The Economics of Superstars

By SHERWIN ROSEN*

The phenomenon of Superstars, wherein relatively small numbers of people earn enormous amounts of money and dominate the activities in which they engage, seems to be increasingly important in the modern world. While some may argue that it is all an illusion of world inflation, its currency may be signaling a deeper issue.[1] Realizing that world inflation may command the title, if not the content of this paper, quickly to the scrap heap, I have found no better term to describe the phenomenon. In certain kinds of economic activity there is concentration of output among a few individuals, marked skewness in the associated distributions of income and very large rewards at the top.

Confidentiality laws and other difficulties make it virtually impossible to obtain systematic data in this field. However, consider the following:

(i) Informed opinion places the number of full-time comedians in the United States at approximately two hundred. This is perhaps a smaller number than were employed in vaudevillian days, though it hardly can be maintained that the demand for (intended) comic relief is in a state of secular decline. Some of the more popular performers today earn extraordinary sums, particularly those appearing on television. The capacity for television to produce high incomes is also manifest in the enormous salaries paid to network news broadcasters.

(ii) The market for classical music has never been larger than it is now, yet the number of full-time soloists on any given instrument is also on the order of only a few hundred (and much smaller for instruments other than voice, violin, and piano). Performers of first rank comprise a limited handful out of these small totals and have very large incomes. There are also known to be substantial differences in income between them and those in the second rank, even though most consumers would have difficulty detecting more than minor differences in a "blind" hearing.

(iii) Switching to more familiar territory, sales of elementary textbooks in economics are concentrated on a group of best sellers, though there exists a large number of very good and highly substitutable alternatives in the market (the apparent inexhaustable supply of authors willing to gamble on breaking into the select group is one of the reasons why so many are available). A small number of graduate schools account for a large fraction of Ph.D.s. A relatively small number of researchers account for a large fraction of citations and perhaps even articles written.

Countless other examples from the worlds of sports, arts and letters, and show business will be well known to readers. Still others can be found in several of the professions. There are two common elements in all of them: first, a close connection between personal reward and the size of one's own market; and second, a strong tendency for both market size and reward to be skewed toward the most talented people in the activity. True, standard theory suggests that those who sell more generally earn more. But that principle applies as well to shoemakers as to rock musicians, so something more is involved. In fact the competitive model is virtually silent about any special role played by either the size of the total market or the amount of it controlled by any single person, because products are assumed to be undifferentiated and one seller's products are assumed to be as good as those of any other.

*University of Chicago and NORC. I am indebted to the National Science Foundation for financial support, and to Gary Becker, David Friedman, Robert J. Gordon, Michael Mussa, Edward Prescott, and George Stigler for helpful discussion and comments.

[1]That escalation is not confined to wars and prices is established by the fact that Stars would have sufficed not long ago. Academics have a certain fondness for Giants, while businessmen prefer Kings. Obviously there is a fair bit of substitution among all these terms in depicting related data in different contexts.

The elusive quality of "box office appeal," the ability to attract an audience and generate a large volume of transactions, is the issue that must be confronted. Recognition that one's personal market scale is important in the theory of income distribution has a long history, but the idea has not been developed very extensively in the literature.[2] I hope to fill in some of the gaps in what follows.

The analytical framework used is a special type of assignment problem, the marriage of buyers to sellers, including the assignment of audiences to performers, of students to textbooks, patients to doctors, and so forth. Rest assured that prospective impresarios will receive no guidance here on what makes for box office appeal, sometimes said to involve a combination of talent and charisma in uncertain proportions. In the formal model all that is taken for granted and represented by a single factor rather than by two, an index q labeled talent or quality. The distribution of talent is assumed to be fixed in the population of potential sellers and costlessly observable to all economic agents. Let p be the price of a unit of service (for example, a performance, a record, a visit, etc.) and let m be the size of the market, the number of "tickets" sold by a given seller. Then an overall market equilibrium is a pair of functions $p(q)$ and $m(q)$ indicating price and market size of sellers of every observable talent and a domain of q such that: (a) all sellers maximize profit and cannot earn larger amounts in other activities, and (b) all buyers maximize utility and cannot improve themselves by purchasing from another seller.

Properties of sellers' maximum net revenue functions, $R(q)$, will have special interest. Specifically, convexity of this function describes much of the observable consequences of Superstars. Since $R(q)$ is the transformation that takes the distribution of talent to the distribution of rewards, convexity implies that the income distribution is stretched out in its right-hand tail compared to the distribution of talent. Hence a genuine behavioral economic explanation is provided for differential skew between the distributions of income and talent, a problem that has been an interesting and important preoccupation of the literature on income distribution down through the years.[3] Convexity of $R(q)$ literally means that small differences in talent become magnified in larger earnings differences, with great magnification if the earnings-talent gradient increases sharply near the top of the scale. This magnification effect is characteristic of the phenomenon under consideration.

Convexity of returns and the extra skew it imparts to the distribution of earnings can be sustained by imperfect substitution among different sellers, which is one of the hallmarks of the types of activities where Superstars are encountered. Lesser talent often is a poor substitute for greater talent. The worse it is the larger the sustainable rent accruing to higher quality sellers because demand for the better sellers increases more than proportionately: hearing a succession of mediocre singers does not add up to a single outstanding performance. If a surgeon is 10 percent more successful in saving lives than his fellows, most people would be willing to pay more than a 10 percent premium for his services. A company involved in a \$30 million law suit is rash to scrimp on the legal talent it engages.

Imperfect substitution alone implies convexity and provides a very general explanation of skewed earnings distributions which applies to myriad economic service activities.

