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Television Program Quality and Restrictions on the Number of Commercials

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This paper presents a model of the problem confronting the National Association of Broadcasters if it behaves as a cartel manager for the commercial broadcasting industry. As a part of its TV Code, the NAB has set maximum allowable amounts of non-program material which may be aired by participating stations during any given hour of television programming. Since virtually all nonprogram material is in fact advertising, either for the station itself or product advertising purchased by others, the code thus limits the amount of advertising which can be sold by television stations.

The problem appears at first glance to be a relatively straightforward one. By limiting the number of commercials, the NAB can restrict the output of commercial broadcasting, thereby raising the price of a minute of advertising. However, a commercial is not the relevant output. A commercial is valuable only if it is seen by an audience, and is more valuable the larger the audience to which it is shown. Thus the relevant output of television stations in the advertising market is commercial exposures, or the number of commercials times the audience per

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* Economist, Federal Trade Commission. The views in this paper are solely those of the author and do not necessarily reflect the views of the Federal Trade Commission or any Commissioner. I am indebted to Pauline Ippolito and Steve Salop for helpful discussions of this model. Remaining errors are of course my own.

commercial. The price in this market is the price of one commercial seen by one person, and, of course, if the total number of exposures is restricted, the price per exposure will rise. Thus, by restricting the number of minutes, the NAB is restricting not output, but rather an input in the production of exposures. Moreover, if more commercials reduce the attractiveness of a given program to potential viewers, thereby reducing the audience of the program, the restriction on the number of commercials has offsetting effects on output--the number itself is lower, but the audience of each commercial is higher. In addition, other inputs are important in attracting an audience, in particular, the quality of the program offered. Since individual stations, confronted with a constraint on the use of one input, are likely to respond by altering their use of other inputs, the problem is further complicated.

We consider first the problem confronted by an individual station, operating under a constraint on the maximum number of commercial minutes which it can air. We assume that the stations are competitive, and identical, although both assumptions are rather strong and unrealistic. We examine the station's choice of inputs in the presence of the constraint. Second, we examine the types of restrictions which would be imposed by an unconstrained cartel, assuming no enforcement costs or other restrictions on the types of policies which it can pursue, and assuming no cheating by individual members of the cartel. Third, we examine the choices which would be made by a cartel with "rational expectation"--i.e., a cartel operating in the presence of constraints, and taking into account the nature of the competitive responses of individual cartel members to whatever constraints it imposes.

I. Competitive Response and Market Equilibrium when Commercials are Restricted

Individual stations must attract an audience (A) before they have a product to sell. They do so by selecting programs of varying quality (Q). Presumably, higher quality programs attract a larger audience.[1] In addition, potential viewers prefer more program of given quality to less. Since a given time period can be devoted to either program or commercials, an increase in the number of commercials (n) leads to a reduction in the audience. Thus, total audience is given by $A=A(Q, n)$.

Each station's output is some number of exposures to advertising defined by nA.[2] Exposures are sold to advertisers at price P, which the station takes as given.

Quality is available only at a cost, given by $c=c(Q)$, which is assumed to be increasing in Q, at a constant or increasing rate.[3] Commercials, however, have no direct cost. Their number is limited by the fact that they drive away some audience.

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1 This is not necessarily the case, if different viewers have different concepts of quality. The model assumes that viewers are homogeneous with respect to what they consider to be quality, although they may differ in how much they value additional quality.

2 We assume that all commercials are the same length. Without this restriction, there is an ambiguity in the definition of exposures--we could define them on the basis of seconds of exposure opportunity, or on the basis of the number of exposure opportunities regardless of length.

3 Possible dependence of $c(Q)$ on station profitability is ignored. If rents to talent are a major component of the costs of programs, then $C(Q)$ would depend on station profitability. See Noll, Peck, and McGowan (1973), and Crandall (1972). If so, then cartel restrictions which increase industry profits would increase the cost of programs of given quality as well.

The assumption that costs are independent of the number of commercials is an important one, as we see below. Nonetheless, it seems quite reasonable for this industry. Stations are provided with commercials by advertisers. While there are transactions costs of selling commercials, and costs of scheduling them, most of these costs are fixed. Given that the station sells some commercials, the increase in transactions costs from selling one more is likely to be zero; this is surely true if the added commercial is sold to an existing advertiser. The costs of inserting one more commercial into the program are also likely to be zero; it is difficult to see why it is more costly to insert two commercials than to insert one. Indeed, given that a minute of commercials replaces a minute of program, the marginal cost of another minute of commercials may be negative.

