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

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Abstract: A number of private colleges and universities have chosen not to compete for students by offering merit-based financial aid. In addition, until 1990 many of these schools jointly calculated a student's financial need. I theoretically and empirically analyze the effects of different financial aid policies on prices paid by students and tuition revenues earned by schools. I model university decision-makers as choosing prices for needy and non-needy students and the quality of the school to maximize a utility function subject to a non-profit constraint. While schools are altruistic in the sense that they derive utility by admitting (qualified) needy students, utility increases with a reduction in price competition for these students. The effect of jointly determining the price charged to needy students is to increase tuition and the average price paid by students receiving aid, while the effect on average tuition revenue earned per student is ambiguous. Using data from the Department of Education and from Peterson's Guides, I find that the adoption of a need-only policy significantly increases the price paid by non-needy students (tuition). The evidence also suggests that students who would qualify for merit-based aid pay higher prices at need-only schools. In addition, a need-only policy substantially increases earnings from tuition; schools that adopt a need-only policy earn an additional $1,400 per student annually. Explicitly coordinating on financial aid awards achieves broadly the same effects as does tacit collusion.

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In May 1991, the Department of Justice formally accused the members of the Ivy Overlap Group of violating Section 1 of the Sherman Antitrust Act by conspiring to restrain trade through horizontal price-fixing.[1] Justice alleged that these schools cooperated on the basis on which to award aid (need, not merit), shared information regarding the financial status of common applicants, and that each school offered qualifying applicants a financial aid package equal to the difference between the comprehensive fee (tuition, fees, and room and board) of the institution and the agreed-upon contribution of the student and her/his family.[2] Thus, needy students would choose to attend a school based only on non-price characteristics. Ultimately, the Ivy Overlap schools and Department of Justice settled out of court. The settlement allows the schools to agree to need-blind admissions, to meet to discuss general financial aid policies, and to compare need claims of applicants to discourage fraud. Schools are not allowed to discuss awards to specific students except after the students matriculate.

All parties agree that price-fixing did occur. The controversy surrounds the welfare effects since the schools engaging in price-fixing are non-profit. It is not clear what the goal of price-fixing by non-profits might be; in addition, price-fixing may have pro-competitive effects in a non-profit setting. If price-fixing by non-profits raises revenues, the proceeds must be spent in order to maintain non-profit status. Increased revenues could be spent in a way favorable to the academic community, *e.g.*, through higher salaries, or in a way that

[1] The Ivy Overlap Group consists of the Ivy League and MIT. Several other schools were investigated, including members of the Pentagonal/Sisters Overlap Group. The Pentagonal/Sisters Overlap Group schools and the schools belonging to neither Overlap Group were not charged.

[2] This process is referred to as the Overlap process. Although not explicitly discussed, the schools also agreed to try to balance the financial aid award between self-help (loans and employment) and grants. Both the Ivy Overlap Group and the Pentagonal/Sisters Overlap Group adopted this process for awarding financial aid. *U.S.* v. *Brown University, et al.*, 1992, describes the process in detail.

enhances education, *e.g.*, smaller class sizes, increased library holdings, better computing facilities, *etc.*[3,4] MIT argued that the goal of the Overlap process was to ensure that financial aid monies were distributed to students with need, rather than used to attract meritorious, non-needy students.[5]

In addition to the Overlap process, colleges and universities adopt two other financial aid policies. Some schools adopt a need-only financial aid policy, but do not participate in the types of coordination described above.[6] Other schools offer merit-based as well as need-based financial aid. In essence, need-only schools are declaring that they will not compete for meritorious students with price discounts, while schools that offer merit-based aid are competing for these students with price discounts. While both types of schools are behaving non-cooperatively, the independent need-only schools may be engaging in tacit collusion. Of course, the legal implications of tacit versus explicit collusion are quite different. Regardless of the legal status, however, the effects of tacit and explicit collusion may be the same.

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 financial aid process may facilitate tacit collusion by providing a focal point. The federal government requires students wishing to obtain federally-funded financial aid to submit the Financial Aid Form. Based on this information, the Department of Education calculates the contribution to be made to education by a student and her orhis family. The College Sscholarship Ssrvice distributes this information to the student and to all schools to which the student has applied.[7] Thus, all schools competing for this student are provided with a

[3] Many of these spending categories benefit faculty and administrators as well as students.

[4] Theoretically, it is not necessarily true that increased competition in non-price categories is an improvement given the reduced competition in the price dimension. Legally, as stated by the court, "...any competition that survives a horizontal price restraint naturally will focus on attributes other than price. This is *not* the kind of procompetitive virtue contemplated under the [Sherman] Act, but rather one more consequence of limiting price competition." (*U.S.* v. *Brown University, et al.*, 1993; emphasis added.)

[5] This is consistent with government goals: students who receive *any* federal financial aid may not receive aid from other sources such that the total amount of financial aid is more than the student's estimated financial need.

[6] I refer to these schools as independent need-only schools.

[7] See *U.S.* v. *Brown University, et al.*, 1992, for a more complete description of the financial aid process.

"suggested" price to charge the student. 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.[8]

I analyze how financial aid practices, including the Overlap process and the independent adoption of a need-only policy, affect the prices pad for higher education and tuition revenues earned. These effects are of interest for several reasons. First, price-fixing that succeeds in raising price is typically taken as evidence that the firms have market power, which may be of particular interest since the schools are non-profits. Second, the schools argue that redistribution occurs solely within the group of students receiving financial aid, implying that the price paid by non-needy students is not affected. In addition, the schools state that the Overlap process does not increase tuition revenue. It would be of interest to see if these distributional hypotheses are consistent with the data. Third, any attempt to determine whether the Overlap process is socially beneficial, which I do not attempt, must consider the price effects. Finally, the success of the legal process depends on whether schools are able to replicate the outcome of the Overlap process simply by independently adopting a need-only policy. That is, if schools can easily tacitly collude, elimination of the Overlap process (explicit collusion) may have been ineffectual.

To obtain some insight into how prices may be affected by collusion in a non-profit industry, Section II presents a model in which decision-makers maximize a utility function that increases in the number of 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 and needy students, while the effect on tuition revenues earned per student is ambiguous. 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

[8] See Rees, 1993, for an overview of tacit collusion.

estimated as a function of the financial aid regime, the type of school, the quality of the school and student body, and demand conditions. I describe the sample and the data in Section IV. Data are from the Department of Education from 1982-1983 to 1990-1991 and from Peterson's Guides.[9]

I present the results in Section V. Schools adopting a need-only policy independently charge about $700 more to non-needy students relative to schools that offer merit-based financial aid, while the Overlap schools charge over $1,100 more to non-needy students. this finding is in direct opposition to the statements by the schools that there are only transfers from meritorious, non-needy students to needy students. On the contrary, I find that all non-needy students pay substantially higher prices. The financial aid regime does not appear to have much of an impact on the average price paid by needy students. The average price paid by students receiving an aid award of any type is higher at independent and overlap schools. The effects combine into additional earnings in tuition revenue per student of $1,300 or more relative to schools that offer merit-based aid. This too is in direct opposition to the statement by the schools that they do not earn more tuition revenue by coordinating financial aid awards. Finally, the analysis reveals that the primary cause of the higher prices is the adoption of a need-only policy rather than explicit coordination. Thus, the elimination of the Overlap process is not expected to have much of an impact on prices.