[2]Albert Rees is a good introduction to the size distribution of income. The selectivity effects of differential talent and comparative advantage on the skew in income distributions are spelled out in my 1978 article, also see the references there. Melvin Reder's survey touches some of the issues raised here. Of course social scientists and statisticians have had a long standing fascination with rank-size relationships, as perusal of the many entries in the *Encyclopedia of the Social Sciences* will attest.

[3]Few economic behavioral models exist in the literature. On this see Harold Lydall. Jacob Mincer has shown that investment can produce skewness through the force of discounting, and established that as an important source of skewness empirically. Learning is not treated here because those issues are well understood, whereas the assignment problem has received little attention. Some recent works, but with different focus and emphasis than is discussed here, are Gary Becker (1973), David Grubb, and Michael Sattinger.

However, preferences alone are incapable of explaining the other aspect of the Superstar phenomenon, the marked concentration of output on those few sellers who have the most talent. This second feature is best explained by technology rather than by tastes.[4] In many instances rendering the service is described as a form of joint consumption, not dissimilar to a public good. Thus a performer or an author must put out more or less the same effort whether 10 or 1,000 people show up in the audience or buy the book. More generally, the costs of production (writing, performing, etc.) do not rise in proportion to the size of a seller's market.

The key difference between this technology and public goods is that property rights are legally assigned to the seller: there are no issues of free riding due to nonexclusion; customers are excluded if they are unwilling to pay the appropriate admission fee. The implied scale economy of joint consumption allows relatively few sellers to service the entire market. And fewer are needed to serve it the more capable they are. When the joint consumption technology and imperfect substitution features of preferences are combined, the possibility for talented persons to command both very large markets and very large incomes is apparent.

A theory of the assignment of buyers to sellers is required to make these ideas precise. The demand and supply structure of one such model is set forth in Sections I and II. The nature of market equilibrium and its implications for income and output distributions are discussed in Sections III and IV. Comparative static predictions of the model are sketched in Section V and conclusions appear in Section VI.

[4]Milton Friedman proposed a model based on preferences for risk taking, but did not explain why or how the market sustains the equilibrium *ex post* with few sellers earning enormous incomes (for example, why the losers in the lottery rest content with such low incomes if they have the same talents as the winners). Issues of uncertainty that make these elements of supply more interesting are abstracted from here. A model of prizes based on effort-incentive monitoring and the principal agency relation is found in my article with Edward Lazear.

I. Structure of Demand

Imperfect substitution among quality differentiated goods in the same product class arises from indivisibilities in the technology of consumption. No satisfactory analytical specification exists in the literature, because indivisibilities lead to nonadditivities in preference relations which are analytically intractable.[5] Yet some specific model is required to make any progress on this problem. My solution to this dilemma is to adopt a smooth quantity-quality substitution technology and introduce the indivisibility through a fixed cost of consumption per unit of quantity. Consumers' attempts to minimize consumption costs gives an extra competitive advantage to higher quality sellers. However, it is a surprising implication of the analysis that this form of indivisibility is not crucial to the central conclusions, so that true nonadditivities would only strengthen the argument.

Assume the consumer has a well-behaved weakly separable utility function $u = u(x, g(n, z))$, where x is a composite commodity and $y = g(n,z)$ has the natural interpretation of consumption of "services" of the type in question. n is the quantity purchased, a measure of exposure to a seller, such as a patient visit, a performance, etc.; and z is the quality of each unit of exposure. Quantity-quality substitution requires that $g(\cdot)$ is increasing in both of its arguments and that $\partial^2 g/\partial n \partial z > 0$.

This specification has the virtue of being simple, at the cost of ignoring some details and not being perfectly general. The definitions of markets are left somewhat vague: for example, for some purposes it is sufficient to think about the market for novels as a whole and for others distinguishing between mysteries, romances, and so forth is necessary. This is simply treated by allowing y to be a vector and is therefore ignored. There are several dimensions to quantity in any specific application which might be treated in a simi-

[5]Some of the thorny issues of primitives in problems of product differentiation are discussed from the point of view of the theory of measurement by Manuel Trajtenberg.

lar manner. For example, most people do not purchase more than one copy of an author's book but may buy several different books written by the same author. Or there may be preferences for variety. But these considerations are less than compelling in markets for professional services where direct personal contact between buyers and sellers is required. Preferences for variety per se cannot be treated in a quantity-quality substitution model, and since the generalization of increasing the dimensionality of exposure is clear enough in any given case, it is ignored too. It is doubtful whether the general nature of the results are greatly affected by these simplifications.

A cardinal measure of quality or talent must rely on measurement of actual outcomes. Taken to extreme, this view would define the talent distribution as the realized output or income distribution. However, that goes too far because it ignores the fact that more talented people typically command greater cooperating resources in producing observed outcomes and it refers to all consumers as a group rather than to any one of them. The service flow y is a natural personal outcome measure in this case and is the prime candidate for scaling talent, so long as n is held constant in the imputation to obtain the right *ceteris paribus* conditions. Still, the measure is strongly dependent on n unless $g(n,z)$ is multiplicatively separable. To avoid ambiguity I restrict $g(n,z)$ to the form $zf(n)$, so that relative talent is defined independently of n (since y is the product of a function of n and another function of z, talent can always be rescaled to be the function of z itself, for example, if $y=f_1(z')f_2(n)$, change the scaling of z' by defining $z\equiv f_1(z')$). The properties of $f(n)$ play no important role in this analysis, so it is assumed to be linear. Therefore $y=nz$, which is the familiar efficiency units specification. This is a very strong form of substitution which obviously works in the direction of spreading sales around all qualities of sellers, not concentrating them among the top, and is a weak specification in that sense.

