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A Competitive Model of (Super)Stars

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Following Rosen [1981], superstar effects (earnings convex in quality and a few firms reaping a large share of market earnings) occur with imperfect substitution between sellers, low (and possibly declining) marginal cost of output, and marginal cost falling as quality increases. However, markets without such characteristics have superstar effects, and the main result from the superstar model---small quality differences result in large earnings differences---may not hold. A competitive model can yield superstar effects when a few firms have quality significantly higher than others and cost increases in output, provided cost does not increase too rapidly in quality.

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INTRODUCTION

In his 1981 paper, Sherwin Rosen was the first to formally analyze the phenomenon of what he called *superstars*. Rosen assumed more talented individuals produce higher quality products. Assuming, for simplicity of discussion, individual talent and product quality are identical, superstar effects imply earnings are convex in quality, the highest quality producers earn a disproportionately large share of market earnings, and the possibility of only a few sellers in the market. Rosen argued superstar effects were the result of two phenomena: 1) imperfect substitution among products, with demand for higher quality increasing more than proportionally so small differences in talent may result in large earnings differences, and 2) technology such that one or a few sellers could profitably satisfy market demand, with higher quality producers having lower marginal cost of output. In the extreme case, we have a *joint good*, where an additional buyer can be serviced at little additional cost to the seller. Borghans and Groot [1998] refer to a market with such cost conditions as one with “media stars.” Rosen [1983] argued such markets almost always require mass media, and, depending on the distribution of consumer preferences, may contain only a few sellers. Television shows and recorded music are examples of media markets.

However, imperfect substitution and joint consumption do not characterize all markets in which superstar effects appear. For example, Krueger [2005] identifies significant superstar effects for music concerts in the U.S.---effects that have become even larger in recent years. He reports revenue for music concerts from 1982 to 2003. Most of the artists would fall under the heading of rock music, but other artists are included.¹ In 1982, the top 5% (in terms of revenue) of artists earned 62% of concert revenue. For 2003, the corresponding figure was 84%. Note, larger superstar effects for music concerts do not necessarily imply either less substitutability

among products or technological changes favoring mass media. Krueger suggests these effects result from changes in pricing due to concerts and recorded music becoming weaker complements. Further, Krueger argues the time and effort for a live performance of a song should not have changed much over time. It is also unlikely the cost of performing a song depends significantly on the quality of the musicians. The technology of reaching more buyers for a live performance is much different than it is for selling additional CDs. As Rosen noted: “It is preferable to hear concerts in a hall of moderate size rather than in Yankee Stadium.”² Quality of live performances is significantly diluted by audience size [Rosen, 1983], and cost thus increases in market size.³

The purpose of this paper is to demonstrate how superstar effects may occur in markets absent imperfect substitution and joint consumption. There are several differences between our model and the typical superstar model. First, imperfect substitution is not required. Superstar effects result because a few sellers have quality significantly higher than other sellers. One apparent advantage of Rosen’s [1981] model is superstars may occur even when quality differences between superstars and others are small. This is because the joint good nature of production in his model allows one seller to satisfy additional buyers at little additional cost. Thus, even if a seller’s quality is viewed as only slightly higher than that of another, everyone is still able to buy from the higher quality seller. However, Adler [2006] notes Rosen’s model may not result in relatively high profit for supposed superstars unless there are significant quality differences between sellers. If several sellers of similar quality exist, and marginal cost declines with firm output, Adler argues firms will compete and drive price towards average cost. If the high quality seller’s product is valued only slightly more than that of the low quality seller, even if marginal and average cost are negatively related to quality, a small quality difference implies

the higher quality seller's price will be only slightly above average cost (since price is competed down to average cost of the lower quality seller, which is only slightly greater than average cost of the higher quality seller). Thus, one "superstar" may survive and sell most, if not all of market output, but it will not earn significant economic profit.

