ON THE EFFICIENCY OF COMPETITIVE MARKETS FOR OPERATING LICENSES*

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Some economists and policy makers have suggested that market allocation of scarce operating licenses, broadcasting licenses, and airport "slots," for instance, would lead to their efficient use. This paper demonstrates that a competitive market allocation of operating licenses, whether attained through auctioning, selling, or allowing resale of the rights, does not, in general, assure efficiency. The profit criterion that would guide the allocation of licenses in a competitive market would not necessarily lead to the uses that maximize social benefits. The paper shows that the difference between private and social incentives in the allocation process can be quite large. The theory is then applied to discussions of allocating airport takeoff and landing slots and broadcasting licenses.

I. INTRODUCTION

Government agencies at the federal, state, and local levels allocate hundreds of different kinds of operating licenses. The supply of these licenses is often limited. In some cases the limit is influenced by real resource constraints, such as with television broadcasting licenses and airport takeoff and landing slots. In other cases, such as with liquor licenses and taxi medallions, the limit appears to be rather arbitrary. In neither situation, however, is it common for the government to set a price for the licenses that equates demand with the restricted supply. Many economists and policy makers have suggested that such a competitive market allocation of operating licenses would allow society to use them most efficiently.[1]

This paper demonstrates that a competitive market allocation of operating licenses, whether attained through auctioning, selling, or allowing resale of the rights, does not, in general, assure their efficient use. Furthermore, in two important cases recently under consideration, the allocation of airport slots and broadcasting licenses, the effects that cause market allocations to be suboptimal

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1. See, for instance, Levine [1969]; Grether, Isaac, and Plott [1981]; Koran and Ogur [1983]; and Kwerel and Felker [1985].

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could be significant. This is certainly not evidence that the results would be inferior to those of the bureaucratic mechanisms currently used. It is, however, reason to consider modifications or restrictions on the market mechanism that could improve efficiency.

Nearly all operating licenses give their holders a great deal of flexibility in how the license is used. Operating licenses seldom dictate the quantity the firm must sell, the production process it must use, the price(s) it must charge, or even a single precise market in which the licensed firm must operate. Yet, it is clear that allocating licenses through a market mechanism will not necessarily cause license holders to charge prices equal to marginal cost or to sell the efficient quantity of their product. Thus, efficiency comparisons among different uses of a license must be made from a second-best view, based on the actual quantity that firms will choose to sell in each market. Recognizing that distortion, however, there seems to be a widely held belief that market allocation will induce firms to use licenses in the way that will produce the greatest social benefits. That is, the profit incentive will guide firms to the market and production process that will maximize total surplus (total consumer surplus plus total producer profits), given the constraint that firms will set prices and quantities in order to maximize profits.[2]

Unfortunately, profits can be poorly correlated with the gain in total surplus from a firm's operations. In some cases, a new licensee may be able to capture only a small proportion of the total surplus it generates. In other instances, the firm's profits may be many times greater than the associated increase in total surplus. With profits and total surplus so weakly correlated, it is quite possible that the profit-maximizing use of a license will not correspond to its surplus-maximizing use.

Spence [1976], Dixit and Stiglitz [1977], Koenker and Perry [1981], and Mankiw and Whinston [1986], among others, have recognized and explicitly investigated this phenomenon in the context of monopolistic competition and optimal variety.[3] While the analysis here is technically analogous to Spence's work, the application is rather different. Spence takes fixed costs of entering a market as exogenous and compares the optimum number of entrants with the outcome under monopolistic competition. In this paper it is the total number of entrants into many different markets

2. The use of total surplus as a welfare measure ignores income effects. This omission has no qualitative effect on the analysis.

3. In a similar vein, Henderson [1947] demonstrated that firms may find unprofitable the production of some goods that increase total surplus.

that is fixed. The price of entry, i.e., the price of a license, is determined endogenously by the profit opportunities in the various markets that may be entered with a license.[4] It is shown that because profits are imperfectly correlated with the change in total surplus, a license-holding firm will not necessarily enter the market in which it could generate the maximum social benefits. This possibility that a license will be used inefficiently exists regardless of how the license is allocated.

The potential for inefficient *allocation* arises because different firms would, if assigned a license, choose to enter different markets or to use different production technologies. A firm's most profitable use of a license depends on its production set and its sunk assets. Sunk assets might include reputation or acquired expertise in a specific industry or market, as well as machinery and equipment that are costly to trade. Of course, if these factors were identical for all potential license holders, then any applicant would choose the same market and production process. If that were the case, assignment of operating licenses would not affect resource allocation and would probably not be a significant public policy issue. Such an assumption, however, is equivalent to supposing that a certain landing slot at La Guardia Airport would be used to serve the same route whether the slot were assigned to United Airlines or Air Vermont. In reality, the most profitable use of a license will differ among firms, depending in large part on the products that they already sell.

Because firms will choose different uses for an operating license, efficiency in the market allocation process depends on a high correlation between profits, which is the most a firm would be willing to pay for a license, and the change in total surplus.[5] The relationship between a firm's expected profits and the change in total surplus that it would generate clearly depends on the firm's production function. It is also greatly affected by attributes of the firm's chosen market, such as the elasticity of demand, the number of other firms in the market, and the difficulty of segmenting the market in order to price discriminate. With firms differing in the markets they would choose to enter, Section II demonstrates that there is little reason to expect profits to be highly correlated with

4. Demand functions among the various markets in which a license may be used are assumed to be independent, though positive or negative cross-elasticities would not change the analysis substantively.

5. A sufficient condition for efficient use of a set of licenses is that a ranking of uses by profits they would generate correspond exactly to a ranking by increases in total surplus they would generate. This result seems very unlikely unless profits and total surplus are highly correlated.

the total surplus a new licensee would generate. In fact, even if all firms would choose to enter the same market, we see that differences in production technologies can lead to inefficient allocation. The firm with the most profitable technology may produce less output and generate lower total surplus.

Section III resolves the apparent conflict between the results of the Section II and neoclassical theories of the efficiency of competitive markets. The standard marginal analysis fails for two reasons. First, operating licenses are lumpy inputs. Though a license may be one among hundreds available, as with airport slots, it usually allows a nontrivial proportion of the output in the market in which it is used. Inframarginal output that a license permits results in consumer surplus that the firm cannot capture.[6] Second, if incumbent firms in a market are not pricing at marginal cost, then some of a new licensee's profits may be just a transfer of surplus from incumbents. Such transfers are privately valuable, but do not represent an improvement in overall resource allocation.

To the extent that lumpiness is the cause of the inefficiency, the problem need not occur in cases in which the quantity allowed by a single license can be made very small, e.g., marketable air or water pollution rights.[7] On the other hand, both causes of inefficiency exist regardless of the source of the limit on licenses; whether the scarcity reflects a true resource constraint or is imposed artificially, the allocation of a fixed number of operating licenses by a market mechanism will not, in general, be efficient.

Section IV addresses the issue of allocative efficiency when there are many licenses to be assigned. Sections V and VI are applications of the theory to two current public policy issues: the allocation of scarce takeoff and landing slots at some airports and the allocation of radio and television broadcasting licenses. Section VII concludes the paper and discusses possible improvements in the allocation process that this work suggests.