The cost of one unit of service of a given quality is its price $p(z)$ plus a fixed cost s. For example, if each unit requires t hours and the wage rate is w, then $s=tw$. Measuring prices in units of x, the budget constraint is

$$(1)\qquad I=x+(p+s)n$$
$$=x+\left[(p+s)/z\right]y=x+vy,$$

where I is full income and v is the full price of services directly implied by the multiplicative specification $y=nz$ (herein lies the analytical value of that assumption).

Marginal conditions for consumer choice are

$$(2)\qquad u_y/u_x=dp(z)/dz \quad \text{for } z;$$
$$u_y/u_x=(p+s)/z \quad \text{for } n.$$

Combining these two, choice of z solves

$$(3)\qquad dp/dz=p'(z)=(p+s)/z.$$

Choice of n follows from the requirements that the marginal rate of substitution between y and x equals the relative marginal cost $v=(p+s)z$. The schedule $p(z)$ is the same for all buyers. It maps the talent of a seller into the unit price charged for that quality of service. Therefore optimal choice of z in (3) depends only on s and not on the form of the utility function under the separability assumption. Condition (3) balances larger direct costs of greater talent against larger indirect costs of greater quantity and lesser talent. For example, customers with larger s prefer more talented sellers to economize on consumption time in this specification. Finally, all effects of intensity of preferences are absorbed in choice of the quantity consumed, given the optimum value of z determined by condition (3).

Because it plays an important role in the analysis below, suppose the equality in (3) held for all possible values of z, not just for one of them. Evidently that occurs only if $p(z)$ happens to follow a definite functional form; the one satisfying (3) interpreted as a differential equation for all z. Integrating and simplifying equation (3) yields

$$(4)\qquad p(z)=vz-s.$$

The full price v is the constant of integration, since $v=(p+s)/z$ by definition. If market prices line up as in (4), the consumer is indifferent among all values of z that appear on the market, since (3) is an identity. Therefore (4) must be a price-talent indifference curve, an equalizing difference function, showing the maximum amount the customer is willing to pay for alternative values of z at a given utility index. The larger is v, the smaller the utility index. Finally, if (4) does in fact hold true in the market, too, then both equations in (2) reduce to $u_y/u_x=v$, so that y is uniquely determined for the consumer even though z and n are not.

II. Structure of Supply: External and Internal Diseconomies

The economic activities under consideration invariably involve direct contact of buyers with the seller in one way or another. If a competitive market was ever impersonal, this surely is not it. The seller's choice of market size (volume of transactions) amounts to determining the number of contacts to make with buyers. In many cases the technology admits a certain kind of duplication in which the seller delivers services to many buyers simultaneously, as a form of joint consumption. Once the author tells his tale to the publisher, it can be duplicated in writing as many times as desired. A performer appearing on television literally clones his performance to whomever happens to tune in. The services rendered by any seller become more like a kind of public good the more nearly the technology allows perfect duplication at constant cost.

Just as it is difficult to find practical examples of pure public goods in public finance, so too it is difficult to find them here. In fact services of this type are analogous to local public goods, due to ultimate limitations on joint consumption economies. To the extent that the technology is subject to congestion, that is, to external diseconomies of scale, the required analytical apparatus is the theory of clubs rather than the theory of pure public goods.[6] These external diseconomies reflect a type of degradation of services a seller supplies to each of his customers as the number of contacts expands. There are two fundamental reasons for this:

First, in cases where duplication is possible, market expansion ultimately requires using inferior techniques to render the service. It is preferable to hear concerts in a hall of moderate size rather than in Yankee Stadium. Recordings are a superior way of reaching a large audience, but are inferior in quality to live performances with smaller audiences. Furthermore, many of the activities in question involve certain creative elements so the ultimate negative impact of market sizes sometimes can be interpreted as the effect of overexposure and repetition.

Second, the analysis should not be constrained to only those activities where some form of cloning is possible. The general model also applies to cases of one-on-one buyer-seller contact, as is true of professional services. Here the negative effects of personal market scale are caused by limitations on the seller's time. As a doctor's patient load increases, the amount of direct contact time available to any person decreases, waiting time between appointments and in the office increases, and so forth. Nevertheless patients may be willing to trade off service time against quality of service per unit time.

In both cases the quality of service z that appears in consumers' preferences is itself produced by both the quality and size of the market of the seller with whom transactions occur: $z=h(q,m)$, where q is an index of seller talent or quality and $m=m(q)$ is the total number of units sold by a seller of type q. The arguments above imply $\partial z/\partial q=h_q>0$ and $\partial z/\partial m=h_m\leqslant 0$. Furthermore, I assume that $h_{qm}\geqslant 0$: superior talent stands out and does not deteriorate so rapidly with market size as inferior talent does. The importance of this assumption will emerge later on.

Preferences are structured on service flows, which in turn depend upon q and m. Therefore $p=p(q,m)$ is the unit price charged by a seller of quality q selling m units. Competi-

[6]That a doctor's patients or a performer's fans might be considered as a club has intuitive plausibility. The original reference in the theory of public finance is James Buchanan. Eitan Berglas and Berglas and David Pines, present elegant developments of that model.

tion in the market for services implies that the *function* $p(q,m)$ is taken as given by a seller. This market is competitive even though a seller affects the unit price charged by choosing m. The reason for competition in markets of this type is that each seller is closely constrained by other sellers offering similar services. Though sellers of different quality are imperfectly substitutable with each other, the extent of substitution decreases with distance. In the limit very close neighbors are virtually perfect substitutes. Assume there is a regular distribution of talent in the population $\phi(q)dq$. Then potential substitution is generated by both the density ϕ in the neighborhood dq of q and by degradation through larger market size of better quality sellers some distance above q, and the opposite for those some distance below q.