I conclude in Section VI. There is evidence that tacit or explicit collusion in setting financial aid awards does have the standard anti-competitive effect of raising price. However, there are (at least) two additional effects to be considered in evaluating the welfare effects. First, there was never an allegation nor any evidence that collusion in this instance leads to a reduction in "output." Thus, the higher price translates into a transfer from students to schools and from some students to other students, rather than a deadweight loss. In addition, the non-profit status of the school requires that increased revenues from the higher prices be "spent" in some way. The theoretical model suggests that the revenues will be

[9] Few if any libraries keep old guides. I am extremely grateful to Peterson's Guides for loaning the necessary volumes to me.

spent on increasing quality, which may increase welfare. Evidence of the socially beneficial effect remains to be seen.[10]

II. Theoretical Motivation

Any non-profit sector is, of course, difficult to analyze because there is no obvious objective function. I utilize a two-stage model of university decision-makers who maximize utility subject to a zero-profit constraint.[11] This objective function is chosen as tractible yet largely consistent with the stated objective of the Overlap schools – to provide more access to needy students – and with the obvious objective of elite colleges and universities – to maintain a high quality reputation. The implications of the model are not unique; for example, the assumption that schools maximize profits, appropriating the proceeds indirectly (*e.g.*,, higher salaries), would yield the same predictions. The goal of the theoretical analysis is to analyze the effect of cooperation on prices in a situation where firms have a "nice" objective function.

Model Set-Up

Utility is a function of the number of needy students (N) and the quality of the school (K): $U = U(N, K)$. For simplicity, 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 $U_{NK} > 0$.

One complication of a model of college and university behavior is that students are both consumers and inputs into production; that is, unlike in conventional markets, schools do care to whom they sell. In particular, the quality of the student body increases the

[10] Carlton, Bamberger, and Epstein, 1995, suggest that the policy did succeed in increasing the racial diversity of the Overlap schools. Their results suggest that the student body is 5% African-American at Overlap schools but only 3% at other (independent and merit) schools, a statistically significant difference. The results for Hispanic students show no statistically significant effect. They do not analyze racial diversity at independent need-only schools.

[11] This is an extensions 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 that they have market power, and examines both the non-cooperative and cooperative situations.

quality of the school, though the quality of the school is measured in other dimensions as well. Because quality 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.[12]

Within the set of acceptable potential students, I assume that the number of students of either type is affected by the price of attending school i, the price of attending alternative schools $-i$, the quality of school i, and the quality of alternative schools. Given the minimum quality of students, quality now refers to characteristics other than characteristics of the student body. Let T_i denote the tuition level at school i, which is the price paid by non-needy students; D_i the average discounted price paid by needy students (tuition less the average financial aid award); and Q the number of non-needy students. Then the demand functions are given by $Q = Q(T_i, T_{-i}, K_i, K_{-i})$ and $N = N(D_i, D_{-i}, K_i, K_{-i})$, where quantity decreases in the school's own-price, increases in rivals' prices, increases in its own quality, and decreases in its rivals' quality.[13]

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 $C_{KK} > 0$. That is, the cost of increasing each output is increasing at an increasing rate. Also, the more students, the more costly it is to increase quality (and the higher quality of the school, the more costly it is to increase the number of students).

[12] Masten, 1995, considers the matching problem between students and schools in more detail, but not in the context of competition between schools.

[13] The model could be relaxed to allow schools to have an "endowment" of quality, K_{i0}, that also increases demand. This endowed quality differential would then allow schools to differ in behavior and outcomes. However, the qualitative predictions of the model would be unchanged.

Non-Cooperative Solution

In a non-cooperative setting, university decision-makers only take into account the effect that their choice variables impose on themselves. Assume that schools act as Nash oligopolists, so that they conjecture that their rivals will not react to their choices.[14] Dropping the non-choice parameters and the i subscript for notational ease, the maximization problem is given by

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

$$s.t. \; \Pi = 0,$$

where $\Pi = TQ(T,K) + DN(D,K) - C(Q(T,K) + N(D,K),K) = 0.$ The first-order conditions are given by[15]

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

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

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

$$\mathcal{L}_\lambda^{nc} = TQ + DN - C = 0 \tag{4}$$

One can solve (2) and (3) each for λ to obtain the standard equilibrium conditions

$$\frac{U_N N_D}{N + DN_D - C_S N_D} = \frac{U_N N_K + U_K}{TQ_K + DN_K - C_S Q_K - C_S N_K - C_K}$$

or

$$\frac{U_N N_D}{U_N N_K + U_K} = \frac{N + DN_D - C_S N_D}{TQ_K + DN_K - C_S Q_K - C_S N_K - C_K}.$$

The numerators in the first form give the marginal utility from D and K, while the denominators indicate the marginal profit with respect to D and K. Note that this is the

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

[15] 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.

standard consumption optimization condition that the marginal utility per dollar be equal across the goods. Alternatively, the second form is simply the condition that the marginal rate of substitution must be equal to the ratio of "prices," where prices are measured as the effect on profits.

It is of interest to 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, leading to the profit-maximizing tuition.[16] The constrained first-order conditions for the price charged to needy students and for the level of quality show that the optimal level depends not only on marginal revenue and marginal cost with respect to those variables, but that it also depends on marginal utility. Marginal utility from quality is positive; therefore the utility-maximizing manager will choose a level of quality that is above the profit-maximizing level.[17] Marginal utility from the average needy price is negative, and the price charged to needy students by a utility-maximizing agent will be below the profit-maximizing level.[18]

In sum, the model shows that a utility-maximizing manager of a non-profit school will set tuition equal to the profit-maximizing level, but that the average discounted price will be lower and the level of quality will be higher than it would be at a profit-maximizing school.

Cooperative Solution

Now suppose that the schools agree to jointly determine the average price paid by needy students. How does the analysis change? Intuitively, when the decision-maker considers decreasing D 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, decision-maker i must consider two other effects:

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

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

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

the effect on j's utility and the effect on j's zero-profit constraint.

More formally, consider for simplicity that there are two schools (i and j) cooperating and the schools maximize the sum of their utilities. Rewriting the maximization 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

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

Assume that the symmetric outcome obtains ($D_i = D_j \equiv D$), in which case the first-order condition can be written as

$$\begin{aligned} \mathcal{L}_D^c = & U_N N_1 + U_N N_2 + U_N N_1 + U_N N_2 \\ & - \lambda_i [N + DN_1 + DN_2 - C_S N_1 - C_S N_2] \\ & - \lambda_j [N + DN_1 + DN_2 - C_S N_1 - C_S N_2] = 0, \end{aligned}$$

where λ_i and λ_j are the Lagrange multipliers for the zero-profit constraint for each school.[19] If we are in a completely symmetric outcome, such that both schools charge the same tuition and have the same quality, then $T_i = T_j$, $K_i = K_j$, and $\lambda_1 = \lambda_2$, and the first-order equation can be simplified to

$$\mathcal{L}_D^c = U_N N_1 + U_N N_2 - \lambda [N + DN_1 + DN_2 - C_S N_1 - C_S N_2] = 0. \tag{5}$$

To compare the cooperatively chosen D, 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

$$\mathcal{L}_D^c \mid_{D=D^{nc}} \; = U_N N_2 - \lambda N_2 [D - C_S] = N_2 [U_N - \lambda (D - C_S)]. \tag{6}$$

[19] I have altered notation to differentiate between the effect of the own price and the rival's price. That is, 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.

Because demand for one school increases in the other's price, N_2 is positive, and the sign of equation (6) depends on the term in brackets. The term in brackets is positive, as shown by rewriting a school's first-order equation in a non-cooperative setting (equation (2)) as

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

The inequality follows because $\lambda < 0$, N is of course positive, and $N_D < 0$. Therefore, beginning at each school's non-cooperative level of the needy price, I find that the cooperative first-order condition is positive, indicating that the needy price should be increased. As in the non-cooperative setting, the needy price will not rise as far as the profit-maximizing price, because the schools will again face a trade-off: a higher price loosens the non-profit constraint, allowing the school to invest in quality, but also reduces the number of needy students, directly reducing utility.