II. Competitive Allocation of Operating Licenses That Are Not Market Specific

Most operating licenses allow quite a bit of flexibility in their use. Radio broadcasting licenses permit almost any programming

6. This argument can apply to any lumpy input. An operating license with no output limit, however, might be the lumpiest of all possible inputs; exactly one must be used in production of any quantity.

7. In the case of pollution rights, the quantity of the firm's output associated with the amount of pollution allowed by a single license must be small relative to the market in which the polluter is selling its output.

format; airport landing rights are not contingent on the flight for which they are used; in most states, the same "on-premise" liquor license allows operation of a corner bar or an expensive French restaurant. Thus, an operating license often allows its holder to choose among very different markets in deciding how to use the license.

Demand will generally differ among these markets. Furthermore, the relationships between the market demand and the demand curve faced by the new license holder will depend on the market structure and interactions among all other firms, if there are any, in the market. Under such circumstances, there is no reason to believe a priori that a ranking of potential licensees by expected profits would correspond to a ranking by the change in total surplus they would be expected to generate. In fact, we see below that the ratio of a new license holder's profits to the associated change in total surplus can quite plausibly vary by an order of magnitude.

In order to isolate the effect of differences in market demand, we look first at alternative monopoly uses of a license in which unit production costs would be the same in any of the potential markets. Thus, market structure and production costs are held constant across the potential uses of the license. Differences in market structure are then examined, followed by an analysis of the effect of different production technologies.

A. Allocation of Operating Licenses among Monopoly Markets

When the markets in which an operating license can be used have significantly different demand functions, the link between profits and total surplus can be quite weak. As an example, consider two firms that intend to use an available operating license to enter different markets. In either market, the new licensee would be a monopolist and would have the same production cost, constant average (equal marginal) cost, c. Figure I is a straightforward graphical presentation of a case in which Firm A would earn greater profits in Market 1, but total surplus would be higher under Firm B's proposed use of the license in Market 2. Clearly, assigning the license to the firm willing to pay the highest price will result in its inefficient use in this example.

With reasonable parameter values, the ratio of the profits of a monopoly license holder to the total surplus its sales would generate can vary significantly. Using the family of isoelastic demand curves, the first column of Table I presents this ratio for the monopoly prices and outputs that would result with different elasticities.

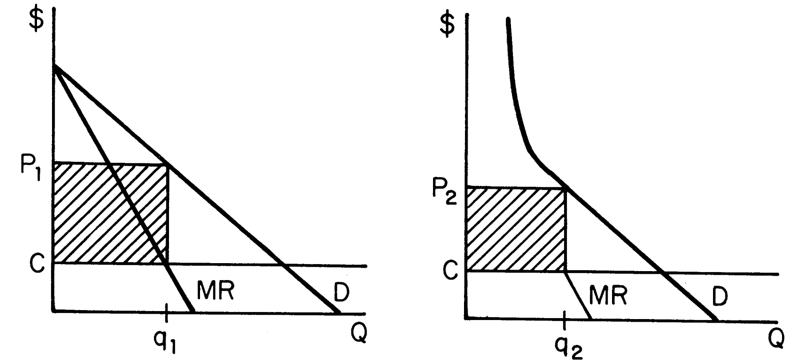

FIGURE I

More generally, we define the parameter ϕ, where[8]

$$\phi = \frac{\text{Profits that the New Licensee would Receive}}{\text{The Change in Total Surplus that the New Licensee would Generate}}.$$

Going from a 1.5 price elasticity of demand to 3.0 causes ϕ to increase from 0.25 to 0.40.

The importance of ϕ is illustrated in the following example. Suppose that Firm A wants to enter a market with a constant demand elasticity of three. If the company's monopoly operations would generate \$10 million in total surplus, it would be able to capture 40 percent, \$4 million, as profits. Firm B wants to use the same license to enter a market with constant demand elasticity equal to 1.5. Assume that Firm B's monopoly service in its chosen market would result in \$12 million in total surplus. The company would earn \$3 million in profits, 25 percent of the total surplus it generates. Because of the different ϕ ratios, Firm A would be able to outbid Firm B for the license in a competitive market, even though assignment of the license to Firm A would generate less total surplus.

Clearly, these numbers are specific to the demand and cost functions used. It is easy to produce an example in which the demand elasticity at the monopoly output is greater in Market 1, yet a monopolist would be able to capture a greater proportion of

8. Though ϕ here is similar to Spence's [1976] β parameter, the two measures differ in one important respect. Spence's β is the ratio of maximized firm profits to maximized change in total surplus, while ϕ in this use is the ratio of maximized firm profits to the change in total surplus at that point of profit maximization.

TABLE I
ϕ RATIO FOR *N*TH ENTRANT IN SYMMETRIC COURNOT-NASH EQUILIBRIUM
($Q = a/P^\epsilon$, $MC = b$, $a, b > 0$)

Demand elasticity	Number of firms in market (including entrant)						
	1	2	3	4	6	8	10
1.5	0.25	0.37	1.20	2.10	4.01	5.97	7.94
2.0	0.33	0.50	1.33	2.25	4.17	6.13	8.10
2.5	0.38	0.58	1.42	2.34	4.26	6.22	8.19
3.0	0.40	0.63	1.47	2.40	4.32	6.28	8.26
4.0	0.43	0.69	1.54	2.47	4.40	6.36	8.34
5.0	0.44	0.72	1.58	2.51	4.44	6.41	8.38

the total surplus in Market 2. Without precise assumptions about the functional form of demand curves, there is no necessary relationship between the price elasticity of demand at the profit-maximizing output (which are likely to be the only elasticities that can be estimated) and the ϕ parameter. The point is that in comparing markets that are not substantially similar, profits of the monopolist can be a very poor indicator of the total surplus that its service in the market would generate.

B. Allocation of Operating Licenses Among Markets with Differing Market Structures

The relationship between a new license holder's profits and the change in total surplus it would generate is also strongly affected by the structure of the market that the licensee intends to enter. If, for instance, the entrant would just force colluding incumbents in some market to share the monopoly profits, then the entry would have little or no effect on price or market output. The result could be no increase in total surplus, even though the entrant might be willing to pay a large sum for the license.[9] This extreme divergence between the private and social value of the licensee's operations is due to collusion, but similar distortions can occur without cooperation among firms.

With entry restricted by a scarcity of licenses and competing firms earning long-run profits, a Cournot-Nash noncooperative game is one appropriate model of license-restricted markets. Again using isoelastic demand functions and constant marginal costs,

9. No change in output or total surplus would occur if all colluding firms had constant and equal unit costs of production.