In addition to market size effects on demand, the other factor influencing the output decision is direct cost of production. Let $C(m)$ be out of pocket costs of producing m units, with $C' \geqslant 0$ and $C'' \geqslant 0$. There are nondecreasing (marginal) costs of production—internal diseconomies—for the usual reasons, including the fact that here the seller must work harder as m increases. Assume also that all sellers have opportunity cost K of working in this sector compared with the next best alternative, with K independent of q.

A seller of type q chooses $m(q)$ to maximize net revenue

$$R(q) = p(q,m)m - C(m). \tag{5}$$

Therefore $m(q)$ is chosen to satisfy

$$mp_m(q,m) + p(q,m) - C'(m) = 0 \tag{6}$$

so long as

$$2p_m + mp_{mm} - C'' < 0 \tag{7}$$

and R exceeds K. Equation (6) determines the intensive margin. If $R(q)$ is monotone in q, then free entry determines an extensive margin as well; the value of q, denoted q_l, which satisfies both $R(q_l) = K$ and (7) simultaneously.

In context a more elaborate return specification decomposes the internal margin above into two additional components, one being the size of each act of joint consumption, m_1, and the other being the number of such acts, m_2. In that case the revenue function is

$$m_2\left[m_1 p(q,m_1,m_2) - C_1(m_1)\right] - C_2(m_2) \tag{8}$$

where $m_1 p - C_1$ are the "gate" receipts for each event and $C_2(m_2)$ is the cost of increasing the number of events. This avoids some of the dimensionality or units ambiguities in (5), as noted in Section I. If all external diseconomies reside in m_1 alone and not m_2 (so that $p = p(q,m_1)$), then (8) and (5) have very similar implications; only the diseconomy associated with each event is somewhat overcome by expanding their number in formulation (8). This carries over to a case where the external diseconomy of m_2 is small. Otherwise, precise results depend on whether the effect on performance services of m_1 are stronger than those of m_2 and on their interaction. It is simplest to merely think of m in (5) as the product of m_1 and m_2, in those cases where this type of decomposition is applicable.

III. Market Equilibrium

A complete closed market solution is available if all buyers have the same fixed cost s, though possibly different marginal rates of substitution between y and x. In that case it is possible to aggregate total services in a single market, with a unique implicit market price v which contains all the relevant information and acts as a "sufficient statistic." The unit price p charged by a seller of type q is then constrained to follow (4) independent of market supply conditions. Though n and z are not uniquely determined for any consumer, each one has a regular demand function for services y which depends only upon v. These demands in turn can be summed across consumers to obtain the total market demand for services $\Sigma y \equiv Y^d = F(v)$. Since consumers are indifferent between n and z, the composition of services between qualities and quantities are determined completely by sellers, who maximize profit according to condition (6). Individual supply choices may be aggregated too, this time by integrating the optimum value of zm, the total services a seller supplies to the market, over those values of q which are actually found in the market, weighted by the number of sellers of type q, $\phi(q)$. This sum represents total services supplied to the market, $Y^s = G(v)$. The intersection of supply and demand determines v itself. Given this equilibrium, the internal cross-section price, output, and income distributional structure may be examined in detail.

To find the supply decision of each seller at a given value of v, substitute $z=h(q,m)$ into the equalizing difference function (4). Applying (6) and (7) yields

$$(9)\quad vmh_m(q,m)+vh(q,m)-s-C'(m)=0;$$

$$(10)\qquad 2vh_m+vmh_{mm}-C''<0.$$

Differentiate (9) with respect to q:

$$(11)\qquad \partial m/\partial q=-v(h_q+mh_{qm})/(2vh_m+vmh_{mm}-C'')>0.$$

Market size increases with q if $h_{qm}>0$. Next differentiate net revenue $R(q)$ in (5) with respect to q, at its maximized value. By the envelope property

$$(12)\qquad R'(q)=vmh_q>0.$$

Net revenue is monotonically increasing in talent, since $h_q>0$. Finally, differentiate (12) with respect to q and simplify to obtain

$$(13)\qquad R''(q)=v(h_q+mh_{qm})(\partial m/\partial q)+vmh_{qq},$$

where $\partial m/\partial q$ is defined by equation (11). So long as h_{qq} is not sufficiently negative, reward is convex in q.

The market supply of services is easily calculated. Let $m(q;v)$ be the solution to (9). Then the amount of service supplied to the market by a seller of quality q is $h(q,m(q;v))m(q;v)$ and the total amount supplied to the market by all active sellers is

$$Y^s(v)=\int_{q_l(v)}^{\infty} h(q,m(q;v))m(q;v)\phi(q)dq,$$

where $q_l(v)$ is the extensive margin. Differentiate with respect to v:

$$dY^s/dv=-h(q_l,m^l)m^l\phi(q_l)(dq_l/dv)+\int_{q_l}^{\infty} h\left[1+\frac{m}{h}\left(\frac{\partial h}{\partial m}\right)\right]\left(\frac{\partial m}{\partial v}\right)\phi(q)dq,$$

where $m^l=m(q_l;v)$. Condition (9) implies that $1+(m/h)h_m$ is positive. Therefore the second (integral) term in dY/dv is positive. The fact that R is increasing in both q and v from (12) implies that $dq_l/dv<0$, so that the first term is positive as well. Hence there is rising supply price in the service market. It is obvious from Section I that there is falling demand price for services, so a conventional equilibrium is obtained and v is uniquely determined.