Second, marginal cost need not decline in output and quality. We assume marginal cost increases in output, and, although superstar effects are more pronounced if marginal cost is inversely related to quality, such effects may occur even if marginal cost increases in quality.⁴

Third, competition occurs in the model because there are many potential and active firms, most of which have the lowest quality level, and none of which sells a significant share of market output. In Rosen's superstar model, price depends on a seller's output. The threat of entry and the assumption sellers of similar quality are good substitutes force firms to behave competitively. However, as discussed above, with declining marginal and average cost, such competition would eliminate one of the superstar effects, the high level of profit for such sellers. Also, if stars are very scarce, potential entrants are likely to be of the lowest quality. Thus, in the Rosen model, small quality differences may imply no large earnings for "superstars," but large quality differences suggest a lack of competition. Our model has price-taking producers, and, because marginal cost increases with output, those with a large quality advantage over other firms will produce only a small percentage of market output, another feature of a competitive market.

We assume there are many potential sellers of the lowest quality called *non-stars*. Since some firms could have quality only slightly greater than that of the lowest level of quality, it seems a bit extreme to refer to such firms as superstars. Thus, herein all firms with quality above the lowest level will be referred to as *stars*. Stars can not be created, unlike non-stars who exist in relatively large numbers. For example, it is easy to put together a musical group that is

comparable to many other groups, but the determination of what groups are high quality is at the whim of consumers.

Since the concept of superstar effects is well established, superstar will still be used to denote the phenomena of revenue and profit increasing and convex in quality, and a few sellers earning a large percentage of market revenue and profit. Rosen [1981] used profit when considering superstar effects, but we use both revenue and profit. Profit is not used exclusively for the following reasons. In our model, low quality producers earn zero profit. Thus, stars always earn all market profit. Also, in our model, as in the special case in Rosen [1981, pp. 851-'52] closest to our model, revenue and profit are identically affected by quality. Further, earnings reported for top performers in entertainment are not net of cost. The data on concert earnings from Krueger [2005] considered below involve revenue.

The assumption herein is quality levels are perfect substitutes.⁵ With free entry, a large number of potential producers with low quality, and full arbitrage between quality levels, a competitive market results without Rosen's assumptions of potential entry by (super)stars and sellers having similar quality levels. Becker and Murphy [2000] note competition and free entry yield a price equal to the marginal and average cost of new units, implying superstar effects can not result in such a world. However, higher quality sellers can sell at higher prices and earn positive economic profit if free entry is at the lowest quality level.

Besides the case of music concerts, discussed above, other examples of growing superstar effects exist. Consider the market for best-selling books [Sorensen, 2006]. From the mid-1980s to the mid-1990s, the share of books sold in the U.S. by the top thirty authors nearly doubled. By 1994, 70% of all fiction sales were accounted for by four authors: Clancy, Crichton, Grisham, and King. Another example is in the market for dentists in the U.S. Frank and Cook [1995] find

the number of U.S. dentists who make more than \$120,000 per year (in 1989 dollars) increased by 78% from 1979 to 1989, while the number of dental specialists (surgeons, orthodontists, etc.) produced each year was basically unchanged, the total number of dentists declined slightly, and average real dental earnings increased only slightly. Real earnings of the highest paid dentists tripled over this period, and dentistry is clearly not a media market. Frank and Cook cite one possible explanation (offered by the editor of the Journal of Dental Education) which is the increased demand for cosmetic dentistry, a high value service. Such a change implies an increased gap between the value consumers place on high and low quality dental services, and growing superstar effects even if the dentistry market is competitive.

One question we do not address is why some are viewed as higher quality than others. Becker and Murphy [2000] offer one reason for the existence of stars in what they call *social markets*. They argue some (*followers*) gain acceptance and prestige by emulating the consumption of others (*leaders*). Whatever the reason for the existence of stars, technological advances in recent years may have caused the perceived quality of stars in some sectors to increase. Products such as Walkman, Discman, and iPod enable consumers to listen to music virtually anywhere. If the music market is indeed “social,” the ability of followers to emulate leaders would have increased, implying an increase in consumers’ valuation of higher quality products. We simply equate higher quality with a higher willingness to pay for the product by consumers.

The outline of the rest of the paper is as follows. In Section 2, the competitive superstar model is developed. Numerical examples of superstar effects are considered in Section 3. Section 4 contains a discussion of recent changes in ticket prices for music concerts. Concluding remarks are presented in Section 5.