While not (entirely) relevant for the analysis of this particular case, it is interesting to consider the effects of cooperating in setting T.[20] If the schools attempted to collude on the price charged to non-needy students, they would face a fairly traditional cartel situation, and T would increase to the monopoly level.[21] The difference relative to a traditional cartel is that increased profits from a monopoly tuition level would have to be spent in order to maintain the non-profit status. The increased profits from non-needy students would be spent in two ways: to reduce D, which attracts more needy students, increasing utility, and to increase K, which increases utility directly and by attracting more needy students.

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? Suppose that D is

[20] The schools were also investigated for colluding on tuition, though no formal charges were ever brought. The consent decree does specify that schools agree to not cooperate in setting tuition.

[21] In the static model here, complete collusion would achieve the monopoly non-needy price. See Rotemberg and Saloner, 1986, for explanations for why firms may not be able to reach the monopoly outcome in a dynamic setting. In addition to the reasons put forth there, not all high-quality colleges and universities were part of the Overlap process, and the existence of a competitive fringe or non-cooperative oligopolists will prevent cooperating schools from achieving the monopoly tuition level.

chosen cooperatively first, then each school chooses T_i and K_i. The maximization is nearly identical to the non-cooperative situation; the only difference is that the decision-maker's choice set has been reduced to T_i and K_i. Therefore, the relevant first-order conditions are unchanged. 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.

In matrix notation, the derivatives are given by

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

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, $\lambda\Pi_K^2\Pi_{TT}$, 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. Thus, the sign of each derivative is determined by the sign of its numerator.

The numerator of dK/dD is given by $-\lambda\Pi_K\Pi_D\Pi_{TT}$. As discussed above, Π_K is negative, Π_D is positive, and λ is negative. From the second-order condition, $\Pi_{TT} < 0$. Therefore $dK/dD > 0$. Intuitively, in a cooperative setting, decision-makers will adjust to the higher profits from needy students by increasing the quality of the school, which affects utility directly, but also affects it indirectly through its effect on the number of needy students and on the non-profit constraint. When the needy price is increased relative to the non-cooperative level, the number of needy students declines, reducing utility, but profits from needy students increase, loosening the zero-profit constraint. Decision-makers increase quality with the increased revenues, which increases utility directly and attracts more needy students, which also increases utility.

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 optimally-chosen level of K. Π_K is negative and Π_D is positive at the optimally chosen levels of K and D. Π_{TD} is positive since it is equal to $Q_T N_D C_{SS}$; as usual, demand is declining in price and I've assumed that 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 positive or not too negative, then the term in parentheses is positive and so is dT/dD. This condition is satisfied if Q_{TK} is positive, or at least not too negative. This is certainly a reasonable assumption. If Q_{TK} were negative, then a higher quality school would face a larger drop in students if it raised tuition by \$1 than would a lower quality school, which seems quite unlikely. So under the reasonable condition that Q_{TK} is positive, an increase in the needy price causes an increase in the price charged to non-needy students. Intuitively, an increase in the needy price decreases the total number of students, decreasing the marginal cost of an additional student. This would tend to suggest that tuition would fall. However, the other effects offset this tendency. The increase in quality induced by an increase in the price to needy students increases demand by needy and non-needy students at a given price, increasing the marginal cost. The increase in quality also directly increases the marginal cost. These increases in marginal cost, along with the shift outward of the demand by non-needy students and the assumption that the demand curve does not twist too far counter-clockwise all cause tuition to increase.

Earnings from Tuition

There is one other term that is of interest in the analysis: the tuition revenue earned per student, or alternatively, the average price paid by students of both types. This term is of interest given the arguments put forth by MIT and the Ivy League that they do not make money by colluding on the need-only policy. Without making many more assumptions regarding functional forms and magnitudes, the effect is theoretically ambiguous. In fact, the theory does not even unambiguously predict whether the number of students will rise or fall. While prices to needy and non-needy students rise, quality of the school increases, which

increases the number of students. Which effect dominates depends on the price elasticity and quality elasticity of demand. The increases in price may increase or decrease revenues, while the increase in quality unambiguously increases revenues.

One thing that we can infer from the model, however, is that it is extremely unlikely that revenues per student are unchanged, as claimed by the Overlap schools. The effect of cooperation over the average price charged to needy students on tuition revenue earned per students remains an empirical issue.

Summary

The model, of course, departs from real-world characteristics of the market in a number of dimensions. First, while the schools in question obviously have some minimum level of quality required of students, schools do have preferences over those students meeting the minimum quality standard. The model could be extended to allow for four types of students: needy meritorious, needy "average," non-needy meritorious, and non-needy average.[22] The utility function could be extended to be a function of the the number of meritorious students as well as the number of needy students and quality. With price competition for meritorious students, the price to needy, meritorious students would be lowest, since these students increase utility in two dimensions. The price of non-needy, average students would be the highest (at the profit-maximizing level, given the quality level), as these students contribute to utility only 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 would depend on the marginal utility of an additional meritorious student compared to the marginal utility of an additional needy student. Cooperation in price-setting for the two meritorious groups of students would lead to the same conclusions drawn in the analysis above. Thus, the predictions of the model are

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

largely unchanged when students are also segmented according to quality.[23]

Another potentially important issue is that schools and universities can use first-degree price discrimination.[24] This allows schools to compete in a targeted manner not captured by the model. With targeted competition, a reduction in the price to one student always increase marginal revenue, since the reduction need not be extended to the infra-marginal students, leading to needy prices to some students that are below the single-price level. However, the same qualitative predictions of cooperation hold: schools will still be better off reducing price competition for needy students (and meritorious students in a model as described in the previous paragraph), especially since they can hold prices low for a targeted group of needy students.[25] Whether this will lead to a larger or smaller increase in the *average* price charged to needy students is unclear, but the direction of the change in price is clear.[26]

The final consideration is the difference between tacit and explicit collusion. Friedman's (1971) folk theorem suggests that an equilibrium of an infinitely repeated game includes the equilibrium that arises under explicit collusion, and as shown in the model, collusion increases the welfare of cooperating schools. So, why don't we see all schools adopting a need-only financial aid policy? There are two primary reasons. First, a school would always prefer to be outside the agreement than within it, so long as the agreement stands.[27] Another important reason is the likelihood that utility functions differ across schools. Schools are likely to have different preferences over granting access to needy students versus investing in quality and to have different preferences over the role of student quality in the school's

[23] Because I do not have data on prices paid by and characteristics of specific students, empirically I cannot analyze the prices paid by meritorious versus average students.

[24] Actually, they use a combination of third-degree and first-degree price discrimination. A large class of students, those who are non-needy, are charged a single price, a lá third-degree price discrimation. Needy students are each charged a different price, a lá first-degree price discrimination.

[25] The higher price for needy students will again induce a higher price to non-needy students and a higher quality level.

[26] The difference between targeted and general price competition for students cannot be empirically tested since all schools use a targeted method.

[27] For example, the Ivy Overlap group tried several times to convince Stanford to join, since the group considered Stanford to be its primary competitor, but Stanford refused to join. See the discussion in *U.S.* v. *Brown University, et al.*, 1992.

overall quality. So, for example, decision-makers who believe that attracting high quality students is more beneficial to a school than investing in another dimension of quality (say, lower class sizes) will prefer to use resources in the form of merit-aid to attract high quality students rather than in the form of hiring more faculty. On the other hand, a school may gain more utility from quality than from needy students, in which case the school would prefer to reduce competition for the needy students to raise profits that can be invested in quality.

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 for needy students, as argued by many of the presidents of the schools that were charged and/or investigated,[28] and in which decision-makers are constrained from distributing earnings to "owners" of the firm. 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 a higher number of needy students does not protect students from the use of market power.

III. Empirical Set-Up and Methodology

I now use data to test the predictions of the model 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 (equations (1) and (2)) show that tuition and the average discounted price are functions of marginal utility; demand conditions; marginal cost; and, implicitly, the level of quality of the school. The equation for the average tuition revenue received per student (equation (7)) is a function of the same variables.