Table I presents ϕ for N-firm symmetric Cournot-Nash equilibria. The table shows clearly that a firm intending to enter a market with many *noncooperative* incumbents could be willing to pay much more for a license than the increase in total surplus it would generate (i.e., $\phi > 1$). This can never be the case in a previously unserved market.[10]

In Table I, ϕ also increases monotonically with N, the number of firms in the market (including the entrant). As N increases, the change in surplus that one more entrant would generate declines more quickly than does the profit that the entrant could expect to earn. Firm A might plan to enter a market with three incumbents in which it would generate only a small increase in total surplus. Firm B, on the other hand, might plan to enter a previously unserved market and would generate a much larger increase in total surplus. Still, Firm A's profits could be more than twice the change in total surplus (ϕ is greater than 2 when $N = 4$), while Firm B might be able to capture only 40 percent of the surplus increase it would generate. These differences in ϕ imply that Firm B could generate a five times greater increase in total surplus and still be unable to outbid Firm A for the license.

It can be shown that ϕ always increases monotonically with N when demand is isoelastic or linear and unit costs are constant. Unfortunately, the result does not generalize in a useful way. For instance, if firms have fixed costs, increases in N eventually cause ϕ to change signs, because firms earn negative profits in (short-run) equilibrium. This, of course, is not relevant to a discussion of selling operating licenses, since they would have no value. Still, when firms have declining average costs, the ratio can turn negative even while firms earn positive profits. With declining costs, entry can lessen production efficiency by an amount that is greater than the surplus gains from greater output, thus lowering total surplus. Though the sign of ϕ changes in such cases as N gets large, the decline in the desirability of assigning a license to such markets (in comparison with the bid a firm would make) continues. It is also possible for an increase in N to cause a decline in ϕ while both the numerator and denominator of the ratio remain positive. This can happen in a

10. It is possible, however, that monopoly service in a market could lower producer profits in a substitute market in which rents were being earned. If that change is taken into account (as it should be in a welfare analysis), then ϕ could be greater than 1 even for entry of the first firm in a market. Of course, the same effect on substitute markets could exist regardless of the number of incumbents in the original market.

Cournot-Nash setting, for instance, if the elasticity of demand increases rapidly as the market price declines.[11]

More relevant to issues of license allocation, however, is the relationship between ϕ and N in cross-market comparisons. If demand elasticities differ significantly across markets, ϕ could be greater in a market with fewer incumbents. Still, Table I indicates that in the absence of large differences in demand functions across markets, competitive market license allocation is likely to lead to too much entry in crowded markets and too little service in markets that could support only one or two firms.

Besides indicating that the bias in market allocation of operating licenses may be systematic, Table I also shows that the potential inefficiency could be quite large. When the number of incumbents differs among the markets that may be entered, the ϕ ratio is not at all stable. For instance, looking just at demand functions with constant elasticity equal to three, the second entrant in a market would be willing to pay about one-tenth as much compared with the surplus it would create as the eighth entrant. As discussed in Sections V and VI, it is not at all implausible that a license will have uses in which the number of firms in potential markets would vary by this much.

Though producers do not collude in the Cournot-Nash model, the basis for the increasing ϕ ratio is similar to the discussion of the collusive case. Part of the profit that the entrant expects to earn is simply a transfer from incumbent firms.[12] The transfer of rents has no net value to society. As the number of incumbents in the market rises, in a Cournot model, there is a tendency for a higher proportion of a new entrant's expected profits to be these transfers.

The Cournot model is, of course, just one possible view of the behavior and interaction of incumbent and entering firms. Game theorists have suggested many other equilibria that might result. A potential competitor's incentive to enter each market will depend in large part on how it believes incumbents will respond. An incumbent might exhibit "toughness" in the face of entry, maintaining its sales through price cuts, increased advertising, or other aggressive

11. In one example, starting from a two-firm Cournot equilibrium at which the elasticity of demand equals 2, the elasticity would have to increase to greater than 3 at the three-firm Cournot equilibrium.

12. Mankiw and Whinston [1986] study this "business stealing" effect in free-entry markets and show when it is likely to lead to excessive and insufficient entry. In what follows, I use "business stealing effect" only to refer to cases in which incumbents lose *profitable* sales to an entrant. Mankiw and Whinston use the term for any instance in which the incumbents' sales decline after entry, even if the lost sales would not be profitable after entry.

behavior. In comparison with Cournot, such a response would lower ϕ by lowering the entrant's expected profits and, quite possibly, by increasing the welfare gain from entry. For the same reasons, greater incumbent "weakness" than is implied by the Cournot model (e.g., the entrant becoming a Stackelberg leader) will tend to increase ϕ. The amount of accommodation that occurs in response to entry is likely to differ among different markets in which the same license could be used. Empirical estimation of these responses is necessary before prudent policy regarding allocation can result.

C. License Misallocation with Marginal Cost Pricing

In both the monopoly and Cournot models, firms have market power that leads them to charge prices above marginal cost. Inefficient pricing of the output, however, is not the only cause of inefficiency in competitive market allocation of operating licenses. To see this, consider a market in which each firm i has constant marginal costs c_i, out to an absolute output constraint K_i. If each firm's capacity is a small enough, though still nontrivial, proportion of total output, then there will be a unique Cournot equilibrium in which each firm produces out to its capacity.[13] The result is efficient, exactly mimicking what would obtain if each firm acted perfectly competitively in the belief that its output would have no effect on price. Yet, if fixed costs are small enough, each firm will earn positive profits, and a license to enter this market will have positive value. With this competitive interaction and efficient pricing, ϕ will almost surely differ across markets.

Figure II illustrates this result. S_N is the market supply curve with N incumbents. S_E is the supply curve (i.e., marginal cost curve) of the potential new licensee. With entry, the market supply curve would become S_{N+E}.[14] Total surplus in the market would increase by area A plus area B, but the entrant would earn only area A in profits. It is worth noting that the entrant's profits are not a transfer from incumbents in this case; there is no business stealing effect. All of the surplus shared by incumbent firms and consumers before the entry remains with those groups. After entry occurs, however, more of that surplus goes to consumers.

In this model, ϕ would equal 1 if demand were infinitely elastic

13. Though each firm recognizes that it faces a downward sloping residual demand curve, if its K_i is small enough, its marginal revenue will be greater than marginal cost for any output less than K_i. I use a constant marginal cost out to a capacity constraint, because unlike the increasing marginal cost case, it yields a Bertrand equilibrium with efficient pricing and positive profits.

14. For clarity, Figure II is drawn as if the c_i of all firms were equal.

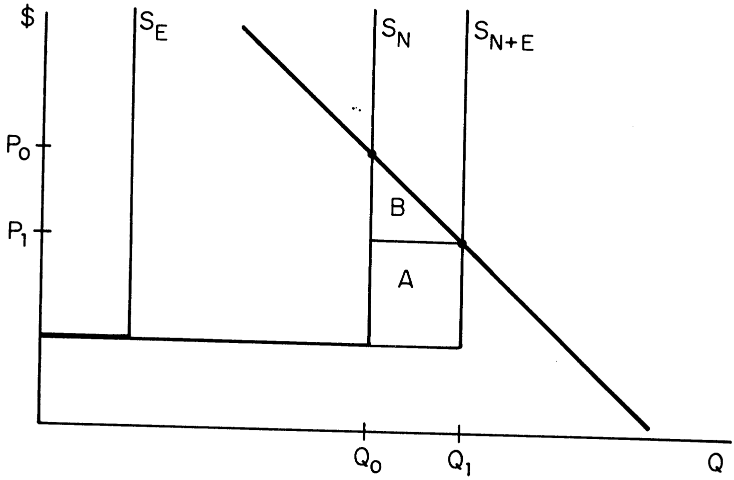

FIGURE II

at quantities greater than Q_0 and would range between 0 and 1 if demand were still downward sloping. Thus, even if price were set at marginal cost in all markets in which the new license could be used, ϕ would vary depending on the pre-entry output, the cost function of the entrant, and the demand function of the chosen market. As a result, the firm and use that maximized profits from the license would not necessarily be the one that maximized the change in total surplus.