THE MODEL

Consumers

Consider an individual who maximizes utility, U . Let $U = U(\sum z_i y_i, x)$, where x is a good with a price of one, and y_i represents the amount consumed of each good of quality z_i . The form of the utility function implies the individual goods (excluding the good measured by x) are perfect substitutes. Income = I , so, with p_i the price of good “ i ,” the budget constraint is $I = \sum p_i y_i + x$. Substituting in $U(\bullet)$ for x using the budget constraint, an individual maximizes $U(\sum z_i y_i, I - \sum p_i y_i)$. For an interior solution for any good, we have with U_1 the derivative of U with respect to its first argument, etc.,

$$(1) \quad \frac{\partial U}{\partial y_i} = z_i U_1 - p_i U_2 = 0.$$

For any two goods “ z_i ” and “ z_j ,” we then have:

$$(2) \quad \frac{z_i}{p_i} = \frac{z_j}{p_j}.$$

Thus, arbitrage must occur in the market if there is to be an interior solution for given quality levels. Without the condition in *eq.(2)*, $y = 0$ for some quality levels. If, for example, for quality “ z_i ,” z_i/p_i exceeded the corresponding ratio for other quality levels, only quality level z_i would be purchased. Thus, in order to sell, and to do so at the lowest possible price, a producer of a particular quality level is forced to adjust its price according to *eq.(2)*.

Since, given arbitrage, an individual is indifferent to the quality levels consumed, we can not derive demand for an individual quality level. We can only consider demand for some

aggregate of the different quality levels. Since, on average, consumers will buy the average quality level offered for sale,⁶ \bar{z} , we consider a consumer maximizing utility given a good of average quality.

Suppose we have $U = (\bar{z}y)^\phi + x$. With p and y price and quantity for a good of average quality, the budget constraint now $I = py + x$, the first-order condition for y yields:

$$y = \left(\frac{p}{\phi\bar{z}^\phi}\right)^{\frac{1}{\phi-1}}. \text{ With } m \text{ identical consumers, market demand } = Q = m\left(\frac{p}{\phi\bar{z}^\phi}\right)^{\frac{1}{\phi-1}}. \text{ Solving for}$$

p , we have the market demand price:

$$(3) \quad p^D = \phi\bar{z}^\phi \left(\frac{Q}{m}\right)^{\phi-1}.$$

Define $A \equiv \phi/m^{\phi-1}$. Note: price inversely related to quantity requires $\phi < 1$. Thus, we have:

$$(4) \quad p^D = A\bar{z}^\phi Q^{\phi-1}$$

Now arbitrage will yield the price of a particular quality level: $p_i = \frac{z_i}{\bar{z}} p^D$. As an example, suppose $\phi = 1/2$ and A and Q are such that $AQ^{\phi-1} = \$10$. Now $p^D = \$10 \bar{z}^\phi$. If $\bar{z} = 2$,

$p^D = \$10\sqrt{2} \approx \14.14 . No one need actually buy a unit of quality level 2 in this case, but this is

of no consequence. If, for example, one buys a unit of the good with $z = 1$, arbitrage tells us

$p_1 = 1/2 p(\bar{z}) = \$7.07$. Now suppose average quality in the market rises, which, by eq.(4), tells us

demand will increase, increasing the price for average quality, p^D . If $\bar{z} = 3$,

$p^D = \$10\sqrt{3} \approx \17.32 . Now, for $z = 1$, $p_1 = [1/3]p(\bar{z})$, so $p_1 \approx \$5.774$.

With $\phi < 1$, the price of a good of average quality increases in average quality at a decreasing rate. Since arbitrage requires a linear relation between the prices of different quality levels, an increase in average quality lowers the price for each quality level. As seen in subsection 2.4, low quality sellers will tend to be driven out of the market as \bar{z} increases unless the relation between quality and cost is significantly positive.

