06)	(1436.00)	(1177.13)	(931.32)
Observations	367	334	354	365
Hausman Test Stat.				
All Vars. Exog.	10.88	41.31***	100.52***	54.53***
Quality Vars. Endog.[1]	0.16	0.66	1.37	1.51

***,**,* Significant at 1%, 5%, and 10% level, respectively.

[1] Tests the null hypothesis that all variables except the quality measures are exogenous.

specification test results, also presented at the bottom of Table 4, for the null hypothesis that all variables other than the quality variables are exogenous do not reject the null hypothesis.

All three types of need-only schools charge statistically and economically significantly higher prices to non-needy students and to students who receive any form of financial aid, and earn more revenue per student relative to schools that offer merit-based aid, based on a one-sided Wald test, while the financial aid regime does not have an impact on the average price charged to needy students.[43] The price paid by non-needy students at need-only schools is substantially higher than that charged by schools that offer merit aid: by over $800 (7.7%) at independent need-only schools and by over $1,400 (12.3%) at Overlap schools. Based on the average undergraduate enrollment and on the average total tuition and fee revenues, the financial aid policy increases tuition revenues by an average of $2.8m (4.6%) annually at independent need-only schools; by an average of $3.1m (10.4%) annually at Pentagonal/Sisters Overlap schools; and by an average of $9.9m (6.9%) at Ivy Overlap schools. In sum, the results show that explicit and tacit collusion in setting financial aid offers leads to higher prices, for all but needy students, and higher earnings.

Carlton, Bamberger, and Epstein find that neither Overlap group earns higher tuition revenues per student.[44] However, there are several problems with their analysis that I correct. First, their data contain timing errors that significantly affect their results. The descriptive data from a Peterson's Guides for any particular edition are derived from the freshmen class of the previous year, while the price data refer to the previous year, the current year, or are estimates of the next year's prices, as indicated.[45] Carlton *et al.*'s data source attributes all data to the same year, while I correctly attribute the variables to the proper years. This data error is quite significant. Carlton *et al.* report that a Hausman test does not reject the null hypothesis that the regressors are not correlated with a school-specific error term. However, when the data are assigned to the correct years, the Hausman specification test statistic is 49.52, which rejects exogeneity at less than 0.001%. Thus, their coefficient estimates are inconsistent; I use instrumental variables to control for endogeneity, generating consistent estimates.

In addition, our methods differ in two important ways. First, Carlton *et al.*'s results are

[43] An F-test of the joint significant of the three variables does not reject that they are jointly equal to zero.

[44] They include separate indicator variables for the Ivy Overlap and the Pentagonal/Sisters Overlap groups. Their control group is schools that do not collude in setting financial aid awards, regardless of whether they offer merit-based aid or not.

[45] ee the "Notes on the Data" section of each edition of *Peterson's Competitive Colleges.*

not estimated precisely, in part because the timing issue mentioned above introduces noise and in part because of their estimation technique. Carlton *et al.* estimate their regressions on one year of data at a time, rather than pooling. Since they are using noisy data and severely restricting the size of their samples, they obtain very large standard errors. Therefore, their conclusion that the Overlap process had no effect may be due merely to a lack of statistical power. Second, Carlton *et al.* form a cross-sectional sample of over 200 schools that are purported to be competitive with the Ivy Overlap schools, including, for example, the University of Southern Illinois at Carbondale, Lehigh University, and Biola University. When I re-estimate the Carlton *et al.* model using more efficient panel data techniques, correcting for the mis-matching of the data across time, and on a smaller, more appropriate sample of competitive schools (as described in Section IV), the estimated tuition effect is both statistically and economically significant. This result holds with or without corrections for endogeneity. Thus, adopting an Overlap process generates significantly higher tuition revenue earnings per student.