[28] See, for example, Bowen and Breneman, 1993.

The estimating equation is assumed to take the following form:

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

where P_{it} represents the price charged by school i at time t. The F matrix represents variables which indicate the financial aid regime; the U matrix contains variables that may indicate structural differences (that is, differences in utility functions); the D matrix variables representing demand conditions; the S matrix factors that indicate quality of the student body; 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. The price paid by non-needy students is measured as out-of-state tuition plus mandatory fees.[29,30] 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 received by needy students includes awards for which the school chooses the recipient and uses funds under its control; it does not include the value of subsidized loans or the value of work-study awards (essentially, subsidized wages).[31] The

[29] This variable is potentially problematic with respect to public schools, which charge a lower price to in-state residents. This lower price to in-state students affects competition between, say, the University of California and MIT for California residents. Alternatively, tuition could be measured as a weighted average of in-state and out-of-state tuition. The results are largely unchanged if a weighted average is used. The only noticeable difference is in the dummy variable on *public*: it is much larger in magnitude when the weighted average is used. A third approach, eliminating public schools, was also used, also without affecting the basic results.

[30] Several schools have mandatory fees, but do not report the level of fees. For these schools, 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 for schools where 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.

[31] The omission of these types of financial aid from the analysis are necessitated by data availability.

average price paid by students who receive aid regardless of type is measured as tuition and fee revenue per student less grant aid administered by the school per student who receives financial aid. This variable too does not include the value of subsidized loans and work-study awards. Finally, tuition revenue earned per student is given by total tuition revenue reported less total grant aid administered by the school, divided by the total number of students.[32]

Inclusion of the two discounted prices allows two comparisons to be made. The first allows comparisons of the price paid by needy students at schools that offer only need-based aid and at schools that also offer merit-based aid. The Ivy League argued in its defense that it was transferring financial aid from meritorious, non-needy students to needy 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 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. A school could 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; a school 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.[33] Which of these strategies prevails, on average, will determine whether financial aid recipients (needy students) at need-only schools pay more than financial aid recipients (needy and meritorious students) at merit schools, consistent with the first strategy, or pay less, which is consistent with the latter two strategies. 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, than we should expect to see schools

[32] As reported in the Department of Education surveys, "tuition revenue" includes "tuition and fee remissions or exemptions even though there is no intention of collecting from the student." "Scholarships and fellowships" include awards where the school chooses the recipients, and "aid to students in the form of tuition or fee remissions should be included." Both variables include funds from/to undergraduate and graduate students. Thus, even though the Overlap process applied only to undergraduates, the appropriate denominator includes graduate students as well.

[33] 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.

that compete for meritorious students by offering merit-based aid to charge financial aid recipients a lower price than do need-only schools.

Several 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. Independent need-only schools are identified separately because, while they may be tacitly colluding, they do not engage in the overt coordination practiced by the Overlap groups. Without explicit coordination, they may be less effective at reducing price competition for meritorious students. 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 on price for the two Overlap groups.[34] Three alternative specifications are considered as well. 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. Second, only Overlap schools are explicitly cooperating. Thus, it is of interest to see whether their pricing policies differ from schools that behave non-cooperatively, whether they offer merit-based aid or not. This hypothesis is tested by including a variable indicating schools that are members of either 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

[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.

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 these types of schools may have different objective functions than other types of schools. 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. Public schools are likewise expected to have different utility functions than private schools. In addition, state schools are typically legislatively limited in the amount of discretion they have over setting prices. Finally, public schools may represent 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 and a public good/subsidy effect as well as any differences in utility-functions. All effects suggest a negative coefficient.

Two variables are included to measure demand conditions, indicated by the D matrix. The first is the average of state and national real median income, weighted by the proportion of in-state students. The expectation is that higher incomes lead to higher prices. The other variable, the acceptance rate, gives the proportion of applicants that are offered admision. It is expected that the lower the acceptance rate, the higher is demand relative to capacity, and the higher will be price.

The variables in the S and Q matrices are designed to proxy for the quality of the

[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 do not exist.

student body and of the institution, respectively.[36] The quality of a school is reflected in and a function of high quality students. Thus, higher quality students indicate a higher quality institution and hence a higher price. Two student-quality variables are included: the proportion of incoming students with verbal SAT scores above 600 and the proportion with math SAT scores above 600. Quality of the school is measured with three variables: library expenditures per student, teaching expenditures per student, and the proportion of faculty members holding doctorates.[37] It is expected that the higher the quality of the school, the higher will be the price.

As discussed in the next section, the data form a panel covering 67 schools over ten years. To maximize efficiency, initially the equations were estimated using generalized least squares random effects.[38] However, the random effects estimator requires that that regressors be uncorrelated with the school-specific error, and a Hausman specification test indicates, that for three of the four prices, the exogeneity assumption is highly untenable.[39] If the school-specific error is correlated with the regressors, the estimated coefficients are inconsistent.

Thus, the equations are also estimated using the Hausman-Taylor (1981) approach. This approach is similar to an instrumental variables estimate of the 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.[40]

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[36] I discuss the possibility that these variables are endogenous below.

[37] Several alternative measures were used: the student-faculty ratio, the proportion of first year students who return, the proportion of the student body that obtains a degree, and the number of library holdings. These variables added no explanatory value.

[38] The Breusch-Pagan, 1980, Lagrange multiplier test strongly rejects the null hypothesis that random school effects are not present. Nonetheless, it is worth noting that the results are robust to the use of the between estimator, which only uses the cross-sectional information in the panel.

[39] The fixed effects estimator does not require the exogeneity assumption because the school-specific error, α_i, is essentially differenced out. However, because it is the time-invariant financial aid regime variables that are of interest, use of the fixed effects estimator is infeasible, as the time-invariant variables are also subtracted out.

[40] Amemiya and MaCurdy, 1986, and Breusch, Mizon, and Schmidt, 1989, identify larger sets of instruments that lead to more efficient estimates. The larger set of instruments includes a vector equal to the value of the time-varying variables for each year (for example, a vector equal to *income* for each school in 1982, another for the value in 1983, *etc.*). Then any school that has missing values for any of the time-varying variables for any year will be omitted from the sample. Sample sizes are already small and fall dramatically (by as much as 50%) as the instrument set is expanded. The gain in efficiency from a larger instrument set is, in this application, offset by a loss in information from a smaller sample size. Thus, the Hausman-Taylor approach is used.

As explained in Hsiao (1986), 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 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 measures of the quality of the student body. Unobserved quality characteristics captured in the school-specific error term may be correlated with the student body quality variables as well as the school quality variables. A Hausman specification test indicates that the exogeneity of the student body quality variables cannot be rejected while exogeneity of the school quality variables, is rejected. The first-stage equations fit well, with R^2s over .6 for library and teaching expenditures per student and over .4 for the proportion of the faculty with Ph.D.s. While the dummy variables indicating the financial aid regime are not in the set of endogenous regressors, not controlling for the simulataneity is likely to lead to inconsistent estimates on these parameters because the collusion dummies are highly correlated with the endogenous variables. The use of the Hausman-Taylor technique does lead to consistent estimates.

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 aid policies. This approach would most accurately control for school-specific

characteristics such as quality. However, such data do not exist. The Overlap process extends back to the 1950s, and data is not available that far back. The Overlap meetings did not end until the 1991-1992 academic year, and even then Congress, through legislation, allowed the schools to continue to agree to collude until 1994, though they could not meet, and after that the settlement allowed a fair portion of the collusive behavior to continue. 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 data form a panel of 67 schools. The schools included in the sample are listed in table 1, which categorizes the schools according to their financial aid policy. I categorize schools into indendent need-only and merit-based depending on whether merit-based aid is not or is available in most of the years in the sample.[41]

The Department of Education data are from the Higher Education General Information Survey (HEGIS) and the Integrated Postsecondary Education Data System (IPEDS), which supercedes the HEGIS for school years 1981-82 through 1990-91.[42] The data from the Finance subsurvey that are used include: revenues from tuition and fees and expenditures on financial aid, teaching, and libraries. All financial data are deflated using the Higher Education Price Index to 1987 real dollars.