Producers

Consider a market in which talent is labeled as quality, z . We assume quality is intrinsic and is not diluted as output increases. Since marginal cost is assumed to increase in output, no firm will produce a large percentage of market output. In contrast, in media markets, one or a few sellers may produce a large percentage of market output. Suppose there is a mass of sellers at the lowest quality level, z_0 . Free entry and exit of these non-stars occur. In contrast, stars have quality greater than z_0 , are relatively scarce, and are only created when consumer tastes dictate individual sellers are stars. Thus, the number of stars only changes exogenously in response to changes in consumer evaluations of the quality of sellers. All stars are in the market; there is no mass of stars ready to enter the market in response to positive profit.

As discussed before, the assumption herein is quality levels are perfect substitutes. Thus, arbitrage yields relative prices. In order to determine actual price levels, suppose each firm has a typical U-shaped average cost curve. Now entry and exit of non-stars will force the long-run price of the lowest quality level, z_0 , to equal the height of the minimum point of average cost, P_0 . For any arbitrary quality z , arbitrage then implies:

$$(5) \quad P(z) = zP_0/z_0.$$

In general, the effect of quality on cost can be positive, zero, or negative. Thus, total cost for a firm, C , is given by:

$$(6) \quad C = z^\sigma q^\alpha + F,$$

where $\alpha > 1$, q = the firm's output, and F = fixed cost. A firm is a price taker: P is independent of firm output. Thus, using eq.(5), and letting $k \equiv \frac{P_0}{z_0}$, profit, π , is given by:

$$(7) \quad \pi = kzq - z^\sigma q^\alpha - F.$$

Cost and superstar effects

Consider what cost conditions are necessary for superstar effects to occur when cost depends on quality.

Proposition One. Given the assumed cost function,(eq.(6)), with marginal cost increasing in output ($\alpha > 1$), revenue and profit increase and are convex in quality even if total cost increases in product quality, as long as it does so at a decreasing rate ($\sigma < 1$).

Proof. Using eq.(7), find the profit-maximizing choice of q , substitute the result into R and π , and differentiate q , R , and π with respect to z . Let the profit-maximizing values of q , R , and π be denoted by q^* , R^* , and π^* , respectively.

$$(8) \quad \frac{\partial \pi}{\partial q} = kz - \alpha z^\sigma q^{\alpha-1} = 0,$$

$$(9) \quad q^* = \left(\frac{k}{\alpha} \right)^{\frac{1}{\alpha-1}} z^{\frac{1-\sigma}{\alpha-1}},$$

$$(10) \quad R^* = \left(\frac{1}{\alpha} \right)^{\frac{1}{\alpha-1}} k^{\frac{\alpha}{\alpha-1}} z^{\frac{\alpha-\sigma}{\alpha-1}},$$

$$(11) \quad \pi^* = (\alpha - 1) \left(\frac{k}{\alpha} \right)^{\frac{\alpha}{\alpha-1}} z^{\frac{\alpha-\sigma}{\alpha-1}} - F,$$

$$(12) \quad \frac{\partial q^*}{\partial z} = \left(\frac{k}{\alpha} \right)^{\frac{1}{\alpha-1}} \left(\frac{1-\sigma}{\alpha-1} \right) z^{\frac{2-\sigma-\alpha}{\alpha-1}},$$

$$(13) \quad \frac{\partial R^*}{\partial z} = \left(\frac{1}{\alpha} \right)^{\frac{1}{\alpha-1}} \left(\frac{\alpha-\sigma}{\alpha-1} \right) k^{\frac{\alpha}{\alpha-1}} z^{\frac{1-\sigma}{\alpha-1}},$$

$$(14) \quad \frac{\partial \pi^*}{\partial z} = (\alpha - 1) \left(\frac{\alpha-\sigma}{\alpha-1} \right) \left(\frac{k}{\alpha} \right)^{\frac{\alpha}{\alpha-1}} z^{\frac{1-\sigma}{\alpha-1}},$$

$$(15) \quad \frac{\partial^2 R^*}{\partial z^2} = \left(\frac{1}{\alpha} \right)^{\frac{1}{\alpha-1}} \frac{(\alpha-\sigma)(1-\sigma)}{(\alpha-1)^2} k^{\frac{\alpha}{\alpha-1}} z^{\frac{2-\alpha-\sigma}{\alpha-1}},$$

$$(16) \quad \frac{\partial^2 \pi^*}{\partial z^2} = (\alpha - 1) \frac{(\alpha-\sigma)(1-\sigma)}{(\alpha-1)^2} \left(\frac{k}{\alpha} \right)^{\frac{\alpha}{\alpha-1}} z^{\frac{2-\alpha-\sigma}{\alpha-1}}.$$