Thus, the station's problem is to maximize

$$\Pi^C = P\,A(Q,n)n - C(Q).$$

In the absence of any constraints, it would choose Q such that

(1) $\Pi^C_Q = P\,nA_Q - C_Q = 0$, and choose n to satisfy

(2) $\Pi^C_N = P(A + nA_N) = 0$, where the subscripts denote partial derivatives with respect to the indicated argument. I assume that the second order conditions for profit maximization are satisfied; thus

(3) $\Pi^C_{QQ} = PnA_{QQ} - C_{QQ} < 0$

(4) $\Pi^C_{NN} = P(2A_N + nA_{NN}) < 0$

(5) $\Pi^C_{QQ}\,\Pi^C_{NN} - (\Pi^C_{QN})^2 > 0,$

$$\Pi^C_{QN} = P(A_Q + nA_{QN}).$$

Equation (1) asserts the usual identity of the marginal revenue product of an input with its marginal cost. One additional member of the audience is worth Pn, the price of one exposure to one person, times the number of spots shown. A_Q gives the incremental audience generated by an added unit of quality. Thus an additional unit of quality generates revenues given by PnA_Q.

Equation (2) asserts that the marginal revenue of an added commercial will be zero. The value of one more commercial, given the audience, is PA; the value of the audience driven away by the ad is PnA_N. Moreover, the n which satisfies this equation is independent of the price; n is chosen solely to minimize the cost of producing exposures.

Each equation implicitly defines a relationship between the station's optimal quality, Q*, the number of commercials and the price of an exposure. Although competitive stations take the price per exposure as given, their collective responses will determine the price. Analysis of the competitive equilibrium therefore requires specification of the market demand for advertising.

Of course, the market price depends on the total number of exposures produced. Total industry output is just the sum of the exposures produced by each individual station. If we assume that the industry consists of m identical stations, total exposures are given by Anm. In turn, price per exposure is given by P= f(Anm). Moreover, we assume that total industry audience is simply the sum of the audiences implied by the individual station's production functions, or aggregate audience is equal to $mA(Q, n)$.

This formulation neglects the importance of competition among stations on the basis of program quality. It assumes that when one station increases Q, and thereby increases its audience by A_Q, the total television audience also increases by precisely A_Q. In reality, at least some of the station's audience gain is likely to be from its competitors.

Ignoring competition for audiences greatly simplifies the analysis without affecting the principal results. In a competitive environment, it is quite reasonable to assume that stations ignore the influence of their actions on competitors even though there is such an influence in equilibrium. Thus, competition for audiences can be viewed as affecting the nature of the audience production function, but not the nature of each station's response to parameter changes or exogenous restrictions. Since I argue below that competitive stations produce too much program quality to maximize industry profits, recognition that quality may benefit the individual station without benefiting the industry as a whole can only strengthen this result.

Differentiating equation (1), taking P as a function of Q and n, we find

$$(6) \qquad \left.\frac{dQ^*}{dn}\right|_{\Pi^c_Q=0} = \frac{P\left[A_Q + nA_{QN} + \frac{A_Q}{\varepsilon A}(A+nA_N)\right]}{-PnA_{QQ} + C_{QQ} - \frac{nA_Q^2 P}{\varepsilon A}} = \frac{\Pi^c_{QN} + \frac{PA_Q}{\varepsilon A}(A+nA_N)}{-\Pi^c_{QQ} - \frac{PnA_Q{}^2}{\varepsilon A}}$$

where ε (< 0) is the elasticity of demand. Since the denominator is positive by equation (3), the sign of dQ^*/dn is determined by the sign of the bracketed expression. At the competitive equilibrium, $A + nA_N = 0$, so the slope at this point is determined by the sign of $A_Q + nA_{QN}$.

Similarly, we can differentiate equation (2) to find

$$(7) \qquad \left.\frac{dQ^*}{dn}\right|_{\Pi^c_N=0} = -\frac{2A_N + nA_{NN}}{A_Q + nA_{QN}} = \frac{-\Pi^c_{NN}}{\Pi^c_{QN}} .$$

As above, the sign of this expression is determined by the sign of $A_Q + nA_{QN}$.

Of course, A_Q is positive. A_{QN} is likely to be negative, however. If, for example, viewers care only about average quality per minute of viewing time, then at a higher n, each additional unit of Q adds less to quality of the average minute of viewing, because it is "diluted" by more nonprogram minutes. Hence A_{QN} would be negative. Thus, the sign of $A_Q + nA_{QN}$ is formally ambiguous.

Using these results, we can graph equations (1) and (2) in (n,Q) space. There are two cases, depending on the sign of $A_Q + nA_{QN}$. Figure 1(a) depicts the case where this value is positive; thus both curves are positively sloped at their intersection. The relative steepness of the two curves can be determined from the second order conditions; in particular, in this case, the curve $\Pi_N^c=0$ must be more steeply sloped.[4]

Along equation (1), dQ*/dn is necessarily positive only in the neighborhood of the competitive equilibrium. Indeed, its slope is zero when $-1/\varepsilon = A(A_Q + nA_{QN})/A_Q(A + nA_N)$. To the left of this point, labeled T in Figure 1(a), the slope is negative. But in the neighborbood of the competitive equilibrium, higher quality programming can be achieved only with a larger number of commercials.