The data from Peterson's *Guide to Competitive Colleges* include financial data (tuition, mandatory fees, the average need-based financial aid award, the proportion of students receiving financial aid, whether merit-based aid is available), characteristics of the school (public or private, proportion of faculty with Ph.D.s, and undergraduate and total enrollment), and characteristics of the student body (percentage with verbal and math SAT scores above 600 and the proportion of in-state students). Real US and state median income is

[41] Schools designated as independent need-only do not offer merit-based aid 87% of the time, while schools that are designated as merit schools offer merit-based aid 98% of the time.

[42] The initial year is chosen as the year when Peterson's, the other data source, began publishing college guides. That 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.

Table 1: Sample of Schools[1]

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

*Associate Member.
[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.*, 1992.
[3]Derived from *Peterson's Guides.*

from the Economic Report of the President.

V. Results

Table 2 presents descriptive statistics for Ivy Overlap schools and Pentagonal/Sisters Overlap schools, where both groups offer only need-based aid and meet to discuss financial contributions; schools that adopt a need-only financial aid policy independently (without meetings); and schools that offer merit-based financial aid. The two measures of the average price paid by students receiving need-based aid and those receiving any type of aid bear comment. For the schools with a need-only policy, this average price may differ for two reasons. First, as discussed below, need-only schools sometimes offer merit-based financial aid. Second, I am using different data sources for financial aid awards. For the average price paid by students receiving need-based aid, data on tuition, fees, and the average need-based financial aid award are from Peterson's Guides. The average price paid by students

Table 2: Descriptive Statistics

	Ivy Overlap	Pent./Sisters Overlap	Independent Need-Only	Merit Schools
Tuition + Mandatory Fees	$11,941†‡*	$11,513‡*	$10,809*	$8,584
	(852)	(1,093)	(1,047)	(2,593)
Tuition – Avg. Need Award[1]	$5,359†*	$4,888‡	$5,270*	$4,761
	(1,112)	(1,365)	(1,025)	(1,370)
Tuition – Avg. Award, Need or Merit[2]	$5,559*	$5,370*	$5,320*	$3,465
	(1,609)	(1,648)	(1,726)	(2,625)
Tuition Revenue per Student	$7,847†*	$8,605‡*	$8,031*	$5,486
	(1,529)	(1,492)	(1,366)	(2,957)
% Receiving Aid	54%†	49%‡*	52%	53%
	(13)	(12)	(12)	(16)
Cheating Incidents[3]	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] Tuition + mandatory fees less the average financial aid award based on need.

[2] Calculated as tuition revenue per student less financial aid of any type per student receiving aid.

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

receiving any type of aid is calculated using data on tuition and fee revenue and grant aid from the Department of Education and on the fraction of students receiving financial aid from Peterson's Guides. The difference between the average value of the two discounted prices is small, with the average price paid by needy students being slightly lower (though only statistically significantly so for the Pentagonal/Sisters Overlap schools) than the average price paid by a student receiving any aid. For schools that generally offer merit-based aid, as expected, the difference is more substantial (and statistically significantly so), 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 receive a total financial award in excess of the calculated need of the student's family.[43]

[43] Federal financial aid is subject to the restriction that any student who receives even one dollar of financial aid, in the form of grants, subsidized loans, or work-study, must not receive a total financial aid award, from all

With one exception, price variables for any type of need-only school are statistically significantly 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) then do schools that adopt a need-only policy independently. The Ivy Overlap schools have a higher tuition less the average need award (the needy price) than do the Pentagonal/Sisters Overlap schools and the independent need-only schools, while the Pentagonal/Sisters Overlap schools charge a lower needy price than do the independent schools; indeed, the Pentagonal/Sisters Overlap needy price is the one price that is not statistically significantly higher than the price charged by schools that offer merit-based aid. However, these differences are not apparent in the alternative measure which uses data from the Department of Education. In terms of average tuition revenue earned per student, all need-only schools earn more than do schools that offer merit-based aid. Among the need-only schools, the Pentagonal/Sisters Overlap schools earn significantly more than the other need-only schools, and the independent need-only schools earn more than do the Ivy Overlap schools. The fraction of students who receive financial aid is virtually identical at all types of schools except at the Pentagonal/Sisters Overlap schools; these schools give financial aid to a statistically significantly smaller fraction of the student body than do any other type of school. This may in part explain why the Pentagonal/Sisters Overlap schools earn more tuition revenue per student while also charging a significantly lower price to needy students.

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 deviating 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.[44] Of course,

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 distinction between the "need" and "merit" portions of the award are meaningless since the money is totally fungible.

[44] Schools self-report whether merit-based aid is available. If there are instances where the schools offered merit-based aid and did not so report this policy to Peterson's, the cheating would not show up here.

in a traditional, for-profit cartel, a firm deviating from the cartel agreement 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 has admitted, merit-based aid may lead to the student matriculating 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. Also, 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 raises 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.

Table 3 presents the results for the random effects estimates and Table 4 for the Hausman-Taylor estimates controlling for endogeneity of library expenditures per student, teaching expenditures per student, and the proportion of the faculty with Ph.D.s. The

Table 3: Random Error Estimates of Price Effects

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Independent	**697.95***	387.69	878.32*	1463.33***
	(376.32)	(361.37)	(529.94)	(447.53)
Pent./Sisters Overlap	**1148.43*****	–117.51	461.37	1364.01***
	(354.65)	(353.84)	(503.92)	(426.42)
Ivy Overlap	**1333.04*****	315.06	900.89	1365.14**
	(475.38)	(498.84)	(724.69)	(575.00)
Liberal Arts	**587.45**	–25.69	998.38*	2119.04***
	(392.57)	(417.90)	(588.04)	(464.42)
Public	**–3591.18*****	–693.84	–3003.69***	–2968.29***
	(487.12)	(506.68)	(724.68)	(585.92)
Income	**6517.99*****	611.81	2493.97***	3139.23***
	(262.52)	(473.11)	(432.74)	(261.33)
Accept. Rate	**4.48**	6.01	8.55	0.55
	(4.53)	(7.22)	(6.98)	(4.41)
Lib. Exp./Student	**169.27****	–209.73	–61.56	85.65
	(82.94)	(137.21)	(127.70)	(80.90)
Teach. Exp./Student	**26.89***	–0.14	93.53***	129.49***
	(14.76)	(26.10)	(31.64)	(15.44)
Faculty w/Ph.D.	**14.20****	30.77***	19.95**	11.33**
	(5.51)	(9.50)	(9.63)	(5.13)
Verbal SAT > 600	**–5.34**	–1.18	1.11	–9.42*
	(5.96)	(9.05)	(8.84)	(5.62)
Math SAT > 600	**17.97*****	13.08	10.15	23.00***
	(6.58)	(10.86)	(9.67)	(5.99)
Constant	**–2932.71*****	380.33	–3404.37***	–2700.28***
	(757.78)	(1222.04)	(1184.69)	(724.41)
R^2 Overall	**0.82**	0.11	0.46	0.72
n	**64**	61	64	66
$\overline{T}$	**4.96**	5.03	6.02	6.03
Observations	**390**	351	480	493
Hausman Test Stat.	**8.43**	21.22***	28.18***	14.89**

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

results of the Hausman specification test, reported at the bottom of Table 3, indicate that the assumption that the regressors are not correlated with the unobserved school effect is inappropriate for all except the non-needy price (tuition). Therefore the discussion draws on column one (in boldface) from Table 3 and from columns two through four (in boldface) from Table 4.