D. The Role of Price Discrimination

The ability of a firm to price discriminate will affect the proportion of the total surplus that it will be able to capture as profits. Still, price discrimination is not likely to lessen substantially the potential for misallocation of licenses. If, for instance, a potential recipient of a license would become a perfectly discriminating monopolist in Market 1, then it would be willing to bid up to the entire surplus it would generate ($\phi = 1$). For illustration, let us assume that the only alternative markets in which the license could be used would be ones in which the new licensee would also be a monopolist. If customers could not be effectively segmented in the alternative markets, then the competitive allocation of licenses would be based on a comparison of all the surplus generated in Market 1 with, for instance, 40 percent (from the first column of Table I) of the surplus that would result from single-price monopoly service in other markets. If some sorting of customers were profitable in alternative markets, then ϕ would most likely increase in those markets depending on the degree to which discrimination was carried out.[15] Price discrimination seems as likely to increase as to decrease differences in ϕ among alternative uses.

With varying market structures, the effect of price discrimination on differences in ϕ becomes even more difficult to predict. Spence [1976] argues that if all firms could price discriminate perfectly, the "product choice problem" would disappear; that is, all products that should be produced on efficiency grounds, would be produced. That result, however, depends on the assumption that only one firm would produce each product. When the market structure is not so restricted, even perfect price discrimination in all markets does not assure efficient license use. If, for instance, a new licensee could force a perfectly discriminating monopolist to share its profits, the entrant might find it more profitable to force such a sharing arrangement, rather than to capture all of the surplus in some alternative market.

The ability of some firms to price discriminate, and thereby gain greater profits relative to the surplus they generate, is not likely to make market allocation of licenses more efficient. The misallocation is not a result of ϕ being low in some markets or being different from one; it is caused by ϕ differing among the possible uses of a license.

E. Allocating Licenses Within a Single Market

It is well-known that a firm with market power will have too little incentive to invest in some cost-reducing technologies.[16] A firm will make an investment that lowers production costs only if the investment increases the firm's profits. Yet, if such an investment would lower the firm's profit-maximizing price, consumer surplus would increase as well. Because the firm cannot capture this additional surplus gain, there could be some changes in technology that would increase total surplus, but would not increase profits. Such changes will not be adopted by the firm.

If potential licensees have different sunk investments in different technologies, then given a license to operate in a certain market, they may do so with different production functions. For the

15. It is possible that price discrimination could lower ϕ by raising consumer surplus proportionately more than profits.

16. This has been pointed out in the literature on optimal regulation (Sappington [1983], for instance) and on research and development (Kamien and Schwartz [1982], for instance).

same reason that firms may not invest in the surplus-maximizing technology, the firm that can earn the highest profits in a market may not be the one whose operations would generate the highest total surplus. It is straightforward, for instance, to demonstrate that a monopolist with low fixed costs and high marginal costs could generate greater profits, but lower total surplus, than one with higher fixed costs and lower marginal costs. Borenstein [1987] proves that a necessary and sufficient condition for the market allocation of a single market-specific license to maximize total surplus for any demand function is that the most profitable firm at every level of output, q, also have the (weakly) lowest marginal cost at that q. When there are firm-specific differences in production functions, it seems quite possible that this condition would not hold and that market allocation of even a market-specific license would not assure its efficient use.

III. How Are Operating Licenses Different from Other Inputs?

The efficiency of competitive input allocation depends upon marginalism. The possibility of licenses being used inefficiently (as described in Section II) occurs in part because a single operating license is a lumpy input that permits a discrete quantity of output. The output allowed by one operating license is usually not a trivial proportion of the total output in the market in which the license is used.

To demonstrate the effect of this lumpiness in an otherwise competitive industry, we consider a set of markets in which all firms are price takers in the following sense: in determining the profit-maximizing use of its license, a firm calculates the price that would obtain in each market if output in the market were increased by the quantity that the firm is licensed to produce. The firm takes this resulting price as given. This "price-taking" behavior is profit-maximizing if the number of units that each firm is licensed to produce is small enough so that it would not choose to sell less than all the units for which it is licensed. That is, though each firm recognizes that its output will affect price in whatever market it chooses, its marginal revenue will still be greater than marginal cost when it sells all the units for which it is licensed.[17]

17. As shown below, the results are quite similar when each firm naively believes that its output will have no effect on price.

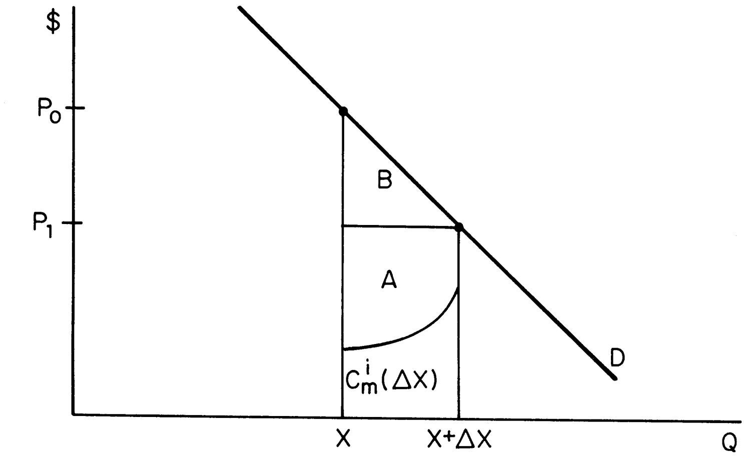

FIGURE III

Firm i has a license to sell ΔX units. The firm can choose to use the license in one of many different markets. The total surplus generated by the output in market m is

$$W_m(X) = U_m(X) - C_m(X), \tag{1}$$

where $U_m(X)$ is the value to consumers of X units of output in market m (the area under the demand curve) and $C_m(X)$ is the cost incurred by incumbent firms in producing X units in market m.[18] The addition to total surplus that firm i would generate if it used the license in market m is

$$W_m(X + \Delta X) - W_m(X) = U_m(X + \Delta X) - U_m(X) - c^i_m(\Delta X), \tag{2}$$

where $c^i_m(\Delta X)$ is firm i's cost of producing ΔX units in market m. Efficiency implies that the license should be used in the market that maximizes equation (2).