A. *Internal Diseconomies*

The cross-section structure of the market equilibrium is most easily established in the case where there are no effects of a seller's market size on service quality.[7] In that case m is not an argument of $h(\cdot)$ and talent is scaled so that $z=h(q)=q$. Now the model has a Ricardian flavor, with differential rent sustained by talent induced product differentiation.

Since $z\equiv q$ the unit price charged by sellers of talent q is increasing linearly in q at rate v, from (4); and since price is higher for the better sellers and cost conditions no less favorable, more talented sellers produce more and have larger markets.[8] Application of (11)

[7] This version of the model has a strong family resemblance to a class of problems previously considered in my 1974 article.

[8] Throughout this paper I make the usual club theory assumptions and ignore indivisibilities requiring an integer number of sellers. This can be problematic when the number of sellers is very small, and raises well-known problems in industrial organization about which I have nothing to contribute. The magnitude of the rent of the lowest rent seller (extensive margin) is the issue. That must be sufficiently small for this analysis to apply.

to this case yields $\partial m/\partial q = v/C'' > 0$. From (12), $R'(q) = vm > 0$, and $R''(q) = v^2/C'' > 0$, from (13). Not only does rent reward increase in talent, but marginal rent reward increases in talent as well. $R(q)$ is convex because both price and quantity increase in q. To see the powerful force of convexity in producing skewness, consider an example where $s=0$ and $C(m)$ is quadratic. Then $m \propto vq$ and both price and quantity increase linearly in q. Therefore, revenue increases in the square of q. In fact $R \propto v^2q^2/2$. A person who is twice as talented as another earns four times more money in this example.[9]

This case is important in showing that the tendency toward skewed rewards arising from convexity of revenues holds under very general circumstances: individuals who, by virtue of superior talent and ability in an activity, can sell their services for higher prices have strong incentives to produce more so long as costs are not perfectly correlated with talent. The increase in both price and quantity with quality implies that talent has a multiplicative effect on reward. It is surprising that the tendency toward skewed rewards is not necessarily dependent on indivisibilities and occurs in the linear efficiency-units case, perhaps the weakest possible specification. However, no relative skew is implied in the distribution of output in this case because there are no interactive effects in that dimension of the problem.

B. *Pure Joint Consumption*

The effect of scale economy on seller concentration is strikingly seen in the extreme case when internal and external diseconomies vanish, when $C(m) \equiv 0$ (nonzero constant marginal costs will do also) and $h_m \equiv 0$, so $z = h(q) = q$. Then there literally is public goods technology and a single seller services the total market in equilibrium. That person

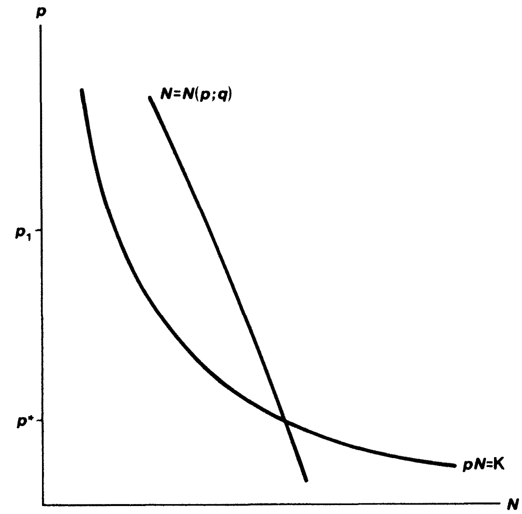

FIGURE 1

is the most talented of all potential sellers. Even though there is one seller, essentially competitive market conditions are maintained by threats of potential entry.

Let $N = N(p,q)$ denote the total market demand for quantity at price p and talent q. If there were several potential sellers of the same talent, only one of them is required to provide the service efficiently, so $m \equiv N$. This is seen in Figure 1. Free entry implies that total revenue pN must be driven down to opportunity cost K in equilibrium. This equation, $pN = K$, is the rectangular hyperbola in Figure 1. It is competitive supply price. Market equilibrium occurs where demand intersects supply from above. Suppose the seller were to charge price p_1. Then the value of sales exceeds K and rents are nonzero. Therefore another seller would enter and charge a slightly lower price, attracting all business away from the initial seller. By continuation, price must be driven down in equilibrium to p^*, rents are driven to zero, there is one seller and potential entry maintains that situation indefinitely.

What happens when sellers have different talents? The demand function facing a more able seller is different from the one in Figure 1 because q is an argument of demand, $N(p,q)$. Whether N_q is positive or negative, less talented sellers are driven out of the

[9]The two functions $m(q)$ and $R(q)$ are the transforms from the distribution of ability to the distribution of output and reward. Inverting and computing the Jacobians, the distribution of output is $(1/v)\phi(m/v)$, the same form as the distribution of talent because $m(q)$ is linear. The distribution of rent is $(v(8R)^{1/2})\phi((2R/v)^{1/2})$, which is skewed to the right relative to ϕ.

market. To see this, note that $R(q)=p\cdot N(p,q)$ in this case. Therefore

$$(14)\quad R'(q)=N[1+(p/N)\partial N/\partial p]\partial p/\partial q+p(\partial N/\partial q).$$

Given the structure of demand above, equation (4) implies that $\partial p/\partial q=v$. Furthermore, it is easy to show that the price and quality elasticities of demand for quantities are related to the full price elasticity of services as follows:

$$(p/N)\partial N/\partial p=\theta(v/Y)\partial Y/\partial v,$$
$$(q/N)\partial N/\partial q=-[1+(v/Y)\partial Y/\partial v],$$

where $\theta=p/(p+s)$ is the share of full price accounted for by nonfixed costs and $Y=\Sigma y$ with the sum extending over individual consumers. The quality elasticity of demand for quantity is negative if the full price elasticity of demand for services is inelastic. Substituting these relations into (14) and simplifying yields

$$(15)\qquad R'(q)=Nv(1-\theta)>0.$$

Consider the following two cases:

(i) Assume $\phi(q)$ is dense on the interval $[q_0,q]$, where q_0 is the least talented and q the most talented potential seller. Equation (15) shows that R is increasing in both q and v. For a given value of v all sellers for whom $R(q)-K>0$ would choose to enter and, since $R'>0$, they must be selected from the upper tail of $\phi(q)$. But in equilibrium there is only one seller. Therefore v must adjust so that $R(\bar{q})-K=0$ and all people for whom $q<\bar{q}$ rationally choose the alternative occupation. There is no rent in equilibrium when ϕ is dense even though there is a single seller, because someone is waiting in the wings who is imperceptably different from that supplier.

(ii) Assume $\phi(q)$ basically the same as before, with the addition of outlier q^* a finite distance ε above $\bar{q}$: $q^*=\bar{q}+\varepsilon$. The Superstar is perceptably different from the closest rival and earns rent on this unique talent. Now it is q^* who supplies the service. Equilibrium v must be slightly smaller than in case (i) so that people for whom $q\leq\bar{q}$ choose not to compete. q^* charges price $p^*=vq^*-s$ (see equation (4), whereas $\bar{q}$ would charge $\bar{p}=v\bar{q}-s$. The price differential $p^*-p=v\varepsilon$ is the unit rent accruing to q^*. This is a small number if ε is small. Yet the total rent received by q^* is $Nv\varepsilon$, which can be very large if N is large. Though unit rent is limited by the equalizing difference (4) and the supply (distance) of close competitors, scale economies can make total rent very large in equilibrium.[10]

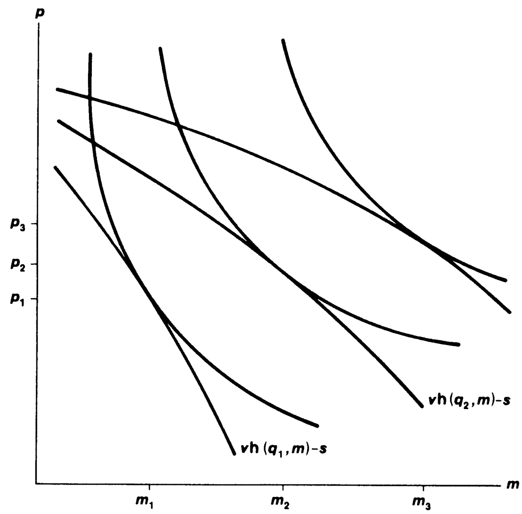

FIGURE 2

C. *External Diseconomies*

External diseconomies support a nondegenerate equilibrium distribution of sellers. The spatial structure of the market is illustrated in Figure 2. Given the market full price v, prices charged by sellers of different talent must satisfy (4) and $z=h(q,m)$. Therefore a seller of talent q must solve the following constrained maximum problem:

$$(16)\qquad \max_m\,[pm-C(m)]\quad \text{subject to}\quad p=vh(q,m)-s.$$

[10]The equilibrium concept used in this particular example is the same as the notion of sustainability in natural monopoly. The equilibrium in Figure 1 is inefficient. This inefficiency vanishes when the externality is bounded sufficiently by either internal or external diseconomies. Those bounds are implicitly assumed in all other portions of this paper.

To examine the pure effect of externalities assume no internal diseconomies, $C(m)\equiv 0$. Two families of curves are shown in Figure 2, one corresponding to the objective function, and the other to the constraint at alternative values of q. A seller of given talent q_1 is constrained by both consumer preferences and sellers of other talents to charge prices along the curve marked $vh(q_1,m)-s$; seller q_2 is constrained by the presence of q_1 and others to operate along $vh(q_2m)-s$, etc. The isorevenue curves are rectangular hyperbolas. Points of tangency between the two represent the solution to (9) and (10) or to (16) for each value of q. Thus q_1 charges price p_1 and has a market size m_1; q_2 charges p_2 and sells m_2 units, etc.

The importance of the crowding condition $h_{qm}>0$ is now apparent. Since the services produced by more talented sellers are less contaminated by crowding, the quantity-price gradient grows as talent increases. Therefore the better sellers can and do handle much larger crowds in equilibrium. Equation (11) demonstrates that the market size gradient increases with q when h_{qm} is positive. To see what effect this has on prices, differentiate the constraint in (16) with respect to q:

$$(17)\qquad dp/dq=vh_q+vh_m(\partial m/\partial q).$$

The first term is positive, but the second is negative if $\partial m/\partial q>0$, which it must be if $h_{qm}>0$. The extra crowding and dilution of unit service of high quality sellers constrains unit prices from rising with quality as much as they would without it. Figure 2 shows market size increasing with quality to a much larger extent than the price-quality gradient. It is definitely not irrational for better sellers to have a great deal of business, but prices that are not much higher than those with lesser talents. The market may impel them to act that way, to become relatively "crowded out" in equilibrium.