All three types of need-only schools charge statistically significantly higher prices to

non-needy students and earn more revenue per student, based on a one-sided Wald test. In addition, independent need-only schools charge a significantly higher price to needy students relative to schools that offer merit aid. In general, the coefficients on the different financial aid regimes are not statistically significantly different than each other.[45] Thus, the results do not support the hypothesis that schools with different degrees of coordination of financial aid charge or earn different amounts. However, the results do suggest that explicit or tacit collusion in setting financial aid offers does generally lead to higher prices and earnings.

The results from the two discounted price regressions suggest two conclusions. First, a need-only policy in conjunction with coordination of financial aid awards does not lead to a higher price charged to needy students, on average, though schools that offer a need-only policy but do not coordinate do charge a higher price to needy students (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 need-based or merit-based aid (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 students' financial needs are met to the same degree by Overlap and merit schools. Given that student's estimation of their financial need is likely to be greater than a school's estimation of financial need, it may be more likely that Ivy League students' families have distribution of income and wealth to the right of the distribution at other schools. Since students would receive financial aid packages less than what they perceive as their need, those students from the lower end of the income and wealth distribution may self-select into lower cost (*i.e.*,, non-Ivy) schools. If true, then the fact that needy prices are the same across the types of schools could indicate that Ivy League schools are more generous in their estimate of financial need (which seems unlikely, since *U.S.* v. *Brown University, et*

[45] Differences do arise in the equation explaining the price charged to needy students. There the price charged by the Ivy Overlap schools is statistically significantly higher than the price charged by the Pentagonal/Sisters Overlap schools, and the data reject the hypothesis that the three coefficients are equal. Only the independent need-only schools charge a price statistically significantly different than merit-based schools, though an F-test of the joint significant of the three variables rejects that they are jointly equal to zero.

Table 4: Hausman-Taylor Estimates of Price Effects

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Independent	722.41***	**382.48***	**892.86*****	**1427.60*****
	(178.68)	**(230.07)**	**(263.93)**	**(189.02)**
Pent./Sisters Overlap	1244.61***	**−260.76**	**468.67****	**1294.11*****
	(155.81)	**(205.93)**	**(218.70)**	**(167.74)**
Ivy Overlap	1484.36***	**520.30**	**960.52****	**1486.17*****
	(263.27)	**(330.68)**	**(448.82)**	**(287.13)**
Liberal Arts	418.74	**611.07**	**912.20**	**1961.97*****
	(392.89)	**(504.29)**	**(583.37)**	**(407.80)**
Public	−3540.12***	**−356.52**	**−3251.55*****	**−3309.91*****
	(365.58)	**(486.34)**	**(563.79)**	**(389.46)**
Income	6324.60***	**1718.45*****	**3269.03*****	**2875.67*****
	(468.16)	**(621.14)**	**(687.74)**	**(513.43)**
Accept. Rate	8.77*	**16.03****	**1.89**	**−13.48****
	(4.87)	**(6.34)**	**(7.08)**	**(5.28)**
Lib. Exp./Student	93.30	**231.55**	**2.32**	**−10.91**
	(173.92)	**(259.10)**	**(240.68)**	**(184.58)**
Teach. Exp./Student	30.20	**−0.53**	**65.19**	**124.74*****
	(33.60)	**(42.91)**	**(64.98)**	**(38.83)**
Faculty w/Ph.D.	13.05	**45.82*****	**37.21***	**13.82**
	(12.69)	**(16.67)**	**(19.24)**	**(12.95)**
Verbal SAT > 600	−0.50	**−6.61**	**−23.41****	**−33.98*****
	(7.88)	**(10.12)**	**(10.49)**	**(7.96)**
Math SAT > 600	24.30***	**8.70**	**13.12**	**29.38*****
	(8.66)	**(11.21)**	**(11.72)**	**(9.08)**
Constant	−220.74***	**−348.84***	**−292.44****	**−36.76**
	(84.47)	**(179.20)**	**(121.05)**	**(60.53)**
R^2 Overall	0.82	**0.03**	**0.47**	**0.73**
n	64	**61**	**64**	**66**
$\overline{T}$	4.96	**5.03**	**6.02**	**6.03**
Observations	390	**351**	**480**	**493**

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

al., 1992, shows that the formula used by the Ivy League for calculating financial need is less generous than is the formula used by the Department of Education), or it 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. The latter interpretation 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, also succeeds in reducing competition for desirable students via financial aid awards beyond the students' need.[46]

While the evidence does, in part, support the schools' arguments that they were reallocating financial aid monies between students receiving financial aid, there is also evidence that other transfers were occuring as well. In particular, the price paid by non-needy students increases substantially: by almost \$700 (6.4%) at independent need-only schools, \$1,150 (10.0%) at Pentagonal/Sisters Overlap schools, and by over \$1,300 (11.2%) at Ivy Overlap schools. In addition, need-only schools earn substantially higher tuition revenue per student.[47]

Several alternative financial aid regime specifications are run in an attempt to separate the effect of tacit (non-cooperative) collusion from explicit collusion. The results on these alternative financial aid regime variables are presented in Table 5.[48,49] 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.[50] The results from this approach (labeled "Alternative Model 1") show that need-only schools charge higher prices to non-needy students, 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. 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

[46] Recall that the model indicates that while competition in the price dimension is reduced, competition in the non-price dimension (quality) increases.

[47] Carlton, Bamberger, and Epstein, 1995, analyze the impact of Overlap behavior on tuition revenue earned per student and find that it has no significant impact. Their estimation and data differ from mine: they use different quality controls; do not utilize variation in the time dimension; do not identify independent need-only schools; do not account for correlation between regressors and the school-specific error; and use a considerably larger sample of schools. Their sample includes, along with the Ivy League, schools such as University of Southern Illinois at Carbondale, Lehigh, and Biola University. When I use my smaller sample and their variables and estiamtion technique, I do find that the Overlap dummy variables have statistically significantly positive coefficients, which magnitudes similar to those reported here.

[48] Full results are presented in the appendix.

[49] Again, the discussion is based on the random effects results for the non-needy price and on the Hausman-Taylor results for the other prices. The appropriate results are in boldface.

[50] This is consistent with the results in tables 3 and 4, which did not indicate a statistically significant difference between the coefficients on the three financial aid indicator variables, in general.

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
	Random Effects			
Alternative Model 1				
Need-Only	**1080.26*****	145.23	684.56*	1391.19***
	(261.34)	(274.85)	(375.17)	(308.10)
Alternative Model 2				
Overlap	**1007.63*****	–118.59	315.88	916.22***
	(258.85)	(270.27)	(364.01)	(317.55)
Alternative Model 3				
Need-Only	**699.80***	380.96	881.37*	1463.06***
	(373.82)	(360.37)	(525.43)	(443.22)
Overlap	**515.92**	–361.51	–273.73	–98.21
	(364.86)	(355.29)	(506.23)	(430.97)
	Hausman-Taylor Technique			
Alternative Model 1				
Need-Only	1100.80***	**120.70**	**723.51*****	**1383.21*****
	(144.54)	**(181.84)**	**(216.87)**	**(151.73)**
Alternative Model 2				
Overlap	1028.62***	**–207.68**	**212.04**	**758.30*****
	(126.44)	**(164.60)**	**(179.15)**	**(143.72)**
Alternative Model 3				
Need-Only	719.99***	**366.80**	**889.50*****	**1431.78*****
	(177.54)	**(231.63)**	**(265.11)**	**(189.79)**
Overlap	599.31***	**–420.53***	**–284.77**	**–78.16**
	(153.55)	**(215.12)**	**(215.04)**	**(165.53)**

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

awards independently. The results (labeled "Alternative Model 2") suggest that these schools charge higher prices to non-needy students and earn more tuition revenue than schools that behave non-cooperatively, but there is no difference in the price paid by students receiving need-based financial aid at the Overlap schools compared to students receiving need-based or merit-based financial aid at schools that offer merit-based aid.