Consider the results from the two discounted price regressions. First, a need-only policy, with or without explicit coordination of financial aid awards, does not lead to a higher price charged to needy students, on average (column 2). Second, a need-only policy, alone or with an Overlap process, does lead to a higher price when compared to the average price paid by students receiving any type of financial aid at merit schools (column 3). Both results are consistent with the Overlap schools' stated goal of allocating financial aid monies to needy students away from non-needy, meritorious students. If the joint distribution of student family income and wealth is the same among students attending different types of schools, then the insignificant coefficients on the need-only dummy variables suggest that students' financial needs are met to the same degree by Overlap and merit schools. Given that a student's estimate of financial need is likely to be greater than a school's estimate of financial need, it may be more likely that Ivy League students' families have a distribution of income and wealth to the right of the distribution at other schools. Those students from the lower end of the income and wealth distribution may self-select into lower cost (*i.e.*, non-Ivy) schools since students would receive financial aid packages less than what they perceive as their need. If true, then the fact that needy prices are the same across the types of schools could indicate that financial need of students at schools that offer merit-based aid is not met to the same degree as it is at need-only schools. This is consistent with the arguments of the Ivy League

that a policy of awarding financial aid on the basis of merit will re-allocate financial aid resources from needy students to meritorious students. A need-only policy, with or without coordination of financial aid awards, succeeds in reducing competition for desirable students via financial aid awards beyond the students' need.

There are some differences across the three need-only groups. The Pentagonal/Sisters Overlap group charges statistically significantly higher prices to non-needy students than do schools that independently adopt a need-only policy, and the Ivy Overlap group charges significantly higher prices to students receiving any form of financial aid and earns significantly more tuition revenue per student than do the Pentagonal/Sisters Overlap and independent need-only schools. Thus, there is some support for the hypothesis that schools with different degrees of coordination of financial aid charge and earn different amounts. On the other hand, while the Pentagonal/Sisters Overlap group sets a similar price to non-needy students as does the Ivy Overlap group, with respect to the price charged to financial aid recipients and tuition revenue earned per student, the Pentagonal/Sisters Overlap group behaves more similarly to need-only schools that implement their financial aid policy independently.

Therefore, several alternative financial aid regime specifications are estimated in an attempt to separate the effect of tacit (non-cooperative) collusion from explicit collusion. The results for these alternative financial aid regime variables are presented in Table 5.[46] Several alternative hypotheses are considered. First, it may be that the important classification of schools is simply whether they offer only need-based aid or also offer merit-based aid, in which case a single need-only indicator variable would be appropriate. The results from this approach (labeled "Alternative Model 1") show that need-only schools charge higher prices to non-needy students than do schools that offer merit aid, charge prices to needy students that are higher than that paid by students receiving any type of financial aid at schools that offer merit-based aid, and earn considerably more tuition revenue than do schools that offer merit aid. A second possible categorization of schools is based on whether they explicitly coordinate in financial aid awards (that is, Overlap schools) or whether they set awards independently. The results (labeled "Alternative Model 2") show higher prices to non-needy students, to students receiving any type of financial aid, and higher tuition revenue earned per student, at schools that explicitly coordinate financial aid awards

[46] Full results are presented in the appendix.

Table 5: Alternative Financial Aid Regime Indicators

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Alternative Model 1				
Need-Only	1332.67***	–99.90	1666.07***	1719.28***
	(283.91)	(473.98)	(368.78)	(312.53)
Alternative Model 2				
Overlap	1285.17***	–220.01	1539.39***	1578.90***
	(303.98)	(522.00)	(374.37)	(328.24)
Alternative Model 3				
Need-Only	872.36***	106.88	1148.57***	1214.76***
	(298.90)	(514.08)	(426.46)	(350.89)
Overlap	692.21**	–276.42	827.46**	772.63**
	(328.03)	(594.07)	(430.36)	(366.56)

***,**,* Significant at 1%, 5%, and 10% level, respectively.

when compared to schools that implement their financial aid policies independently. Thus, explicit cooperation leads to higher prices and higher earnings than does independent behavior.

Finally, I include both a need-only and an Overlap indicator variable in order to separate the influence of the two financial aid policies on prices and revenues earned. The results show that the decision by schools to not compete in the price dimension (with financial aid awards) for meritorious students, whether they implement the policy cooperatively or non-cooperatively, is responsible for about 60% of the increase in prices and tuition revenues earned. Implementing a need-only policy jointly (that is, adopting an Overlap process) raises prices and tuition earnings even more. If the settlement between the Ivy Overlap group and the Department of Justice is sufficient to break the cartel, then we may see a reduction in real prices and tuition revenue earnings at the Overlap schools. However, prices and tuition revenue earnings at need-only schools should continue to be substantially higher than at schools that offer merit-based aid.