Firm i, on the other hand, wants to use the license where it will generate the greatest profit,

$$\pi^i_m = \Delta X \cdot U'_m(X + \Delta X) - c^i_m(\Delta X), \tag{3}$$

where π^i_m is the profits firm i will earn if it sells ΔX units in market m and $U'_m(\cdot)$ is the inverse demand function for market m. Maximization of total surplus, equation (2), is different from the entrant's profit-maximization, equation (3). This is illustrated in Figure III,

18. In using this measure of total surplus, we assume that the cost of each input, other than the license, reflects its true social opportunity cost, i.e., each input is sold at $P = MC$.

in which the entrant's profit is area A and the surplus increase is area A plus area B.

The difference between (2) and (3) vanishes, however, when the quantity allowed by a license goes to zero. To see this, we divide each equation by ΔX and look at the limit of the surplus increase per unit and the profit per unit as ΔX gets arbitrarily small:

$$(4) \quad \lim_{\Delta X \to 0} \frac{U_m(X + \Delta X) - U_m(X)}{\Delta X} - \frac{c_m^i(\Delta X)}{\Delta X}$$

$$= U_m'(X) - c_m'^i(0) = \lim_{\Delta X \to 0} U_m' (X + \Delta X) - \frac{c_m^i(\Delta X)}{\Delta X}.$$

When the number of units allowed by a license is near zero, both the firm and society want the license to be used in the market in which the difference between price and marginal cost is greatest.[19] Thus, even when firms are competitive and never choose to restrict output, social and private preferences for the use of an operating license can differ because the resulting output is not marginal.

In an industry without lumpy inputs, firms purchase inputs up to the point that the marginal revenue-product (MRP) of each input is equal to its price. For a price-taking firm, MRP is equal to the social value of the marginal input unit used by the firm. Since the firm is a price taker, the revenue gained by the marginal sale is the price of the output. Since the unit of output is marginal, price equals the value of the output to the marginal consumer. That is, the marginal output yields no first-order change in consumer surplus. Thus, the firm captures all of the surplus generated by the marginal unit of output. The (net) revenue product of an operating license, however, is the profit earned on all units that the license allows the firm to sell, not just the marginal unit. Inefficiency can occur because the social value of inframarginal units includes consumer surplus (area B in Figure III) which is ignored in the firm's valuation. The consumer surplus is not strictly proportional to the producer's surplus across markets, so ϕ values will differ.

The potential for inefficient use of a license is increased if firms restrict output and set $P > MC$. In many models of oligopoly behavior, Cournot-Nash for instance, the incumbent firm or firms will sacrifice profitable sales to an entrant in order to avoid a price

19. The analysis is very similar if the firm is a naive price taker, mistakenly believing that its production of ΔX units would have no effect on price. In that case the area it would try to maximize would be larger $(U_m'(X) \cdot \Delta X - c_m^i(\Delta X))$ rather than smaller than society's maximand. Still, the difference would vanish as ΔX goes to zero.

war that might drive price to marginal cost. This does not occur in price-taking markets. When firms each set $P = MC$, none would want more sales than it has, even if it could gain sales without driving down the market price. This transfer of profits to an entrant is the reason that ϕ could exceed one in the Cournot-Nash model in Section II. On the other hand, ϕ could not be greater than one in the model that followed with efficient pricing (subsection II.C), because all surplus that incumbents lost when entry occurred was transferred to consumers, not to the entrant.

Thus, there are two reasons that the private and social preferences for use of an operating license can differ. Consumer surplus that the new licensee cannot capture will cause him to undervalue the license, while transfers of profits from incumbent firms will cause him to overvalue the license. Lumpiness of the operating license is at the heart of the consumer surplus effect. As shown above, if licenses could be sold separately for production of quantities that were a trivial proportion of the market output, this effect would disappear. Sellers would be able to capture all of the surplus generated by the marginal license. The ϕ ratio would equal 1 in all potential uses of the license and would thus be equal for all uses.

This lumpiness is equivalent to the integer constraint on N in Mankiw and Whinston [1986] (MW). MW prove a result that appears to bound to some extent the degree to which lumpiness can result in insufficient entry. Their Proposition 2 states that the socially optimal number of firms in a market will never exceed the equilibrium number by more than one. This appears to imply that if four licenses would be optimally distributed, two to each of two markets, then competitive allocation could never result in four in one market and zero in the other. Yet, it is straightforward to develop numerical counterexamples.

The reason for this apparent contradiction is MW's assumption that the price of each input reflects its true social opportunity cost. Only then is total surplus equal to the gross surplus minus the cost of inputs. Though this is a common and perhaps innocuous assumption in some contexts, it would be quite inappropriate to apply the MW result when one of the inputs is a scarce operating license. In the terms of this paper, MW's Proposition 2 would require that $\phi = 1$ in all alternative uses of a license. Their proof is still valid if no input (e.g., license) costs more that its social opportunity cost (i.e., $\phi \leq 1$ in all alternative uses), but it will not hold when a business stealing effect in some alternative use of an input causes the input's market price to exceed its social opportunity cost ($\phi > 1$).[20] Of course, this sort of second-best criticism can be leveled at many efficiency discussions. As this paper demonstrates, however, the exceptions are likely to be especially common when entry into other markets is constrained by a shortage of licenses.

Unlike the lumpiness (or integer) problem, business stealing effects, which may cause $\phi > 1$, would not vanish even if the quantity allowed by a single license were very small. If a firm with a license to produce ϵ units entered a market in which incumbents had market power, the incumbents would, in all likelihood, further restrict their own output. The decline in incumbents' output would partially offset the surplus increase from entry, because incumbents who set $P > MC$ generate first-order surplus with even their marginal units of production. This output restriction by incumbents, in response to entry, raises the entrant's expected profits and lessens the increase in total surplus, thus increasing ϕ. Because the degree to which incumbents respond to entry will differ across markets, ϕ would still vary among the potential uses of such a license.

IV. Markets with Many Licenses

The discussion thus far has concerned the effect of market allocation of one license. Implicitly, we have assumed that all other existing licenses would remain in their current uses and no new licenses would be issued. Yet, if there were a resale market for operating licenses, it would most likely be available to all license holders. Would the inefficiencies described above still obtain in an equilibrium with all licenses subject to resale?

If all firms were price takers in the license market, then each license would be allocated to the use in which it generates the greatest profits. The effect that one transaction would have on the profits earned from other licenses would be ignored in such a competitive market. Thus, any equilibrium would be Nash in that each license would be generating maximum profits given the use to which every other license is being put.

In such an equilibrium, the discussion of Section II applies

20. Their proof is based on demonstrating that $\pi_{N^*-1} \geq 0$, that marginal entry up to one less than the social optimum N^*, is always profitable. If this is true when all inputs are priced at their social opportunity cost, it will also hold if some input (an operating license, for instance) is priced below its social opportunity cost ($\phi < 1$ in alternative uses). If $\phi > 1$ in alternative uses, however, then $\pi_{N^*-1} > 0$ cannot be assured.

directly. That the market allocation is not necessarily efficient can be shown by contradiction. If all licenses were allocated efficiently, then each would be in the use that generated the greatest increase in total surplus given the use of all other licenses. But given *any* allocation of all other licenses, we saw in the previous sections that the market would not necessarily allocate a single license efficiently. Thus, with all other licenses allocated efficiently, the market will not necessarily allocate the last license to the use that maximizes the increase in total surplus.