Finally, I include both a need-only and an Overlap indicator variable to try to separate the influence of the two financial aid policies on prices and revenues earned. The results support the hypothesis that it is the decision by schools to not compete with financial aid awards (in the price dimension) for meritorious students, whether they implement the policy cooperatively or non-cooperatively, that is the main influence leading to higher prices and

higher revenues earned. Adopting an Overlap process in addition to a need-only policy may lead to a higher price charged to non-needy students: the random effects coefficient is significant at the 15% level while the Hausman-Taylor coefficient is significant at the 1% level. The only statistically significant effect of adopting an Overlap process has is to reduce the price paid by needy students. A need-only policy leads to significantly higher tuition revenue earnings, but an Overlap policy itself does not affect tuition revenue earnings.

The other variables perform approximately as expected. Liberal arts schools earn more than universities, while public schools charge less and earn less than private schools. This may reflect different institutional goals and/or different quality levels. Of the variables included to reflect demand conditions, income is highly significant, and as one would expect has a much larger influence on the full-price than on either discounted price. The acceptance rate is unexpectedly significantly positive for the needy price, but significantly negative for tuition revenue earned per student, as one would expect. Measures of school quality have positive coefficients when significant, as expected. Higher expenditures on library or teaching items increases the price charged, as does increasing the proportion of faculty with Ph.D.s for the full-price.

When significant, the coefficient on math SAT is positive, as expected. In essence, the more students who receive over 600 on the math portion of the SAT is an indicator of the quality of the student body of the school and of the school itself, allowing the school to command a higher price. Interestingly, the coefficient on the verbal SAT score is negative, indicating that the higher the average verbal SAT score, the lower the price and the lower tuition revenue earned. Perhaps this reflects the lower return to education in fields where the verbal SAT is important, such as English and history.

In sum, the adoption of a need-only policy results in a 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 outcomes are roughly the same whether the schools behave non-cooperatively in their decision to not compete in the price

dimension or cooperate in the implementation of the policy.

VI. Conclusion

The purpose of this paper is to analyze the impact of tacit and explicit collusion 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 collusion may be especially likely to arise in this market. A policy of not competing for meritorious students in the price dimension increases prices to non-needy and needy students, and is likely to increase tuition revenue earnings; and 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 $700 at a school that adopts a needy-only policy independently and by over $1,000 at schools that coordinate financial aid offers. A need-only policy also significantly increases tuition revenue earned per student, by $1,000 to $1,300.

I also compare the difference of the effect of tacit and explicit collusion on the resulting outcomes. There is weak evidence that explicit collusion in the form of an Overlap process may lead to a higher tuition price than that obtained under tacit collusion, but the Overlap process does not contribute to higher revenues earned per student. Simply adopting a need-only financial aid policy independently leads to a significantly higher price charged to non-needy students and to meritorious students and to higher tuition revenue earned per student. Thus, the success in the Department of Justice in preventing the Overlap schools from meeting each spring to collectively determine a student's financial need may be a success in principle, but it may have little practical effect.

Appendix

Table A1: Random Error Estimates of Price Effects
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	**1080.26*****	145.23	684.56*	1391.19***
	(261.34)	(274.85)	(375.17)	(308.10)
Liberal Arts	**515.48**	–204.88	930.11*	2116.95***
	(326.95)	(362.11)	(480.17)	(374.16)
Public	**–3598.98*****	–823.36*	–3129.85***	–2979.01***
	(471.28)	(488.83)	(684.99)	(556.82)
Income	**6506.36*****	639.26	2518.69***	3143.52***
	(262.38)	(472.53)	(431.58)	(261.01)
Accept. Rate	**–0.82**	6.37	8.44	0.51
	(4.47)	(7.16)	(6.95)	(4.40)
Lib. Exp./Student	**176.53****	–203.91	–58.43	83.32
	(82.50)	(135.33)	(126.44)	(80.32)
Teach. Exp./Student	**27.32***	–4.29	89.98***	129.00***
	(14.69)	(25.84)	(31.21)	(15.38)
Faculty w/Ph.D.	**14.53*****	29.58***	19.27**	11.24**
	(5.50)	(9.45)	(9.59)	(5.12)
Verbal SAT $>$ 600	**–4.85**	–1.41	0.73	–9.66*
	(5.95)	(8.96)	(8.79)	(5.59)
Math SAT $>$ 600	**17.71*****	13.39	10.31	23.10***
	(6.58)	(10.82)	(9.65)	(5.99)
Constant	**–2926.67*****	560.85	–3228.25***	–2679.05***
	(743.96)	(1208.45)	(1157.19)	(702.44)
R^2 Overall	**0.81**	0.09	0.45	0.72
n	**64**	61	64	66
$\overline{T}$	**4.96**	5.03	6.02	6.03
Observations	**390**	351	480	493
Hausman Test Stat.	**2.09**	22.17***	71.29***	15.08**

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

Table A2: Hausman-Taylor Estimates of Price Effects
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	1100.80***	**120.70**	**723.51***	**1383.21***
	(144.54)	**(181.84)**	**(216.87)**	**(151.73)**
Liberal Arts	405.41	**326.61**	**723.83**	**1894.78***
	(365.20)	**(479.04)**	**(515.49)**	**(376.65)**
Public	–3505.18***	**–530.01**	**–3385.96***	**–3352.92***
	(353.42)	**(473.96)**	**(523.62)**	**(370.98)**
Income	6327.36***	**1644.68****	**3251.15***	**2872.37***
	(478.54)	**(633.12)**	**(691.33)**	**(514.05)**
Accept. Rate	7.15	**16.37****	**2.18**	**–13.50****
	(4.93)	**(6.45)**	**(7.10)**	**(5.27)**
Lib. Exp./Student	129.17	**227.61**	**–11.98**	**–11.42**
	(177.99)	**(259.91)**	**(241.89)**	**(184.34)**
Teach. Exp./Student	30.80	**1.60**	**63.71**	**124.83***
	(34.29)	**(43.57)**	**(65.15)**	**(38.82)**
Faculty w/Ph.D.	13.17	**47.03***	**37.36***	**13.43**
	(12.93)	**(16.91)**	**(19.23)**	**(12.91)**
Verbal SAT > 600	1.27	**–7.08**	**–23.92****	**–34.13***
	(7.96)	**(10.27)**	**(10.38)**	**(7.88)**
Math SAT > 600	22.51**	**9.79**	**14.03**	**29.60***
	(8.78)	**(11.38)**	**(11.63)**	**(9.01)**
Constant	–211.80**	**–330.95***	**–282.62****	**–33.24**
	(83.03)	**(176.27)**	**(118.60)**	**(59.77)**
R^2 Overall	0.81	**0.01**	**0.45**	**0.73**
n	64	**61**	**64**	**66**
$\overline{T}$	4.96	**5.03**	**6.02**	**6.03**
Observations	390	**351**	**480**	**493**

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

Table A3: Random Error Estimates of Price Effects

Overlap Dummy Variable

(Standard errors in parentheses.)