With only internal diseconomies, the multiplicative effect of both positive price and quantity gradients with respect to quality implies convexity of the return function $R(q)$. In this case the quantity gradient tends to be larger and the price gradient tends to be smaller. Nevertheless, there are strong forces working toward convexity. Substitute (11) into (13) to obtain

$$(18)\ R''(q)=-v^2(h_q+mh_{qm})^2 \\ /(2vh_m+vmh_{qm}-C'')+vmh_{qq}$$

Since the first term in (18) is positive, $R(q)$ is convex so long as h_{qq} is not sufficiently negative. In fact, given the caveat about $h_{qq}, R''(q)>0$ independent of the sign of h_{qm}. When $h_{qm}<0$ the constraint functions in Figure 2 become steeper as q increases, tending to stretch out the equilibrium price-quality gradient and to compress the quantity-quality gradient, just the opposite of the case where $h_{qm}>0$. Symmetry of the reward function in p and m implies similarity of $R(q)$ in either case.

The effects of external diseconomies are illustrated by the following example. Let $z=h(q,m)=q-a(q/m)^{-b}$ where a and b are constants. Here adulteration depends on the talent-audience ratio and the unadulterated service satisfies $z=h(q,0)=q$. Assuming $s=0$, it is readily verified that $p(q)$ is proportional to q, $m(q)$ to $q^{1+1/b}$ and $R(q)$ to $q^{2+1/b}$. Suppose $b=1$. Then p is linear in q, m is quadratic in q, and R is a cubic in q. A seller that is twice as talented has a market that is four times larger and earns eight times more money. If $b=1/2$ market size grows with the cube of talent and incomes by powers of four: a seller who is twice as talented earns sixteen times more, but only charges prices that are twice as large.[11]

IV. Heterogeneous Consumers

Consumer differences in intensity of demand for services are unrestricted in Section III, though much use is made of the assumption that s is identical among them. How

[11] Notice that with imperfect information the effect of a reputation and fixed costs creates a type of scale economy which broadens the scope of this result. If two scholars write on the same subject, the one with the better track record is much more likely to be read and subsequently cited. Similarly, a firm with a fine reputation is more likely to get the business than one that is of unknown quality. While a reputation has many of the elements of a public good, the analogy is not quite complete because this discussion ignores the dynamics of how reputations are established. An "epidemic model" is an intriguing possibility.

should the equilibrium be described when s is distributed in the population of customers? That analysis is more complex because there is no longer a single equilibrium market price for services, v, that summarizes all the information. Nevertheless, differences in s imply restrictions on market outcomes that actually strengthen the qualitative results. I do not attempt a full analysis here, but the reason is that the market assignment of customers to sellers may force the relationship between p and z to be convex. Therefore the more talented sellers receive even greater rents and service even larger markets than when p is linear in z as in (4).

That $p(z)$ must be convex can be sketched as follows: Figure 3 shows the equalizing difference function (4) for two types of customers, s_1 and s_2, at alternative values of v. Each line represents the willingness to pay for z at a given utility index. At the same value of v the functions are parallel and s_1 type consumers outbid s_2 types at all values of z. In equilibrium the relevant v (the negative of the utility index) for type s_2 must exceed that for type s_1. Otherwise the former group would not purchase the service at all. Consequently the observed market relation must be the envelope of functions such as $p=v_1z-s_1$ and $p=v_2z-s_2$, the heavier curve in Figure 3. The envelope is convex. Evidently the main features of the analysis above hold for each linear piece of $p(z)$ in Figure 3. There are, however, additional implications of sorting between segments. First, the more talented sellers gravitate to that segment of the market with the largest value of v, precisely the reason why the convexity implications of the previous analysis are strengthened. Second, consumers with smaller values of s buy from less talented sellers. This is quantity-quality substitution at work: buyers with smaller values of s find quantity relatively cheaper and economize on quality, while those with large values of s demand greater quality and economize on quantity. Adding more types of consumers smooths the locus of equilibrium points in Figure 3 without affecting the general principles.[12]

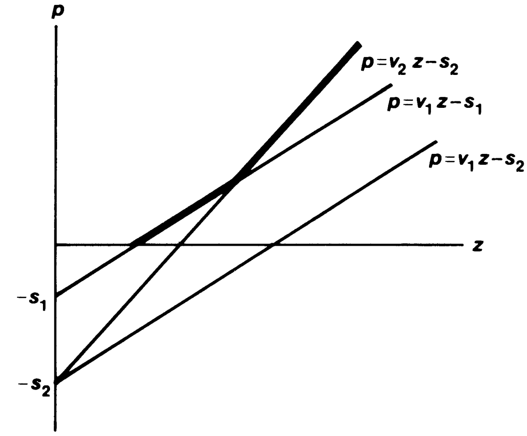

FIGURE 3

V. Comparative Statics

Since Section IV indicated that the qualitative results are not affected, it is convenient to exploit the assumption of common s in the consuming population. Demand and supply shifts are considered in turn.

A. *Demand Shifts*

An increase in the number of consumers or in the intensity of their demands for y increases the market demand for services. Market equilibrium price v rises due to rising supply price. Hence unit prices, $p(q)$, of all sellers increases. Since $R(q)$ increases everywhere, less talented people enter. At the same time, existing sellers expand their scales of operations. Though average quality of sellers falls, all previous entrants earn larger rents than before, and the largest increases accrue to the most talented persons (see the effect of v in equation (13) or (18)). Therefore the distribution of reward becomes more skewed than before.

The important practical implication is that it is monetarily advantageous to operate in a larger overall market; and it is increasingly advantageous the more talented one is. No

[12]Reder points out that the market is less concentrated if there are differences of opinion on who is the most talented. This raises subtle questions of the definition of markets that remain to be solved. An approximate solution in the analysis here is to adjust the density of $\phi(q)$: if several sellers are thought by different customers to have the same value of q, that is nearly the same as more mass in ϕ at that value.

wonder that the best economists tend to be theorists and methodologists rather than narrow field specialists, that the best artists sell their work in the great markets of New York and Paris, not Cincinnati, or that the best writers are connected with the primary literary centers such as New York or London. The best doctors, lawyers, and professional athletes should be found more frequently in larger cities. For a given place in the distribution of talent, it is more lucrative to be a violinist than an accordianist, a heavyweight than a flyweight, a rock musician than a folk singer, a tennis player than a bowler, or a writer of elementary texts rather than of monographs.