Figure 1(b) depicts these relationships on the assumption that $A_Q + nA_{QN}$ is negative. In this case, both curves slope downward; again their relative slopes can be established from the second order conditions.

Each figure also includes an isoquant, along which total exposures are a constant, labeled $E = E^0$. Since the slope of an isoquant is given by $-(A + nA_N)/nA_Q$, the curve $\Pi_n^c=0$ is the locus of the minima of different isoquants. Movement up this curve constitutes movement to a higher output. In each figure,

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[4] At the equilibrium, a steeper slope for $\Pi_n^c = 0$ implies $-\frac{\Pi_{NN}}{\Pi_{QN}} > \frac{-\Pi_{QN}}{\Pi_{QQ} + \frac{PnA_Q^2}{\varepsilon A}}$ which is true if $\Pi_{NN}\Pi_{QQ} - \Pi_{QN}^2 > -\Pi_{NN}\, PnA_Q^2/\varepsilon A$. Since the left hand side is positive by equation (5), and the right hand side is negative by (4), $\Pi_n^c = 0$ must be more steeply sloped. A similar argument establishes the relative slopes when Π_{QN}^c is negative. The graphical analysis is based on Sheshinski (1976).

the competitive equilibrium values of Q and n are given by the intersection of the two curves.

Figure 1 can also be used to analyze the effects of an exogenous restriction on the number of commercials, $n \leq \bar{n}$. Competitive stations cannot now satisfy equation (2). Equation (1), however, is unaffected; stations still choose program quality to satisfy the same necessary condition.[5] In figure 1, the curve $\Pi_n^c=0$ is replaced by a vertical line at $n = \bar{n}$. Equilibrium quality is determined by the intersection of this line with the curve $\Pi_Q^c = 0$.

If $A_Q + nA_{QN}$ is positive, figure 1(a) is relevant. Small restrictions on n will result in lower equilibrium quality, and lower equilibrium output of exposures. If this expression is negative, figure 1(b) applies; small restrictions on n will raise equilibrium program quality. However, they will also raise equilibrium output of exposures; since the slope of the isoquant is zero at the competitive equilibrium, and negative for smaller values of n, the curve $\Pi_Q^c=0$ must lie above the isoquant for

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[5] More formally, the constraint is incorporated into the objective function via a lagrangian multiplier. (2) then becomes $P(A + \bar{n}A_N) - \lambda = 0$. If the constraint is binding, $\lambda > 0$, i.e., it would be valuable to the station to relax the constraint. Equation (1) is unaltered except that $\bar{n}$ replaces n. Interior solutions, where the constraint is not binding, are uninteresting.

the competitive output for small restrictions in n.[6] Since we are interested in restrictions on the number of commercials imposed by a profit maximizing cartel, and since such a cartel would necessarily restrict the total output of exposures, we henceforth assume that $A_Q + nA_{QN} > 0$.

II. Cartel Choices of Quality and Commercials

Consider a cartel in an industry composed of m identical stations. The cartel's problem is to choose values for n and Q which will maximize industry profits.[7] We assume for the moment that the cartel can choose any values it likes, and neglect enforcement costs.

Industry profits are given by

$\Pi^u = P(mA(Q, n)n)\ m\ A(Q,n)n - mc(Q).$

The cartel must choose Q to satisfy

$$(8)\quad \Pi^u_Q = PnA_Q(1 + \frac{1}{\varepsilon}) - C_Q = 0$$

and choose n to satisfy

$$(9)\quad \Pi^u_n = P\ (1 + \frac{1}{\varepsilon})\ (A + nA_N) = 0.$$

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[6] This argument does not necessarily hold globally. Whether it does or not depends on the slope of the isoquant away from the equilibrium and the slope of $\Pi_Q{}^c = 0$. It seems likely that $\Pi_Q{}^c = 0$ will eventually cut the competitive isoquant at a smaller n, but higher Q. A constraint to a still smaller n would then reduce output.

[7] The cartel could, of course, choose output per station and let stations select the cost minimizing way of producing that output. The formulation here is equivalent if there are no enforcement costs, and much more informative later on.

As before, we assume that the second order conditions are satisfied. Equation (9) can be satisfied at three points. The cartel could choose P=0, but that solution cannot be profit maximizing. It could also choose $1 + \frac{1}{\varepsilon} = 0$, or $\varepsilon = -1$. However, this solution is inconsistent with (8), which requires that $1+\frac{1}{\varepsilon}=C_Q/PnA_Q$, which is positive unless the marginal cost of quality is zero. Therefore, the cartel must choose n such that, given optimal quality, $A + nA_N = 0$. As equation (2) reveals, this is precisely the same condition for the number of commercials which must be satisfied by competitive firms; thus the curve $\Pi_n^u = 0 = \Pi_n^c$. At given levels of quality, the cartel and competitive firms would each provide the same number of commercials. Indeed, if the production function is such that $A + nA_N$ is independent of quality, the cartel will choose precisely the same number of commercials as would competitive firms, regardless of the levels of quality chosen by each.