	Tuition + Fees	Avg. Price for Needy	Avg. Price Students w/Aid	Tuition Rev. per Student
Overlap	**1007.63*****	–118.59	315.88	916.22***
	(258.85)	(270.27)	(364.01)	(317.55)
Liberal Arts	**514.89**	–193.38	808.78*	2147.12***
	(331.09)	(361.93)	(483.05)	(934.33)
Public	**–3846.96*****	–909.31*	–3418.94***	–3427.26***
	(463.41)	(475.52)	(665.35)	(569.78)
Income	**6529.99*****	647.23	2235.56***	3145.37***
	(262.72)	(472.50)	(432.63)	(262.75)
Accept. Rate	**–1.04**	5.17	7.48	0.08
	(4.48)	(7.15)	(6.96)	(4.44)
Lib. Exp./Student	**173.09****	–194.68	–51.38	92.03
	(82.82)	(135.44)	(126.91)	(81.32)
Teach. Exp./Student	**23.81**	–6.36	84.50***	126.61***
	(14.65)	(25.68)	(31.11)	(15.45)
Faculty w/Ph.D.	**13.52****	29.37***	18.17*	10.56**
	(5.50)	(9.44)	(9.60)	(5.15)
Verbal SAT > 600	**–4.73**	0.32	1.80	–8.51
	(5.96)	(8.95)	(8.82)	(5.66)
Math SAT > 600	**18.04*****	12.87	10.44	23.14***
	(6.59)	(10.83)	(9.68)	(6.03)
Constant	**–2609.47*****	702.82	–2821.93**	–2175.66***
	(731.85)	(1195.26)	(1131.43)	(693.84)
R^2 Overall	**0.82**	0.09	0.44	0.67
n	**64**	61	64	66
$\overline{T}$	**4.96**	5.03	6.02	6.03
Observations	**390**	351	480	493
Hausman Test Stat.	**1.71**	22.23***	15.57**	20.77***

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

Table A4: Hausman-Taylor Estimates of Price Effects
Overlap Dummy Variable
(Standard errors in parentheses.)

	Tuition + Fees	**Avg. Price for Needy**	**Avg. Price Students w/Aid**	**Tuition Rev. per Student**
Overlap	1028.62***	**−207.68**	**212.04**	**758.30***
	(126.44)	**(164.60)**	**(179.15)**	**(143.72)**
Liberal Arts	464.56	**208.58**	**761.68**	**2132.50***
	(378.82)	**(484.11)**	**(542.36)**	**(422.41)**
Public	−3688.42***	**−743.87***	**−3636.61***	**−3611.90***
	(346.30)	**(448.52)**	**(508.37)**	**(389.88)**
Income	6447.24***	**1916.48***	**3429.99***	**2959.90***
	(473.39)	**(605.97)**	**(696.38)**	**(554.48)**
Accept. Rate	6.97	**13.17****	**−0.86**	**−16.79***
	(4.95)	**(6.20)**	**(7.15)**	**(5.70)**
Lib. Exp./Student	170.06	**224.00**	**58.79**	**69.11**
	(180.10)	**(259.85)**	**(244.47)**	**(299.30)**
Teach. Exp./Student	27.24	**−17.93**	**44.18**	**123.32***
	(34.10)	**(41.98)**	**(65.72)**	**(41.98)**
Faculty w/Ph.D.	14.02	**41.42****	**35.17***	**16.36**
	(13.10)	**(16.52)**	**(19.86)**	**(14.19)**
Verbal SAT > 600	0.32	**−2.54**	**−20.61***	**−32.06***
	(8.02)	**(9.93)**	**(10.52)**	**(8.57)**
Math SAT > 600	25.04***	**6.82**	**14.20**	**31.16***
	(8.91)	**(11.16)**	**(11.91)**	**(9.89)**
Constant	−221.96***	**−276.59**	**−261.36****	**−37.52**
	(83.89)	**(175.79)**	**(119.77)**	**(60.70)**
R^2 Overall	0.80	**0.01**	**0.43**	**0.68**
n	64	**61**	**64**	**66**
$\overline{T}$	4.96	**5.03**	**6.02**	**6.03**
Observations	390	**351**	**480**	**493**

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

Table A5: Random Error Estimates of Price Effects
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	**699.80***	380.96	881.37*	1463.06***
	(373.82)	(360.37)	(525.43)	(443.22)
Overlap	**515.92**	–361.51	–273.73	–98.21
	(364.86)	(355.29)	(506.23)	(430.97)
Liberal Arts	**520.90**	–179.73	833.09*	2116.13***
	(324.91)	(363.75)	(483.54)	(376.93)
Public	**–3628.55*****	–782.86	–3106.02***	–2971.84***
	(468.43)	(491.79)	(691.33)	(561.23)
Income	**6518.45*****	617.25	2506.96***	3140.63***
	(262.29)	(472.78)	(432.06)	(261.22)
Accept. Rate	**–0.53**	5.74	8.35	0.51
	(4.47)	(7.20)	(6.97)	(4.40)
Lib. Exp./Student	**171.59****	–195.61	–55.56	84.79
	(82.42)	(135.70)	(126.75)	(80.47)
Teach. Exp./Student	**26.56***	–2.63	91.02***	129.29***
	(14.69)	(25.88)	(31.28)	(15.40)
Faculty w/Ph.D.	**14.16****	30.43***	19.69**	11.31**
	(5.51)	(9.48)	(9.62)	(5.13)
Verbal SAT > 600	**–5.22**	–0.58	1.17	–9.51*
	(5.94)	(9.01)	(8.82)	(5.61)
Math SAT > 600	**17.92*****	12.88	10.09	23.03***
	(6.57)	(10.84)	(9.66)	(5.99)
Constant	**–2891.96*****	501.60	–3275.99***	–2691.68***
	(743.00)	(1210.35)	(1160.50)	(704.32)
R^2 Overall	**0.82**	0.09	0.45	0.72
n	**64**	61	64	66
$\overline{T}$	**4.96**	5.03	6.02	6.03
Observations	**390**	351	480	493
Hausman Test Stat.	**2.03**	21.12***	36.46***	15.01**

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

Table A6: Hausman-Taylor Estimates of Price Effects
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	719.99***	**366.80**	**889.50*** **	**1431.78*** **
	(177.54)	**(231.63)**	**(265.11)**	**(189.79)**
Overlap	599.31***	**−420.53***	**−284.77**	**−78.16**
	(153.55)	**(215.12)**	**(215.04)**	**(165.53)**
Liberal Arts	344.06	**348.83**	**751.86**	**1905.37*** **
	(358.76)	**(482.90)**	**(517.11)**	**(378.58)**
Public	−3578.90***	**−509.48**	**−3349.66*** **	**−3338.42*** **
	(347.98)	**(477.26)**	**(526.83)**	**(374.08)**
Income	6315.38***	**1719.71*** **	**3275.78*** **	**2869.84*** **
	(469.23)	**(627.82)**	**(690.01)**	**(513.96)**
Accept. Rate	8.46*	**14.79** **	**1.41**	**−13.71** **
	(4.85)	**(6.40)**	**(7.10)**	**(5.29)**
Lib. Exp./Student	97.56	**255.85**	**11.70**	**−8.30***
	(173.80)	**(260.62)**	**(240.26)**	**(183.81)**
Teach. Exp./Student	30.88	**−2.09**	**62.94**	**125.67*** **
	(33.64)	**(43.31)**	**(65.16)**	**(38.89)**
Faculty w/Ph.D.	13.15	**45.56*** **	**37.20***	**13.94**
	(12.69)	**(16.84)**	**(19.31)**	**(12.96)**
Verbal SAT > 600	−0.31	**−5.34**	**−22.99** **	**−33.82*** **
	(7.84)	**(10.19)**	**(10.45)**	**(7.93)**
Math SAT > 600	24.15***	**8.13**	**13.03**	**29.21*** **
	(8.66)	**(11.33)**	**(11.74)**	**(9.10)**
Constant	−216.94**	**−325.06***	**−284.46** **	**−35.05**
	(83.45)	**(178.84)**	**(119.72)**	**(60.07)**
R^2 Overall	0.82	**0.01**	**0.45**	**0.73**
n	64	**61**	**64**	**66**
$\overline{T}$	4.96	**5.03**	**6.02**	**6.03**
Observations	390	**351**	**480**	**493**

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

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