B. *Supply Shifts*

The interesting experiments are changes in internal and external diseconomies. Lesser diseconomies increase the market supply of services, reduce the equilibrium value of v, and make consumers better off. The effects on the distributions of talents and rents are less obvious and complicated by the presence of two opposing forces: the reduction in v lowers unit prices of all sellers, tending to decrease individual output and reward; whereas the reduction in costs or congestion tends to increase them. The balance between the two depends on the elasticity of demand for services.

If demand for services is sufficiently elastic, then cost reducing effects swamp the decline in unit prices and rents of sellers increase. The rent-talent gradient increases as well and there is greater concentration in the distribution of rewards among the most talented. A reduction in the internal diseconomy induces entry at the extensive margin, and the average seller becomes less talented. However, a reduction of the external diseconomy, if large enough, can actually reduce the number of sellers, kicking out the less talented and increasing the average quality of those remaining. If demand is inelastic, then the number of sellers declines and, since those leaving are selected from the lower tail, the average remaining talent rises. Effects on the return function $R(q)$ are ambiguous in this case, though sufficient reductions in the costs of congestion still can imply increases in both $R(q)$ and $R'(q)$. However, that is a less likely outcome than when demand is elastic.

The practical importance of all this is related to technical changes that have increased the extent of scale economies over time in many activities. Motion pictures, radio, television, phono reproduction equipment, and other changes in communications have decreased the real price of entertainment services, but have also increased the scope of each performer's audience. The effect of radio and records on popular singers' incomes and the influence of television on the incomes of news reporters and professional athletes are good cases in point. And there are fine gradiations within these categories. Television is evidently a more effective medium for American football and basketball than it is for bowling, and incomes reflect it. Nonetheless, television has had an enormous impact on the incomes of the top bowlers, golfers, and tennis players, because their markets have expanded. The "demise" of the theatre is more a complaint about competition from the larger scale media; and incomes of the top performers in the theatre, motion pictures, and television certainly are closely geared to audience size. These changes are not confined to the entertainment sector. Undoubtedly, secular changes in communications and transportation have expanded the potential market for all kinds of professional and information services, and allowed many of the top practitioners to operate at a national or even international scale. With elastic demands there is a tendency for increasing concentration of income at the top as well as greater rents for all sellers as these changes proceed over time.

C. *Interactions*

A change in s shifts the supply of services, not demand, even though it is a consumer parameter. This has no counterpart in standard theory. Demand is not directly affected because v embodies all relevant information for the consumption decision. Supply is shifted because s affects unit prices (see (4)). An increase in s reduces unit prices at any value of v and reduces market supply. Therefore the equilibrium service price v increases and the rent distribution is altered in favor of the more talented sellers. The less talented leave the market. Both the increase in average quality of sellers and greater concentration in rewards at the top reflect customers' substitution of quality for quantity as s rises.

Since important components of s are time and effort costs, time-series changes are correlated with consumer earnings. Therefore market demand increases at the same time that supply is reduced, resulting in an even greater increase in v and additional skew. It can even push the extensive margin down rather than up. The incentives for investments in time saving innovations that tend to reduce s as earnings rise, for example, consumption at home, have been well remarked upon in the literature.[13]

VI. Conclusion

In discussing the general influence of economic progress on value, Alfred Marshall wrote:

> The relative fall in the incomes to be earned by moderate ability... is accentuated by the rise in those that are obtained by many men of extraordinary ability. There never was a time at which moderately good oil paintings sold more cheaply than now, and ... at which first-rate paintings sold so dearly. A business man of average ability and average good fortune gets now a lower rate of profits... than at any previous time, while the operations, in which a man exceptionally favoured by genius and good luck can take part, are so extensive as to enable him to amass a large fortune with a rapidity hitherto unknown.
>
> The causes of this change are two; firstly, the general growth of wealth, and secondly, the development of new facilities for communication by which men, who have once attained a commanding position, are enabled to apply their constructive or speculative genius to undertakings vaster, and extending over a wider area, than ever before.
>
> It is the first cause... that enables some barristers to command very high fees, for a rich client whose reputation, or fortune, or both, are at stake will scarcely count any price too high to secure the services of the best man he can get: and it is this again that enables jockeys and painters and musicians of exceptional ability to get very high prices... . But so long as the number of persons who can be reached by a human voice is strictly limited, it is not very likely that any singer will make an advance on the £10,000 said to have been earned in a season by Mrs. Billington at the beginning of the last century, nearly as great as that which the business leaders of the present generation have made on those of the last. [pp.685–86]

Even adjusted for 1981 prices, Mrs. Billington must be a pale shadow beside Pavarotti.[14] Imagine her income had radio and phonograph records existed in 1801! What changes in the future will be wrought by cable, video cassettes, and home computers?

[13] See Becker (1965).

[14] The entries for Elizabeth Billington in the eleventh edition of the *Encyclopedia Britannica* and *Grove's Musical Dictionary* indicate that she earned somewhere between £10,000 and £15,000 in the 1801 season singing Italian Opera in Covent Garden and Drury Lane. She is reported to have had an extraordinary voice and was highly paid throughout her professional life, but there is a hint that the 1801 sum was unusual even for her. No information is given on endorsements.

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[Footnotes]

[3] **A Theory of Marriage: Part I**
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