However, the cartel will restrict quality, as comparison of equations (1) and (8) immediately reveals. Since $\varepsilon<0$, and all other elements are positive, a Q which satisfies (1) is too large to satisfy (8).[8] Thus, the curve $\Pi_Q^u = 0$ lies everywhere below the corresponding curve for Π_Q^c.

At first blush, it appears surprising that a cartel would choose the same number of commercials at a given quality level as would competitive firms. It appears obvious that a cartel should restrict output, and it therefore appears that it should restrict

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[8] That it, for any Q and n at which (1) is satisfied, (8) is negative. Since the second order conditions require $\Pi_{QQ}^u < 0$, a lower Q will restore equality in (8), holding n constant.

the number of commercials at each quality level. The reason for this result is that the number of commercials is not the output of this industry; rather, it is an input in the production of exposures. Moreover, commercials are essentially a "free" input; the only cost is that they drive away some viewers. This cost is fully internalized by competitive firms; they will provide commercials until the marginal revenue from another one is zero. Since the monopolist chooses to operate in a region where demand is elastic, marginal revenue is zero only when $A + nA_N = 0$. Competitive firms satisfy precisely the same condition.

In a sense, the cartel can restrict output by restricting either input. It will choose to restrict the more expensive input, quality, "first," though, of course, it may end up restricting both inputs. If it imposes a binding restriction on quality, however, it need not worry about restricting n. Competitive firms operating under the quality constraint will choose precisely the right n to maximize industry profits.

Given that the unconstrained cartel would restrict quality, would it also restrict the number of commercials? Figure 2 reproduces figure 1(a), adding the curve $\Pi_Q^u=0$ on the assumption that $A_Q + nA_{QN}$ is positive.[9] Clearly, on these

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[9] Along $\Pi_Q^u=0$, $\frac{dQ}{dn} = \frac{-(R_Q(A + nA_N) + R(A_Q + nA_{QN}))}{R_Q nA_Q + RnA_{QQ} - C_{QQ}}$,
where $R = P(1 + \frac{1}{\varepsilon})$ = marginal revenue, and $R_Q = \partial R/\partial Q$. The denominator is just Π_{QQ}^u, which is negative by the second order conditions. Equation (9) insures that the first term of the numerator is zero at the intersection, while (8) requires $R>0$. An argument parallel to that in footnote 4 establishes that $\Pi_Q^u=0$ is flatter than $\Pi_n=0$ at the intersection.

assumptions, the cartel will choose lower program quality and fewer commercials. Total exposures will be lower as well, since movement down the curve $\Pi_n=0$ is a movement to a lower output.

Figure 2 also includes the curve $A=A^0$, along which total audience is a constant. Again, movements up the curve $\Pi_n=0$ are movements to a larger total audience. Thus, although the unconstrained cartel would provide fewer commercials, it would also provide sufficiently lower quality to reduce the total audience. Judged by the number of viewers, audiences would prefer the competitive solution.[10] Clearly, advertisers would prefer it as well.

This model of the unconstrained cartel implies that the problem confronting a potential cartel manager in the television broadcasting industry is not that competitive firms air too many commercials to maximize industry profits, but rather that competitive firms provide too much program quality to maximize their collective profit. From the perspective of the cartel manager, the restriction on the number of commercial minutes would appear to be a more readily observable method of restricting program quality, given that each individual station has an incentive to

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[10] The number of viewers is not the appropriate welfare criterion for comparing equilibria. Because the number of viewers does not necessarily reflect the surplus received by inframarginal consumers, a combination of Q and n which generates more viewers does not necessarily generate greater consumer surplus. Because programs are distributed to viewers free of charge, differences in the intensity of preferences for different combinations of n and Q are not reflected in differences in the size of the audience.

cheat on any agreed quality level. Of course, this only makes sense if $\Pi_Q^c=0$ is positively sloped. In that case, by reducing n, the cartel can induce a reduction in Q as well. If individual firms increased Q when n was reduced, which is the situation in figure 1(a), the cartel may choose to impose a minimum number of commercials, greater than the competitive equilibrium, and thereby induce a reduction in program quality. In this case, the unconstrained cartel would provide lower quality, and increase the number of commercials as well. We explore optimal behavior of a cartel which can set only n in the next section.