Note, with $\alpha > 1$ (marginal cost increasing in output), $\alpha > \sigma$ is necessary for R^* and π^* to be positive functions of z . From eqs.(12) - (16), with $\alpha > 1$ and $\sigma < 1$, the profit-maximizing q is positively related to z , and both R^* and π^* increase and are convex in z . Thus, a superstar effect can exist if cost increases with z at a decreasing rate. If $\sigma = 0$, cost is

independent of z , and, if $\sigma < 0$, C is inversely related to z . Clearly, for $\sigma < 1$, the smaller is σ , the larger is $\frac{\partial^2 R^*}{\partial z^2}$, that is, the more convex R^* and π^* are. ■

It is not possible to replicate the results above using a general relation between cost and quality. However, with a simple, specific relation between cost and output, and a general relation between cost and quality, it can be demonstrated (see the Appendix) a positive but diminishing effect of quality on cost may not be necessary and is not sufficient for revenue to be positively related to and convex in quality.

Exogenous changes in the number of stars

Proposition Two. An influx of stars (due to changes in consumer tastes) that raises \bar{z} will tend to cause non-stars to leave the market.

Proof. Unlike non-stars, potential stars who would enter when comparable firms earn positive profit do not generally exist. However, consumers may now deem some previous non-stars to be stars, which is equivalent to an exogenous increase in the number of stars. With a market demand like the one considered above (eq.(4)), $\frac{\partial \ln P^D}{\partial \ln \bar{z}} < 1$ in order to have downward sloping demand. In that case, if new stars cause \bar{z} to increase, demand increases vertically by a smaller percentage than \bar{z} increased. Additionally, the market equilibrium price for average quality, $P(\bar{z})$, increases by a smaller percentage because i) supply is not vertical, and ii) supply increased. Thus $P(\bar{z}) < \frac{\bar{z}}{z_0} P_0$, or $\frac{z_0}{\bar{z}} P(\bar{z}) < P_0$. However, arbitrage requires $P(z_0) = \frac{z_0}{\bar{z}} P(\bar{z})$, so $P(z_0) < P_0$, which means non-stars earn negative profit. Some non-stars will exit,⁷ decreasing market supply, but also raising \bar{z} and thus increasing market demand. Both the demand increase

and supply decrease will raise $P(\bar{z})$, and this process will continue until $P(z_0) = P_0$ and non-stars earn zero profit.⁸

Additional stars with average quality below \bar{z} would cause a reduction in $P(\bar{z})$ initially, since demand would decrease along with the increase in supply. The result could then be the same as in the previous paragraph: non-stars would exit until $P(\bar{z})$ increased sufficiently so $P(z_0) = P_0$.⁹ ■

The model with specific parameter values

In order to consider how a competitive market might look, explicit functions for a firm's cost and for market demand are used. Using eq.(6), since we are interested in demonstrating superstar effects when marginal cost is *not* inversely related to quality and output, it is assumed total cost is independent of quality ($\sigma = 0$), and total variable cost is simply the square of output ($\alpha = 2$): $C = q^2 + F$. Entry and exit will force $P(z_0)$ equal to the height of the minimum point of average cost. At this point, $q = F^{1/2}$, and the height of average cost equals $2F^{1/2} \equiv P_0$.

As a price taker, a firm maximizes π by setting marginal cost equal to price, so $q(z) = zP_0/2z_0$, with the lowest quality sellers ($z = z_0$) producing $q = q_0 = P_0/2$. Additionally, to simplify the derivations, from eq.(4), assume $\phi = 1/2$, so inverse market demand becomes:

$$(17) \quad p^D = A\left(\frac{\bar{z}}{Q}\right)^{1/2}.$$

Suppose we have two types of sellers: *stars*, of whom there are s , and *non-stars*, of whom there are n . Since stars each produce $q_{Star} = zP_0/2z_0$, and non-stars each produce $q_0 = P_0/2$, then

average quality is:

$$(18) \quad \bar{z} = \frac{sq_{Star}z + nq_0z_0}{sq_{Star} + nq_0}.$$

Using the arbitrage condition (*eq.(5)*) with $z = \bar{z}$, and inverse market demand (*eq.(17)*), total demand is:¹⁰

$$(19) \quad Q = \left(\frac{Az_0}{P_0}\right)^2 \frac{1}{\bar{z}}.$$

Total supply is:

$$(20) \quad Q = \frac{P_0}{2} \left(n + s\frac{z}{z_0}\right).$$

Using market demand and supply, we have:

$$(21) \quad (P_0)^3(nz_0 + sz) = 2A^2(z_0)^3\left(\frac{1}{\bar{z}}\right).$$

Given values for z , z_0 , s , P_0 , and A , we can use *eqs.(18)* and *(21)* to determine the number of non-stars in the market, and star's share of total output and revenue. We do this in the next section.

NUMERICAL VALUES OF MARKET EQUILIBRIUM

As discussed in the introduction, for music concerts, Krueger [2005] finds the top 5% (in terms of revenue) of artists earned 62% of U.S. concert revenue in 1982 and 84% of concert revenue in 2003. Also, Figure 2 in Krueger [2005] shows artists with the highest ticket prices had prices more than three times the \$40 plus average for recent years. To see if the competitive model developed herein can generate similar results, consider two numerical examples using *eqs.*(18) and (20). The numerical values were chosen for their simplicity, constrained by choosing the number of stars (s) such that stars would represent only a small percentage of the total number of producers (as is the case with music concerts).

Example One. Let $z = s = 5$, $P_0 = z_0 = \$1$, $A = \$10$.

Let \bar{P} = the average price of goods sold (weighted by quantities) = $P(\bar{z})$. We now derive the long run equilibrium \bar{P} using *eq.*(18). That is, we solve for the average price given the types and number of each type of sellers that are active. Using *eq.*(18), we solve *eq.*(20) for n , and then find other variables. We have $n = 75$, $\bar{z} = \bar{P} = \$2$, $P(z) = \$5$, $P(z)/\bar{P} = 2.5$, $q_0 = .5$, $q_{Star} = 2.5$, total output from non-stars = 37.5, and total output from stars = 12.5. Stars represent 6.25% of all firms, sell 25% of Q , and earn 62.5% of market TR .

Example Two. Let $z = 6$, $s = 4$, $P_0 = z_0 = \$1$, and $A = \$10$.

Now $n = 54.73$, $\bar{z} = \bar{P} = 2.52$, $P(z) = \$6$, $P(z)/\bar{P} = 2.38$, $q_0 = .5$, $q_{Star} = 3$, total output of non-stars = 27.3765, and total output of stars = 12. Stars represent 6.8% of all firms, sell 30.5% of Q , and earn 72.5% of market TR .¹¹

Example One yields stars' share of total revenue almost exactly that for music concerts in 1982, albeit for the top 6.25% (versus the top 5%) of earners. Example Two demonstrates the importance of relative star quality in terms of stars' share of market output and revenue. Compared to Example One, Example Two has 20% fewer firms, but stars quality rises by 20%. Stars' share of market output rises by 22%, and their share of market revenue rises by 16%. Even with fewer stars, the increase in quality of stars drives up demand, but, similar to an influx of stars (Proposition Two), this increase in star quality reduces the number of non-stars in the market, despite the fact we also reduced the number of stars. The reason total revenue rises fairly rapidly as quality increases in this model is simple: both price and output are linear in quality.

TICKET PRICES FOR ROCK CONCERTS

Krueger [2005] found the average U.S. concert ticket price increased almost five times as fast (82% versus 17%) as the U.S. Consumer Price Index from 1996 to 2003. Also, the top performers sold fewer tickets over this period.¹² Krueger's explanation for these effects is based on a monopoly model. The introduction of zero-price music downloads during this period (*i.e.* Napster) suggests concerts and purchased CDs are not as strongly complementary as before. Thus, the absolute value of the (negative) cross-price elasticity of demand between concert ticket prices and purchased music CDs would have declined. This would induce a monopolist to charge a higher price for concerts, and to reduce the quantity of concert tickets sold.