The other variables perform approximately as expected. Liberal arts schools charge a higher price on average to students who receive any form of financial aid and earn more tuition revenue per student than do universities. Public schools charge lower prices to all students except students receiving any form of financial aid and earn less money from tuition than do private schools. The lower prices and lower earnings are likely to reflect lower quality levels at public schools than at private schools in ways that are not captured by the included quality variables. That public schools

do not charge a higher price to financial aid recipients suggests that public schools are competing vigorously in the price dimension in order to attract the best students. Thus, public schools may place more emphasis on improving quality and reputation via talented students rather than via other means (in part, perhaps, due to their weaker financial position). Income is highly significant and, as one would expect, has a considerably larger influence on the full-price than on either discounted price or on tuition earnings per student. Students who receive financial aid awards are "taxed" at a lower rate than non-needy students, since any increase in income results in a lower increase in price for financial aid recipients than for non-needy students.

Measures of school quality generally have positive coefficients when significant, as expected, with two exceptions. First, as the number of volumes in the library increases, the average price to financial aid recipients and average tuition revenue earnings both decline. It was expected that large library holdings indicated quality, presumably leading to higher prices and earnings. However, since library holdings are cumulative over time, the variable may simply proxy for how long the school has existed, rather than quality. In addition, quality would be reflected not only in the number of holdings but in the quality of the holdings; the two may not be positively correlated. The other surprise is that the variables measuring the proportion of freshmen with verbal SAT scores between 600 and 700 and over 700 are negative. Perhaps this reflects the lower return to education in fields where the verbal SAT is important, such as English and history. Or, perhaps after controlling for other school characteristics, schools that concentrate on English have lower costs and therefore lower prices. The magnitude of the coefficients on the verbal SAT and the math SAT variables suggest a non-linear relationship. For both verbal and math, the coefficient for the proportion of students with an SAT score above 700 is larger in absolute value than the coefficient for the proportion of students with an SAT score between 600 and 700. The magnitudes of all the quality variables are individually relatively small. For example, a one standard deviation increase in the proportion of graduating students that pursue further studies increases tuition and fees by only $113, while average tuition and fees is $10,242. However, the quality variables are highly correlated. That is, an increase in the overall quality of a school will be reflected in an increase in most of the quality variables. If all the quality variables increased by one standard deviation, tuition and fees would increase by $616 or 6%.

I include two variables to control for measurement issues: the proportion of the student

body that is graduate students and the proportion of the undergraduate student body that receives financial aid. The first controls for the fact that the data on total grant aid includes expenditures on graduate and undergraduate students, while the Overlap policy applied only to undergraduates. The positive coefficient suggests that, on average, graduate students receive smaller grant awards than do undergraduate students. Thus, when including graduate students as aid recipients, the average prices are underestimated. The effect of financial aid recipients has no effect on the average price paid by needy students, a positive effect on the average price paid by students receiving any form of financial aid, and a small, negative effect on average tuition revenue earned per student. The first effect is somewhat surprising. The expectation was that, as tuition increased, more students would qualify for financial aid, but would qualify for smaller amounts. Then the average price charged to needy students should increase. The insignificant effect may be driven by the fact that grant aid is generally concentrated on the lowest income students. Thus, as tuition increases, schools may meet the financial need of better-off students with self-help (loans and work-study). The average prices considered subtract only scholarship aid, not self-help awards. The middle effect may reflect differential policies regarding merit-based awards. A school may adopt several strategies in its use of merit-based aid; it could offer a meritorious student a financial aid award in excess of the student's need; it could offer meritorious students a financial aid package equal to their need and call part of the package a merit award; or it could offer non-needy meritorious students a small merit-based award.[47] If the third strategy is adopted, then by offering relatively small awards (charging high prices to meritorious students), more awards might be granted. The latter effect is intuitive: the more students that are receiving financial aid, the fewer students are paying the full price and the lower the average price.