III. A Cartel Which Can Restrict Only the Number of Commercials

It would be very difficult for a cartel to establish and enforce an agreement to restrict program quality. Actual quality is difficult to define, and difficult to measure. Since stations have a strong incentive to cheat on any agreement, it would be necessary to monitor quality carefully, and to somehow punish cheaters. In the present environment, it is far easier to restrict the number of commercials. They are readily observable, and easy to measure. While stations have an incentive to cheat, it may be smaller, because an increase in the number of commercials when everyone else stays the same is likely to drive away some audience. Moreover, the FCC may well threaten cheaters with loss of their license to broadcast; the agency has looked with favor on agreements to limit the number of commercials as a means of protecting the public. The analysis so far suggests a very different interpretation.

Suppose that the cartel can restrict only the number of commercials. Clearly, it should behave differently than the cartel which can restrict quality as well. Moreover, the cartel should take into account the quality responses of individual stations in determination of the industry profit maximizing number of commercials. What kind of a restriction will such a cartel set, and how will it compare to competition and the unconstrained cartel?

We assume that the cartel chooses n to maximize equilibrium industry profits, taking into account the response of firms subject to its rules. We again neglect costs of enforcing an agreement.

Equilibrium profits are given by

$\Pi^* = f\ [mnA\ (Q^*\ [n],\ n)\ ]\ mnA\ (Q^*[n],\ n) - mC\ (Q^*\ (n)).$

Q^* is the function relating firm choices of quality to n implicitly defined by equation (1); its derivative is given by equation (6). Differentiating Π^* with respect to n the cartel must choose n to satisfy

$$(11)\ \ P\ (1 + \frac{1}{\varepsilon})\ (A + nA_N) + \frac{dQ^*}{dn}\ [(1 + \frac{1}{\varepsilon}\ nA_Q\ P - C_Q] = 0$$

This equation is simply the weighted combination of the two necessary conditions for the cartel which can choose both inputs, given in equations (8) and (9), with the weight for the quality condition equal to the equilibrium change in quality with respect to changes in the constraint. Neither of the necessary conditions for the unconstrained case will be satisfied.

Since competitive firms operating under the constraint will choose Q to satisfy $nA_Q P = C_Q$, (11) can be written as

$$(12) \quad \Pi_n^* = P(1+\frac{1}{\varepsilon})(A+nA_N) = -\frac{C_Q}{\varepsilon}\frac{dQ^*}{dn}$$

This equation can be viewed as requiring the equality of the marginal revenue from another commercial and its marginal cost. The left hand side of (12) is simply the marginal revenue from another ad, as in the case of the unconstrained cartel. Now, however, additional commercials have a cost, which depends on the cost function and the responses of firms subject to the constraint. Marginal cost is not necessarily positive, however; in regions where dQ*/dn is negative, increases in the number of commercials reduce industry costs.

On the assumption that $A_Q + nA_{QN}$ is positive, the constrained cartel will indeed restrict the number of commercials. Equation (12) implicitly defines a relationship between Q and n. This curve must lie to the left of the curve $\Pi_n=0$. Consider a point on $\Pi_n^u=0$, and hold Q constant. Then the right hand side of (12) is positive, as argued above. Since Π_{NN}^u is negative, by the second order conditions for the unconstrained cartel case, a reduction in n is required to increase Π_n^u, thus producing equality in (12). If, on the other hand, $A_Q + nA_{QN}$ is negative, the reverse of this argument establishes that the constrained cartel should increase the number of commercials.

Equation (12) defines two possible equilibria. The cartel can choose to operate where both marginal revenue and marginal cost are positive, or it can operate where both are negative. Presumably, reductions in the number of exposures increase marginal revenue, so the negative marginal cost solution is possible only if demand is inelastic at the competitive solution. If so, then which solution results depends on the location of the isoquant along which marginal revenue is zero. At higher outputs, marginal revenue is negative; at lower outputs, it is positive. If this isoquant intersects the positively sloped portion of Π_Q^c, ($E=E_1$ in figure 3) then the negative marginal cost solution is unattainable. Reductions in n beyond the point of intersection will increase marginal revenue, so it cannot be negative at the equilibrium. If, however, the zero marginal revenue isoquant intersects Π_Q^c in the negatively sloped region of that curve, ($E=E_0$ in figure 3) the positive marginal cost solution is unattainable, since marginal cost is negative in the region where dQ*/dn is negative, and marginal revenue is negative for higher outputs. These results allow comparison of the equilibria which result from the competitive solution, the unconstrained cartel, and the cartel which can choose only n. Unfortunately, most of the results are ambiguous.

Consider first the constrained cartel versus the unconstrained cartel. If the negative marginal cost solution prevails, then the constrained cartel produces a larger output of exposures. It clearly provides more quality than the unconstrained cartel, but it does not necessarily provide fewer commercials. If the curve Π_n is sufficiently flat, the smaller output at the monopoly solution may result in fewer commercials. Regardless of the comparative number of commercials, audiences are larger at the constrained cartel solution. The constrained cartel produces more exposures, and does so with an inefficiently large audience; both factors favor a larger audience.