V. The Allocation of Airport Takeoff and Landing Slots

Many airports in the United States cannot safely accommodate all of the requests they receive for clearance to take off or land. Historically, takeoff and landing "slots" at a few of these airports were assigned to existing airlines after lengthy negotiations among all the carriers wishing to use the airport. When they reached a consensus, the airlines would recommend an allocation of slots to the Federal Aviation Administration (FAA), which would generally approve the recommended plan.[21]

This allocation mechanism has been widely criticized as being inefficient and particularly unfair to new airlines.[22] A frequently suggested alternative is to auction, or at least allow resale of, airport slots. In fact, in April of 1986, the Department of Transportation began to allow such resale at the four "slot-constrained" U. S. airports.[23]

A slot is effectively a license to operate one flight to or from an airport at a given time. The slot can be used to serve any one of hundreds of different city-pair markets. If the slot market were competitive, as those advocating the market approach claim it would be, then each slot would be put to its most profitable use. Many economists have mistakenly inferred that this would assure that each slot would be put to its most efficient use.[24] In fact, this

21. At most crowded airports access continues to be allocated on a "flow control" basis. Landing and takeoff authority at any point in time is assigned on a first-come, first-served basis.

22. See Grether, Isaac, and Plott [1981] and Koran and Ogur [1983].

23. Those are O'Hare in Chicago, LaGuardia and Kennedy (5–10 P.M. only) in New York, and National Airport in Washington, DC. Resale was allowed beginning April 1, 1986. In 1982 the FAA experimented briefly with allowing the resale of slots. Despite questions about the legitimacy of the airlines' property rights, as well as uncertainty over the length of time before the FAA would reallocate with a different mechanism, over 300 slots changed ownership during the six-week experiment. See *Regulation* [1982]. The market allocation of slots clearly differed quite a bit from the negotiated allocation.

24. For instance, in criticizing the committee allocation process, Grether, Isaac, and Plott [1981, p. 169] state that, "Certainly, operations should not be transferred from more profitable applications to less."

allocation scheme could possibly result in large inefficiencies. From Chicago's O'Hare airport, one of those that is "slot constrained," there are routes served by as many as seven different carriers and as few as one.[25] There are, of course, also potential markets that currently have no flights. Table I indicates that with that much variety in market structure, the correlation between firms' willingness to pay for a landing slot and society's valuation of their operations is probably very low. It seems likely that market allocation of slots would yield too many flights on the high-density routes that have many firms and too little service on the routes that can support only one or two carriers.

Of course, a full analysis of the effect of market structure on ϕ in the airline industry will be more complex. For instance, one must consider the effect of the limited capacity of any single flight. This constraint implies that entry of additional capacity may be more welfare enhancing in markets that already have many incumbents, and thus ϕ may be lower, than the constant unit cost analysis of Section II would indicate. An additional complication is the fact that one airline may be responsible for many or most flights on a route. ϕ will be lower for such airlines, because profits of the new flight will be in part diverted from the firm's other flights on that route. On the other hand, this effect will not hold for an airline wishing to enter a crowded market in which it has no flights already. Still, these aspects of the air transport industry indicate that the range of ϕ values may not be as great as Table I would indicate.

The range of market structure, however, is not the only reason to suspect that the ϕ ratio is not equal among routes that have O'Hare as one endpoint. Some of these markets have very high demand elasticities—the tourist routes to Florida and Hawaii, for example—while others have quite inelastic demand, such as the business-oriented traffic to New York City. The ability to price discriminate also varies. On long-haul routes, minimum-stay and advance-purchase requirements probably sort out vacation travelers more effectively than on shorter, less expensive flights. As shown earlier, these differences are likely to have significant effects on a firm's profits as a proportion of the total surplus it generates.

The evidence from the first fifteen months in which slot sales have been allowed at O'Hare airport shows a clear pattern of which airlines are increasing and which are decreasing slot use. To examine this, Table II presents the shares of daily scheduled jet

25. *Official Airline Guide, North American Edition,* January 1, 1987. This counts only direct flights. A similar range of concentration exists at the other slot-constrained airports.

TABLE II
CHANGES IN SLOT USE AT O'HARE AIRPORT, CHICAGO

Airline	Share of daily departures July 1985[a]	Share of daily departures July 1987[a]	Change[a]	Average route share[b]	Average load factor[c]	Passengers per flight[c]	Passenger-miles per flight[c]
United	41.4%	45.8%	+4.4%	40.1%	60.1%	85.4	83689
American	27.6	31.4	+3.8	31.8	59.8	85.2	82297
Piedmont	2.6	2.5	−0.1	38.8	39.3	42.0	22828
USAir	1.9	1.4	−0.5	35.1	39.7	42.2	15267
Delta[d]	5.5	4.8	−0.7	30.6	53.4	71.3	54810
Texas Air[e]	5.8	5.0	−0.8	20.1	60.3	85.6	77102
TWA[f]	4.1	3.1	−1.0	15.5	36.4	68.7	35678
Northwest[g]	8.3	3.9	−4.4	22.7	55.5	63.6	52207
Others	2.8	2.1	−0.7				

a. *Official Airline Guide*, July 1, 1985, and July 1, 1987. b. D.O.T. Databank 1A of Origin and Destination Survey (1986, first→second quarter). c. D.O.T. Service Segment Data (1986, first→second quarter). d. Includes Western. e. Combination of Eastern, Continental, People's Express, Frontier, and New York Air. f. Includes Ozark. g. Includes Republic.

carrier departures in July, 1985, and July, 1987.[26] While American and United have been increasing operations, the merging airlines, particularly Northwest/Republic, are decreasing their presence at O'Hare.

The fourth column in Table II is each carrier's passenger-weighted average share of traffic on routes it serves, either directly or with plane changes, out of O'Hare. Thus, for instance, if an airline carried one-third of its passengers out of O'Hare on a route on which it had a 10 percent share and two-thirds on a route on which it had a 40 percent share, the passenger-weighted average share would be 30 percent. If it were the case that (1) business-stealing effects cause ϕ to be higher for operations on which a carrier has a small share of a city-pair market, (2) sunk investments strongly influence which route a firm would choose to serve with an additional slot, and (3) the FAA had closely approximated the optimal slot allocation under the old administrative mechanism, then we would expect to see market allocation result in transfers of slots from firms that tend to have large market shares on routes

26. Changes in departures rather than in slot ownership are presented, because if one seeks to study changes in license use due to reallocation, it is the user, not the owner, that is of interest. The two measures differ due to a small, but active, short-term leasing market.

they serve to ones that tend to have small shares. The data refute any assertion that this is a dominant effect. The result is not surprising given the third condition. The starting allocation from which changes have occurred was widely criticized for its inefficiency. In order to accurately gauge the potential inefficiency due to market allocation, direct calculation of ϕ or, at least, the business stealing effect would have to be carried out. The results of such a study for radio license allocations are reported in the following section.