A competitive model of rock music can also explain the recent increase in concert prices. Suppose a seller produces both rock concerts and music CDs, and is a price taker in both markets. However, the price for concert tickets depends negatively on the price of a seller's recorded music consumers listen to, whether from CDs or internet downloads, if concerts and

recorded music are complements. Let the amount of a seller's recorded music consumed equal θ , with the price of θ equal to P_θ . Then the price a seller of quality z can charge for a concert ticket is $P(z, P_\theta)$, and $\frac{\partial P(z, P_\theta)}{\partial P_\theta} < 0$. If a large percentage of recorded music consumed is now available at a zero price, the effective P_θ to buyers is reduced significantly. Oberholzer-Gee and Strumpf [2007] claim downloads have almost no effect on CD sales. However, Leibowitz [2003] argues there is a reduction in sales of CDs of one unit for every five to six downloads. If P_θ has been reduced significantly, then $P(z, P_\theta)$ should have increased. Thus, either competition or monopoly could explain an increase in concert ticket prices. However, the competitive model does not predict a decline in output for stars, so some monopoly power may be present in the market for music groups.

An alternative explanation for the decline in output (that is, fewer concerts performed) by stars involves the age of these performers and is consistent with a competitive market. Artists with the highest revenue per show in 1996-'99 include the Eagles, Barbra Streisand, Jimmy Buffet, Eric Clapton, and Rod Stewart. All of these artists had reached middle age by the mid-1990s. It is possible age has increased their marginal cost of performing, resulting in a reduction in the profit-maximizing number of concerts per year.¹³

DISCUSSION AND SUMMARY

Although, in media markets, a few firms may produce most of the output, and earn a large percentage of the revenue and profit, these results require imperfect substitution between goods with different qualities, and marginal cost low and possibly declining in output. However, not all markets have such conditions, but they still may exhibit at least some of the characteristics of superstar markets. One example, considered in some detail herein because of

the availability of data, is the market for rock concerts. In that market, no seller produces a significant fraction of total output, but a few sellers claim a large percentage of market revenue.

Additionally, following Rosen [1981], an interesting feature of the typical superstar model has been the idea small quality differences can lead to large differences in earnings. However, as Adler [2006] argued, small quality differences between sellers when marginal and average cost decline with output will result in price being competed towards average cost, implying one superstar may remain and sell a large percentage of market output but will not earn significant economic profit. Large quality differences may be necessary for sellers to earn positive profit---just as in the model derived herein. However, large quality differences in the Rosen model imply a lack of competition. Thus, the model herein can explain why some firms earn significant positive profit---while others earn zero profit---without imperfect substitution between products, marginal cost declining in output, or monopoly.

Finally, Frank and Cook [1992] refer to markets with superstar effects as “winner-take-all markets.” They suggest such effects result from *indivisibilities*---e.g. two tennis players can not work together to win a singles title---and *rank-order contests* in which payoffs do not depend on absolute quality. They conclude such markets have too many resources allocated to them due to rent-seeking by market participants. In the model herein, no rent-seeking occurs and the market is competitive. This suggests one should not conclude the equilibrium in all markets with superstar effects is inefficient.¹⁴

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NOTES

¹ Among the non-rock artists are country performers (George Strait and Reba McEntire), a pop singer (Barbra Streisand), and an opera singer (Luciano Pavarotti).

² Rosen, 1981, p. 849.

³ Cost increases in market size because it is more expensive to reach a larger audience in a given concert, but, more importantly, the large decline in quality as the audience at a concert grows necessitates more concerts to reach additional customers.

⁴ Rosen [1981] briefly considered a case similar to that herein in which technology is such a few producers could not profitably sell a large percentage of market output; he found superstar effects in that case. However, Rosen spent little time on that situation, and focused mainly on the case with joint consumption.

⁵ Rosen [1981] compared the model in his 1981 paper on superstars to the model in his paper on hedonic prices [Rosen, 1974]. In his earlier paper, Rosen assumed *arbitrage* was not possible. In the case of hedonic prices, a good may have many attributes, one bundle of attributes may not be comparable to another, and thus it seems reasonable to assume arbitrage does not occur. However, in Rosen's superstar model (as in the model herein), quality is one-dimensional, with all consumers valuing quality identically. In this case, there is no reason why arbitrage between different quality levels should not occur.