In sum, the adoption of a need-only policy results in considerably higher prices paid by non-needy students and by students who would qualify for merit-based aid were it available and in higher tuition earnings per student. The prices and tuition earnings are even higher when the schools cooperate in the implementation of the policy.

[47] The existence of these strategies is evident in the Peterson's Guides. For some schools the average for merit-based aid is higher than the average need-based aware, for others they are about equal, and for others the merit-based average is about $200-$250.

VI. Conclusion

The purpose of this paper is to analyze the impact of financial aid policies on the prices charged for higher education. Three alternative financial aid policies are considered: overt coordination in implementing a need-only policy, non-cooperative adoption of a need-only policy, and non-cooperative adoption of a policy to offer merit-based aid (that is, to compete for meritorious students in the price dimension). Because the government provides a focal point, non-cooperative (tacit) collusion may be especially likely to arise in this market. A simple model of utility-maximization subject to a non-profit constraint shows that cooperation in setting the price to needy students increases prices to non-needy and needy students, and is likely to increase tuition revenue earnings; these predictions are largely borne out by the data. The results show that an independent need-only policy increased the average price paid by non-needy students by $800 and by over $1,400 at schools that coordinate financial aid offers relative to schools that offer merit-based aid. A need-only policy also significantly increases tuition revenue earned per student, by $900 to as much as $3,300.

The evidence also shows that adopting a need-only financial aid policy, regardless of whether it is implemented independently or cooperatively, leads to a significantly higher price charged to non-needy students and to meritorious students and to higher tuition revenue earned per student. Explicit collusion in the form of the Overlap process causes prices and tuition earnings to increase even more. Thus, the success of the Department of Justice in preventing the Overlap schools from meeting each spring to collectively determine a student's financial need should reduce prices and tuition revenue earnings to some extent, but so long as the schools continue to adopt a need-only financial aid policy and the Department of Education provides a focal point, prices will be higher than if the schools competed for meritorious students in the price-dimension.

Appendix

In matrix notation, the total derivatives are given by

$$\begin{bmatrix} \mathcal{L}^{nc}_{TT} & \mathcal{L}^{nc}_{TK} & -\Pi_T \\ \mathcal{L}^{nc}_{KT} & \mathcal{L}^{nc}_{KK} & -\Pi_K \\ -\Pi_T & -\Pi_K & 0 \end{bmatrix} \begin{bmatrix} \frac{dT}{dD} \\ \frac{dK}{dD} \\ \frac{d\lambda}{dD} \end{bmatrix} = \begin{bmatrix} -\mathcal{L}^{nc}_{DT} \\ -\mathcal{L}^{nc}_{DK} \\ \Pi_D \end{bmatrix},$$

where $\mathcal{L}$ is the Lagrangian, the nc superscript indicates non-cooperative, and the subscripts indicate the derivatives. Because T is chosen to maximize profits, Π_T is zero by the envelope theorem. Making this simplification and substituting for the $\mathcal{L}^{nc}$ terms, the matrix can be re-written as

$$\begin{bmatrix} -\lambda\Pi_{TT} & -\lambda\Pi_{TK} & 0 \\ -\lambda\Pi_{TK} & U_{KK} - \lambda\Pi_{KK} & -\Pi_K \\ 0 & -\Pi_K & 0 \end{bmatrix} \begin{bmatrix} \frac{dT}{dD} \\ \frac{dK}{dD} \\ \frac{d\lambda}{dD} \end{bmatrix} = \begin{bmatrix} -\lambda\Pi_{DT} \\ -U_{DK} + \lambda\Pi_{DK} \\ \Pi_D \end{bmatrix}$$

The denominator of each of the derivatives is given by the determinant of the bordered Hessian, $\lambda\Pi^2_K\Pi_{TT}$, which is positive when the second-order conditions hold. A necessary condition for the second-order conditions to hold is that profits be concave in T, since λ is negative. I therefore assume that $\Pi_{TT} > 0$. The sign of each derivative is determined by the sign of its numerator.