Though it is quite difficult to calculate the total surplus generated from the *marginal* slots transferred from some airlines to others, Table II gives measures of the *average* efficiency which each airline converts the scarce input, a slot, into output, passenger transportation. Critics of the FAA administered slot allocation often asserted that it did a poor job of getting the slots to users who would produce the most transportation with them. In particular, carriers that served the constituents of influential politicians were given slots, even though other airlines would carry more passengers, using larger aircraft along with the same slot.

Table II indicates that the "buy/sell" program at O'Hare may be effectively addressing this inefficiency. The two airlines that have had a net increase in slot use are among the most efficient users of the resource in producing air transportation. Along with the amalgam of airlines that make up Texas Air, American and United carry the most passengers per flight, fly among longest distances thereby generating the most passenger-miles per flight, and have the highest load factors (percentage of seats occupied). If these averages are at all representative of the marginal uses to which United and American have put their new slots, "buy/sell" may be viewed as a great success in increasing the productive efficiency of slot use at O'Hare.[27]

The data do, however, point out another change that may affect the efficiency of the slot market and slot allocation in the future. Of all the airlines with significant output at O'Hare, only the two largest have increased operations during the two-year period studied. American and United's combined share of 77 percent, up from 69 percent in July 1985, casts some doubt on the competitiveness of the market for slots. Regardless of whether other changes may explain the two-year increase, control of 77 percent of a

27. These data are, for the first quarter of 1986, just before "buy/sell" began. At this writing, traffic data more than six months past the initiation of "buy/sell" are not yet available.

necessary input with a zero supply elasticity[28] might put American and United in a position to block medium or large-scale entry into O'Hare.[29] If that is the case, the effects of the inefficiencies discussed in this paper may be small in comparison with the loss due to noncompetitive allocation.

In addition to the assertion that market allocation would ensure efficient use of each slot, some analysts have also argued that the market equilibrium price would indicate to policy makers the social shadow value of additional airport capacity.[30] Thus, the argument goes, an additional runway should be built if and only if it would generate enough revenue in slot sales to finance construction. For this argument to hold, ϕ would not only have to be equal across all potential uses, it would have to be equal to one in all cases. In reality, the ϕ of the use to which the marginal slot is put could be much greater or much less than one. Thus, the market price of a slot is likely to be a poor guide for airport expansion plans.

Still, these arguments in no way suggest that the negotiated allocations were more efficient than a market allocation will be. It does, however, point out that the market, by itself, may not be the best solution. One possible improvement might be to put restrictions on some slots, requiring that they be used on routes with few carriers. Such restrictions might help to avoid an allocation dominated by high ϕ uses that do not necessarily contribute significantly to social welfare.

Another alternative, controlling which carriers receive the slots, would be effective only to the extent that airlines would choose different uses for the same slot. Though this is certainly true to some extent, those who argue that city-pair markets are highly contestable imply that sunk assets do not play a significant role in airlines' decisions about which routes to serve. If that is correct,

28. Some might argue that the supply of slots can be expanded by use of Midway Airport. Yet, the high value of slots at O'Hare in conjunction with free-entry at Midway implies that the latter is a poor substitute.

29. To judge the potential for anticompetitive behavior, ownership, rather than use, should be the focus of analysis. The share of slots owned by American and United is slightly higher than the share used. These share figures also exclude the jet operations of Air Wisconsin (less than 2 percent of all slots for jet aircraft), which primarily operates small, piston-engine aircraft, and is a "code-sharing" affiliate of United, operating under the name United Express.

30. Koran and Ogur [1983, p. 25] note the absence of an indicator of the value of additional slots under bureaucratic allocation; and they assert, "The prices generated by a slot market would provide such a measure and would signal when more capacity was needed." Grether, Isaac, and Plott [1981, pp. 170, 171] seem to concur, stating that, "With the committee process, the value of a slot does not serve as the means and the reward for creating additional airport capacity," and later suggesting that, "Revenues from the auction should be used to relax capacity constraints."

then regulation of the slot allocation process would not be effective in controlling inefficient use of these licenses.

VI. Radio and Television Broadcasting Licenses

The limit on the number of radio and television stations that can operate in the same geographic area is dictated to some extent by the state of technology. The Federal Communications Commission (FCC) divides the broadcast spectrum into frequency ranges and then licenses stations to be the only broadcaster in the area operating within a certain frequency range.[31] In nearly all U. S. television markets, the limited number of licenses is a binding constraint on VHF television. Fewer than half of all markets have unused UHF licenses as well. In most metropolitan areas, FM radio broadcast entry is also constrained by a scarcity of broadcasting licenses.[32]

The "shortage" of spectrum space implies that a broadcast license allows firms to earn profits and thus gives value to the license. Recently, the FCC has considered auctioning off new licenses as changes in technology or policy make additional licenses available. They already allow existing licenses to be resold.

Just as the FAA does not dictate the use of an airport slot, the FCC exercises almost no control over the programming of a broadcasting station. The same radio license can be used for top-40 music, country music, news, or religious programming. Presumably, these are different radio markets, country music being a poor substitute for news of the latest wrangling in Congress. A license up for sale could be bought by a company planning to enter the crowded top-40 market or could go to a first-of-its-kind all-opera station. The top-40 use of the license might well yield greater profits for the license holder, but the change in total surplus generated from this use will probably be small if there are already many stations playing top-40 music. The opera station might barely be able to break even, but its listeners would have access to music that they otherwise would not be able to hear. They might derive great surplus that the staion would not be able to capture.

31. Recent changes in technology and FCC policy have allowed the broadcasting spectrum to be used more intensively. In many areas, cable television will soon offer the potential for more stations than can profitably exist, thus eliminating license allocation as an economic issue in television.

32. Information on television licenses is from FCC Public Notice "Television Channel Utilization," April 19, 1985. Information of FM radio is from the FCC FM Engineering Database Listing of Vacant Assignments and Applications Therefor.

This comparison points out two aspects of the broadcasting industry that make the arguments against market allocation of licenses particularly powerful. Both result from the public good aspects of most broadcasting.[33] First, the marginal cost of serving one more listener is zero. For a specific programming format, economies of scale are virtually inexhaustible. Thus, entry of a second station into the market for a certain type of programming lowers production efficiency. Of course, the increase in competition and variety could still cause an overall increase in allocative efficiency, but the gain in surplus would be smaller than if firms had constant or increasing average costs.

Second, the broadcaster's income comes from advertisers, not consumers. Steiner [1952] and Spence and Owen [1977] have studied the effect of this institutional arrangement. Though advertisers are willing to pay more for time on stations that reach many people, they are probably not concerned with the amount of pleasure listeners receive from the programming.[34] Thus, 1,000 committed fans of opera are no more valued by advertisers (ignoring differences in demographics) than 1,000 top-40 listeners who would just as soon tune to one of the other top-40 stations. Programming that is valued highly by a very narrow sector of the population is unlikely to be very profitable when station income is based primarily on total audience. Even though that programming may generate a large increase in total surplus, the firm's inability to capture much of the surplus will result in a low willingness to pay for a broadcasting license.