If the positive marginal cost solution prevails, all comparisons are ambiguous. Both constrained and unconstrained cartels operate with positive marginal revenues; it cannot be determined which produces the larger output. If the constrained cartel produces a larger number of exposures, it must also provide higher quality and attract a larger audience. If it produces a smaller output, neither result is necessary. Comparison of the number of commercials is also ambiguous; if the constrained cartel produces more exposures, it may also use more commercials. If it produces fewer exposures, it must use fewer commercials as well.

Comparison with the competitive outcome is only slightly less ambiguous. It is at least clear that the constrained cartel provides fewer commercials. If the positive marginal cost solution prevails, quality is clearly higher at the competitive solution. With fewer commercials and less quality, audience size is ambiguous; if the constant audience curve is more steeply sloped than the curve Π_Q^c at the competitive equilibrium, then competition results in larger audiences than the constrained cartel. At the negative marginal cost solution, comparative quality levels are ambiguous, as are audience levels. If the constrained cartel chooses an n which results in more quality than the competitive equilibrium, total costs will be higher as well. The constrained cartel may choose to operate at such an equilibrium, if the increase in total revenues is greater than the increase in total costs. For the cartel to operate in a region where further reductions in the number of commercials increase quality, it must impose a relatively large reduction in the number of commercials from the competitive solution. If quality is higher than at the competitive level, the reduction in commercials must be greater still. For small restrictions, the cartel will operate in the region where relaxing the constraint would lead to increases in program quality. Without specifying demand and production functions, little more can be said.

Empirically, it is possible to determine whether the positive or the negative marginal cost solution prevails, if the elasticity of demand is known. Equation (12) requires that if demand is elastic, marginal cost must be positive; thus the cartel must be operating in the range where dQ^*/dn is positive. If demand is inelastic, marginal revenue is negative, and dQ^*/dn must be negative as well. If demand is unit elastic, the cartel must be operating at the trough of the curve $\frac{c}{Q}$, where $dQ^*/dn = 0$. Thus, knowledge of the demand elasticity is sufficient to determine the sign of dQ^*/dn. Available evidence suggests that for network television, the elasticity is not significantly different from one (Bowman, 1976). If so, then the cartel must be operating near the trough. Removal of the restrictions would then increase quality, but tighter restrictions on the number of commercials would increase quality as well.

It is worth noting that the constrained cartel does not produce exposures at minimum cost. Because it can restrict only the "free" input, commercials, it tends to use too few commercials, and too much quality, to produce any given level of exposures. Of course, given the exposure levels, audience would prefer the constrained cartel to either competition or monopoly; ambiguous comparisons result because the output of exposures changes as well. The result is quite general; a cartel which restricts an input, rather than an output, will not produce at minimum cost unless inputs are used in fixed proportions.

IV. Conclusions

The cartel which can restrict only the number of commercials faces a very complicated problem. It regulates an input in the production of exposures, rather than output directly. Because it can restrict only one input, it cannot minimize the costs of producing any given output; it may even increase total costs over the competitive solution. Even though the cartel's problem is that stations produce too much program quality to maximize their collective profit, there is nothing to rule out the possibility that the cartel will operate with higher quality than the competitive solution. This result is clearly an extreme; it requires a relatively large reduction in the number of commercials.

Without more information, it is not possible to predict a priori the responses of program quality to public policies which alter the nature of the constraint. Relaxing the constraint may increase or decrease program quality, and audiences. Similarly, tightening the constraint may shift audiences and quality in either direction. If the model is correct, knowledge of the elasticity of demand is sufficient to determine the direction of the effect.

This paper has examined a narrow aspect of the NAB's restrictions on the number of commercials. It has not considered the effects of those restrictions in the markets for products which advertise, or the effects of the restrictiveness on total viewer welfare. Nonetheless, changes in program quality are an important element of decisions about the value of the restrictions. Better policy could be developed with better knowledge about program quality effects.