The numerator of dK/dD is given by $-\lambda\Pi_K\Pi_D\Pi_{TT}$. At the optimum, Π_K is negative, Π_D is positive, and λ is negative. From the second-order condition, $\Pi_{TT} < 0$. Therefore $dK/dD > 0$.

The numerator of dT/dD is given by $\lambda\Pi_K(\Pi_D\Pi_{TK} - \Pi_K\Pi_{TD})$. The sign of this expression depends on the sign of the term in parentheses, since λ is negative and Π_K is negative at the optimum. Π_K is negative and Π_D is positive at the optimally chosen levels of K and D. Π_{TD} is negative since it is equal to $-Q_T N_D C_{SS}$; by assumption, demand is declining in price and costs are increasing at an increasing rate. Only the sign of Π_{TK} is unknown. If $\Pi_{TK} > (\Pi_K\Pi_{TD})/\Pi_D$, that is, Π_{TK} is sufficiently positive, then the term in parentheses is positive and so is dT/dD.

Table A1: Hausman-Taylor Random Effects Estimates

Need-Only Dummy Variable

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Need-Only	1332.67***	–99.90	1666.07***	1719.28***
	(283.91)	(473.98)	(368.78)	(312.53)
Liberal Arts	360.46	202.74	573.93	1647.07***
	(605.41)	(973.55)	(672.21)	(566.26)
Public	–6294.51***	–3595.72***	–449.45	–3157.40***
	(493.80)	(848.31)	(740.85)	(598.90)
Income	689.03***	4.67	224.42***	446.04**
	(34.03)	(61.12)	(48.65)	(40.53)
Volumes in Library	46.48	58.44	–896.72***	–441.93**
	(206.47)	(313.56)	(223.37)	(186.40)
Further Study	7.58**	4.07	7.42	6.61
	(3.70)	(7.12)	(5.22)	(4.34)
% Faculty w/Ph.D.	6.69	22.36**	–9.23	2.10
	(6.44)	(11.22)	(10.26)	(7.58)
African-American	27.63	–17.21	63.82	83.82**
	(34.85)	(60.72)	(50.22)	(41.48)
Verbal SAT 600-700	–20.82**	–0.18	10.77	–9.86
	(8.27)	(14.18)	(11.68)	(9.74)
Verbal SAT $>$ 700	–17.07	–44.02*	–37.10*	–48.39***
	(13.26)	(23.53)	(19.34)	(15.60)
Math SAT 600-700	14.23*	29.95**	–1.61	10.22
	(8.48)	(14.60)	(11.97)	(9.97)
Math SAT $>$ 700	34.90***	25.27	16.21	31.36***
	(9.42)	(16.38)	(13.34)	(11.01)
% Graduate Students			57.73***	53.00***
			(10.94)	(9.07)
% Receive Fin. Aid		0.63	93.26***	–8.82*
		(7.33)	(6.26)	(5.00)
Constant	–2366.19***	1210.33	–4527.61***	–2119.87**
	(857.15)	(1493.77)	(1203.07)	(948.45)
Observations	367	334	354	365
Hausman Test Stat.				
All Vars. Exog.	8.99	39.92***	67.77***	81.56***
Quality Vars. Endog.[1]	0.27	0.56	1.45	1.88

***,**,* Significant at 1%, 5%, and 10% level, respectively.

[1] Tests the null hypothesis that all variables except the quality measures are exogenous.