Again, these arguments say nothing about the efficiency of a government-mandated allocation of licenses in comparison with a market allocation. There are, however, obvious pitfalls of an allocation based solely on willingness to pay for a broadcasting license. An inefficient lessening of diversity in programming seems to be quite possible. This is an important argument for "public" television and radio in the United States, as well as for the now defunct "community service" standards for commercial licensees, and for government-financed broadcasting in many European countries. Furthermore, due to the zero marginal cost of an incumbent firm serving

33. The recent advent of scrambled signals in some commercial broadcasting has allowed stations to make their products exclusive, albeit at a significant cost. To a limited extent, cable television also has this effect.

34. An argument can surely be made that listeners who get great pleasure from a station listen to its ads more carefully as well. Though this may increase the value to the advertiser somewhat, it seems very unlikely that changes in listener surplus are fully reflected in the advertisers' willingness to pay for air time.

one more listener, entry into a market that already has many stations can actually lower total surplus. The actual size of these various possible inefficiencies is an empirical question. Only through attempts to measure these effects can we gauge how the benefits of market allocation compare with those from an administrative system.

Borenstein [1986] explores one aspect of the empirical issue. That paper looks at the "audience stealing effects" that seem likely to lead to excessive crowding into popular formats. It presents a characteristic-space model of competition within a city format-market (e.g., classical music in Chicago). It shows that in such a model the proportion of a new station's audience that is stolen from incumbent firms would be expected to increase when there are more incumbents in the market. It then looks at 118 entries and exits from format-markets in the top five radio city-markets (New York, Chicago, Los Angeles, Philadelphia, and San Francisco).[35] It finds evidence of a business stealing effect, but the effect is barely statistically significant and is estimated to average only 8 percent of an entrant's audience. The business stealing effect is estimated to increase more than linearly with the number of incumbents in the market, but the standard error of this estimate is so large that this cannot be distinguished from no relationship. Unfortunately, the data available and the small sample do not allow testing of the full model. Furthermore, the degree of error in audience estimates is thought by many in the industry to be very high. Still, this is some indication that in radio license allocation the business stealing effects may be quite small. If this could be confirmed with larger samples and more reliable data, it would imply that ϕ is usually not greater than 1. A narrower range for ϕ should inspire greater confidence in market allocations of radio licenses.

Though a narrow range of ϕ values makes it more likely that market allocation of spectrum space *within* the radio industry will be efficient, a more serious concern is arising over spectrum allocation *between* different media.[36] Cellular telephone systems, for instance, can employ the same frequencies as radio and television. As use of these mobile phones expands, the FCC is facing the question of how to determine the quantity of spectrum that should be allocated to each medium. It seems quite likely that private,

35. Just as an audience-stealing effect in entry implies that the format-market audience expands by less than the entrant's audience, in exit, it would imply that the format-market audience contracts by less than the exiting firm's audience.

36. See, for instance, *New York Times*, January 8, 1987.

exclusive uses of the spectrum, such as cellular telephones, are able to capture a greater proportion of the surplus they generate than uses that generate significant public goods, such as radio and TV. If bandwidths of spectrum are allocated between media by a market mechanism, it seems likely that more of the resource will be put to "private" uses than is socially efficient.

VII. Conclusion

This paper has demonstrated that there is no theoretical justification for the idea that a competitive market allocation of operating licenses will assure that each is put to its surplus-maximizing use. Furthermore, the loss of surplus from inefficient license use can be very large. It is plausible that the profit-maximizing use of an operating license could generate less than one-tenth the increase in total surplus that would result from its surplus-maximizing use. Because firms differ in their intended uses of a license, the process employed to allocate these rights is likely to affect the use to which a license is put. Thus, solutions to the problem of inefficient license use could come either directly, from restrictions on license use, or indirectly, from intervention in the allocation process.

Identifying when a problem exists and is of a magnitude that warrants intervention is intrinsically an empirical exercise. The discussions of spectrum and airport slot allocation indicate two issues on which an administrator might focus in carrying out such an analysis. First, are there significant differences among the potential license holders in their abilities to capture the surplus that they generate? The case of broadcast radio versus cellular telephone use of spectrum space indicates that such differences could be particularly important when the same lumpy input can be used to produce outputs in different industries. Within an industry, the efficiency with which firms can capture surplus is probably more similar than between industries in most cases. Administrative review might be triggered by a showing of unusually large consumer benefits from one potential licensee's planned operations.

Second, the administrator should focus not just on the output of the new licensee, but also on the change in total output of the market in which the licensee would operate. If a licensee would increase competition without altering total market sales significantly, that license use would generally increase total surplus less than if the new licensee would greatly expand market output.[37] In cases where total output is affected very little, that use of the license would be more likely to just transfer surplus from incumbent firms to the entrant and, to the extent that the entrant causes the market price to decline, to consumers. Of course, if brands in a market are heterogeneous, the increased surplus from greater variety must also be considered.

A complete analysis of the alternative ways of addressing this problem is beyond the scope of this paper. It is evident from the discussions of airport slots and broadcasting licenses that the best approach will depend on many factors specific to the kind of license being allocated. For instance, if firms' specific sunk assets are the dominant factor in their decisions of how to use a license, then intervention in the allocation process could be effective. A master French chef is unlikely to use a liquor license to open a corner bar. On the other hand, if firms can easily move between markets, then direct use restrictions may be called for. Eastern Airlines can quickly and at reasonably low cost switch a La Guardia Airport slot from use on a New York-Ithaca route to use on its shuttle service between New York and Washington, D.C.

Still, the analysis and brief applications have pointed out at least two possible directions in which solutions might be found. The government might restrict the markets to which a license applies. Firms' valuations of a license seem to be a better basis for allocation when the uses they intend for the license are reasonably similar. As suggested earlier, one such restriction could be on the number of incumbents that can be present when a license is used to enter a market.[38] The FAA does have use restrictions on some airport slots; a separate pool of slots exists for commercial carriers using small planes (fewer than 60 seats). This may correspond, though quite roughly, with slots put to low ϕ uses.

An alternative approach that may offer more flexibility would be to weight the bid of each potential licensee depending on the market that the firm intends to enter. If a firm's intended operations correspond to a situation in which ϕ is likely to be large, its bid would be downweighted. This approach resembles franchise bidding as proposed by Demsetz [1968], and it suffers from many of the

37. This is not the same criterion as was often imposed in airline, trucking, and railroad route cases, in which the applicant had to show that its operations would not take business away from incumbents. The magnitude of the expansion of the market is questioned here, not the allocation of sales among the firms in the market.

38. Of course, this must be balanced against the possibility of collusive behavior in the markets shielded from entry.

difficulties of such schemes, as pointed out by Williamson [1976]. Still, in cases in which the product is fairly standardized within each market, rough estimates of ϕ may be possible.

Clearly, no solution will be costless or error free. Given the expensive and unreliable nature of government intervention, the market mechanism may still be the preferred alternative in most cases. This, however, is an empirical question, not one that can be answered by microeconomic theory. To accept the market allocation simply because no obvious improvement exists is to choose arbitrarily from among a number of imperfect approaches. Without empirical study of the alternatives, there is little more justification for the market approach than for the bureaucratic mechanisms that are so often criticized.

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