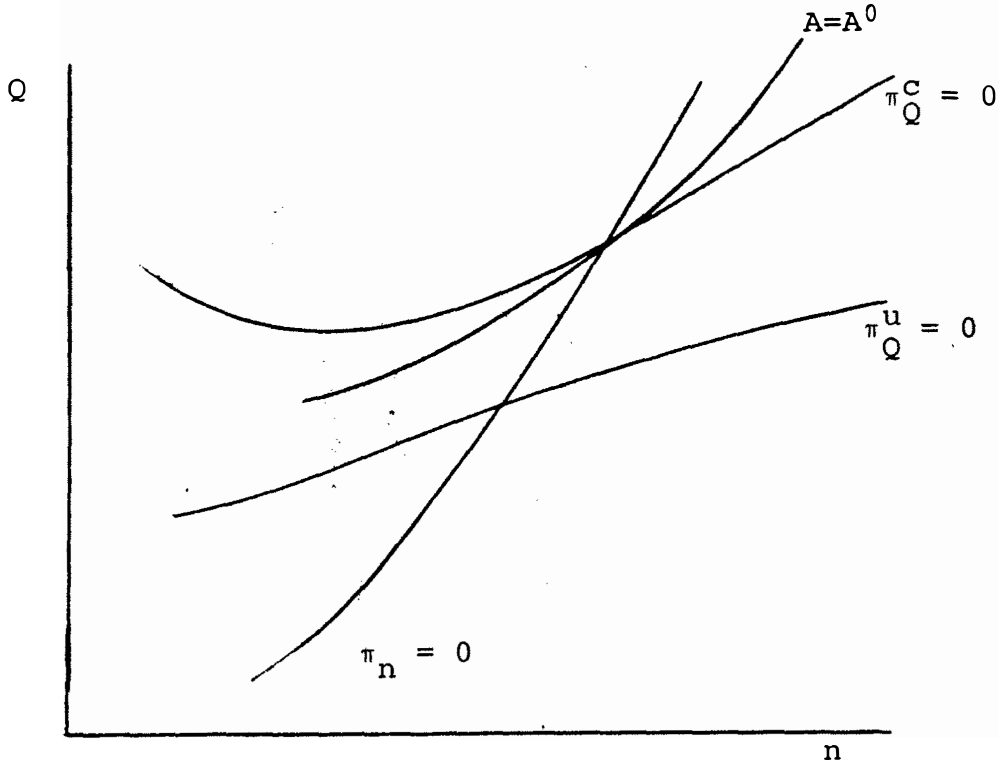

Figure 2

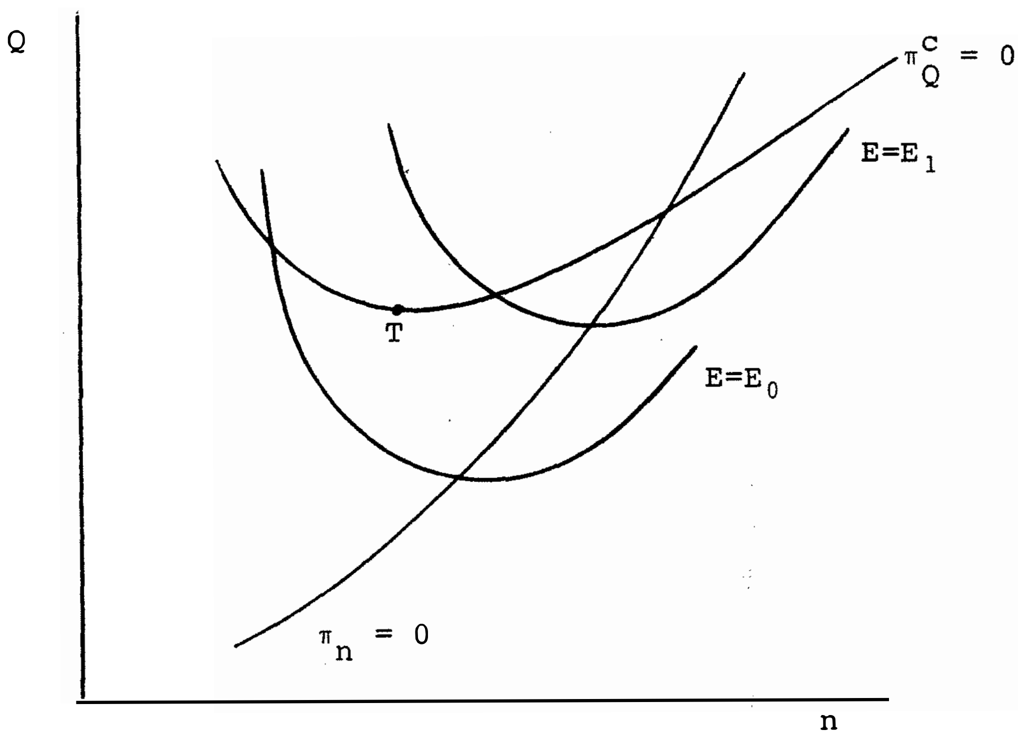

Figure 3

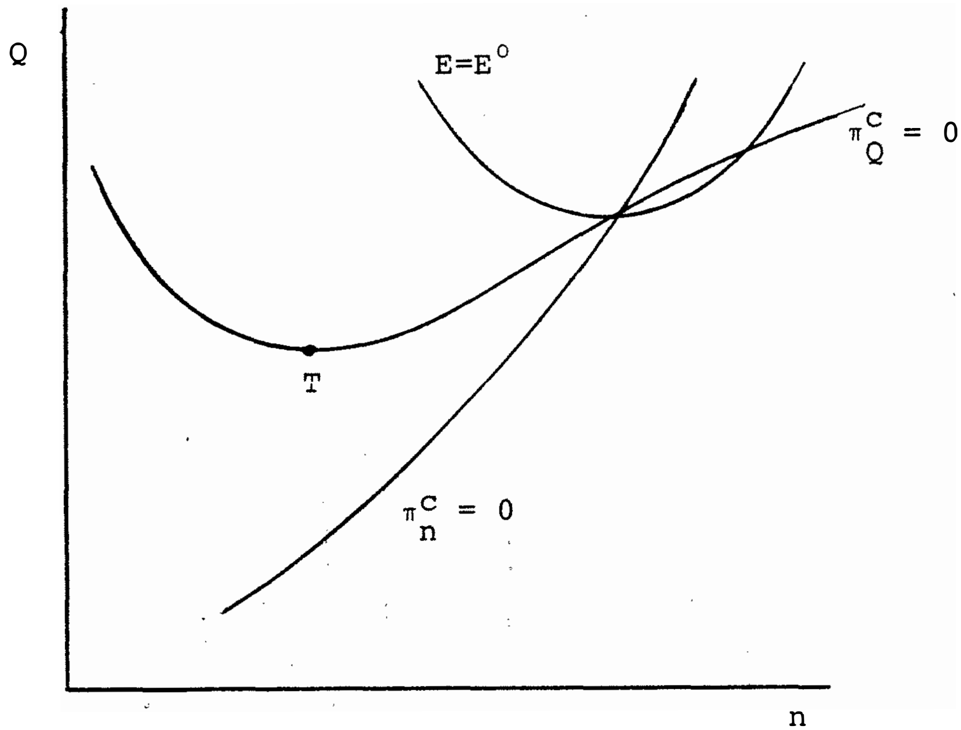

Figure 1(a): $A_Q + nA_{QN} > 0$

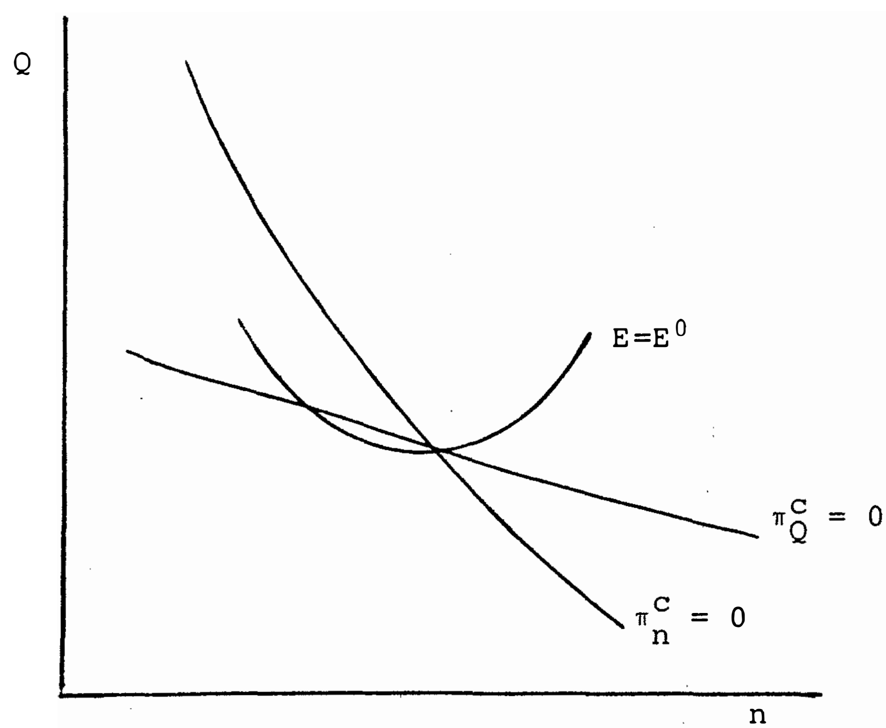

Figure 1(b): $A_Q + nA_{QN} < 0$

REFERENCES

Bowman, Gary (1976) "Demand and Supply of Network Television Advertising," Bell Journal of Economics, Spring 1976, p. 258.

Crandall, Robert W. (1972) "FCC Regulation, Monopsony, and Network Television Program Cost," Bell Journal of Economics, Autumn 1972, p. 483.

Noll, Roger G., Merton J. Peck and John J. McGowan, (1973) Economic Aspects of Television Regulation, Washington: The Brookings Institution, 1973.

Sheshinski, Eytan (1976) "Price, Quality and Quantity Regulation in Monopoly Situations," Economica, 1976, p. 127.