Table A2: Hausman-Taylor Random Effects Estimates

Overlap Dummy Variable

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Overlap	1285.16***	–220.01	1539.39***	1578.89***
	(303.98)	(522.00)	(374.37)	(328.24)
Liberal Arts	359.95	159.96	481.81	1587.39***
	(612.04)	(958.22)	(684.14)	(580.95)
Public	–6602.98***	–3617.60***	–919.26	–3592.77***
	(478.20)	(826.63)	(713.71)	(584.39)
Income	690.94***	5.76	222.88***	447.56***
	(34.28)	(60.91)	(48.94)	(41.06)
Volumes in Library	50.81	39.80	–881.19***	–442.79**
	(207.21)	(304.22)	(225.56)	(189.05)
Further Study	7.67**	3.83	6.79	6.38
	(3.72)	(7.11)	(5.24)	(4.39)
% Faculty w/Ph.D.	6.79	22.24**	–9.64	2.21
	(6.48)	(11.23)	(10.32)	(7.68)
African-American	28.68	–16.84	66.13	86.73**
	(35.02)	(60.72)	(50.38)	(41.93)
Verbal SAT 600-700	–21.22**	0.12	12.19	–9.60
	(8.33)	(14.20)	(11.74)	(9.87)
Verbal SAT $>$ 700	–18.76	–44.49*	–38.00*	–49.84***
	(13.36)	(23.46)	(19.44)	(15.83)
Math SAT 600-700	14.80*	30.25**	–0.49	11.35
	(8.52)	(14.58)	(11.99)	(10.06)
Math SAT $>$ 700	35.08***	25.30	16.33	31.63***
	(9.47)	(16.37)	(13.39)	(11.13)
% Graduate Students			56.01***	51.93***
			(10.92)	(9.11)
% Receive Fin. Aid		0.38	92.54***	–9.36*
		(7.36)	(6.27)	(5.07)
Constant	–2130.38**	1288.49	–4048.75***	–1721.67*
	(867.92)	(1479.56)	(1207.51)	(961.30)
Observations	367	334	354	365
Hausman Test Stat.				
All Vars. Exog.	12.04	57.92***	81.5***	54.97***
Quality Vars. Endog.[1]	0.18	0.52	1.43	1.86

***,**,*Significant at 1%, 5%, and 10% level, respectively.

[1]Tests the null hypothesis that all variables except the quality measures are exogenous.

Table A3: Hausman-Taylor Random Effects Estimates

Need-Only and Overlap Dummy Variables

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Need-Only	872.37***	106.88	1148.57***	1214.76***
	(298.91)	(514.08)	(426.46)	(350.89)
Overlap	692.21**	–276.42	827.46**	772.63**
	(328.03)	(594.07)	(430.36)	(366.56)
Liberal Arts	342.53	138.30	462.55	1584.62***
	(606.35)	(951.94)	(677.34)	(569.73)
Public	–6309.52***	–3578.41***	–473.37	–3187.32***
	(489.43)	(847.25)	(736.15)	(593.30)
Income	688.60***	7.00	224.07***	444.13***
	(33.77)	(60.69)	(48.28)	(41.14)
Volumes in Library	48.67	31.96	–903.08***	–433.12**
	(205.12)	(300.95)	(221.27)	(184.06)
Further Study	7.57**	4.05	7.36	6.53
	(3.68)	(7.13)	(5.20)	(4.31)
% Faculty w/Ph.D.	6.69	22.32**	–9.93	1.75
	(6.40)	(11.25)	(10.24)	(7.54)
African-American	27.55	–17.37	61.17	82.88**
	(34.61)	(60.84)	(50.12)	(41.23)
Verbal SAT 600-700	–20.75**	–0.38	10.66	–9.76
	(8.21)	(14.18)	(11.64)	(9.67)
Verbal SAT $>$ 700	–16.79	–44.80*	–37.88*	–48.56***
	(13.15)	(23.42)	(19.27)	(15.51)
Math SAT 600-700	14.15*	30.10**	–2.03	9.65
	(8.42)	(14.61)	(11.92)	(9.90)
Math SAT $>$ 700	34.85***	25.42	16.39	31.46***
	(9.35)	(16.39)	(13.30)	(10.93)
% Graduate Students			56.73***	51.68***
			(10.84)	(8.93)
% Receive Fin. Aid		0.50	93.96***	–8.19
		(7.39)	(6.27)	(5.00)
Constant	–2351.89***	1261.61	–4366.80***	–2017.18***
	(854.09)	(1487.94)	(1205.94)	(947.69)
Observations	367	334	354	365
Hausman Test Stat.				
All Vars. Exog.	7.93	54.92***	74.82***	66.98***
Quality Vars. Endog.[1]	0.22	0.58	1.49	1.97

***,**,* Significant at 1%, 5%, and 10% level, respectively.

[1] Tests the null hypothesis that all variables except the quality measures are exogenous.

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