⁶ In one sense, the problem is like that for an irrational consumer, one who is completely random and consumes goods that are not perfect substitutes. On average, such a consumer would be at the mid point of his budget constraint [Becker, 1962]. In that problem, a small change in one price would result in a small change in quantity consumed of the different goods. Thus, the demand for particular goods *could* be derived. With perfect substitutes, starting with a set of prices such that arbitrage occurs, a small change in the price of one type of the good will lead to a corner solution for that good: if p_i rises slightly, $y_i = 0$, and, if p_i falls slightly, only the good with quality z_i will be purchased.

⁷ Stars will earn positive profit in this model, so one with $z > z_0$ could charge a price slightly below $P(z) = \frac{z}{z_0} P_0$, still earn positive profit, and induce buyers to strictly prefer buying an item with $z > z_0$. Non-stars earn zero profit.

⁸ The decrease in supply must be larger than the increase in demand for $P(\bar{z})$ to increase proportionally more than \bar{z} does. Otherwise, we would continue to have $P(z_0) < P_0$, and, ultimately, no non-stars would be in the market.

⁹ Since \bar{z} has been reduced, it is *possible* the decrease in $P(\bar{z})$ would be small enough so $P(z_0) > P_0$. Non-stars would earn positive profit, more of them would enter the market, demand would decrease due to the further reduction in \bar{z} , and $P(\bar{z})$ would fall until $P(z_0) = P_0$. Assume appropriate shapes for demand and supply, so the equilibrium does not result in a corner solution in which \bar{z} is driven to z_0 as supply increases and demand decreases continue to lead to $P(z_0) > P_0$.

¹⁰ In long run equilibrium, \bar{z} is derived from the sellers active in the market. Market demand *eq.*(19) makes use of the \bar{z} that reflects active sellers (*eq.*(18)).

¹¹ Contrast Example Two, where the top 4 firms sell about 30% of market output with the market for fiction books (Section One) where the top 4 sell 70% of market output. The dominance of a few fiction writers is due to low and possibly constant marginal cost in this "media market."

¹² Krueger [2005] considered what happened to those who were the top revenue earners in the period 1996-'99. From the period 1994-'95 (before concert prices began to increase significantly [1997]) to the period 2000-'01, the number of shows performed by these individuals or groups fell by 18%, and revenue per show increased by 60%.

¹³ Age may also be used to explain results consistent with monopoly. The audience for older performers tends to be older and wealthier, and may have less elastic demand than consumers for other musical groups, implying a higher price for older performers.

¹⁴ Superstar markets in sports differ from what we have considered because the individual is the superstar. In this case, an inefficient result may occur because of an externality---other teams reap some of the gains from a superstar in attendance and television revenue. Hausman and Leonard [1997] found a significant superstar externality in the National Basketball Association. For example, for the 1991-'92 season, Michael Jordan was worth an estimated \$53 million to other teams.

APPENDIX

We now consider whether revenue, given the profit-maximizing q , is necessarily convex in quality (z) if total cost (C) increases with z at a decreasing rate---the result found in the text for the case when $C = z^\sigma q^\alpha + F$, with q = firm output and $\alpha > 1$. Since it is the effect of z on C when C is not an explicit function of z that is of interest, and the effect of q on C is not of interest, use the simplest specific functional relation between q and C , with a general relation between z and C :

$$(A1) \quad C = q^2 c(z) + F,$$

where $\frac{\partial c}{\partial z} \equiv c_z > 0$. Let $c_{zz} \equiv \frac{\partial^2 c}{\partial z^2}$. With $R = kzq$ and k a positive constant, the first-order condition for the profit maximizing choice of q is:

$$(A2) \quad q^* = kz/2c.$$

Substituting into R using eq.(A2) yields $R^* = k^2 z^2 / 2c$. To get rid of constant terms, let $r \equiv 2R^*/k^2 = z^2/c$, where the derivatives of r with respect to z are identical in sign to those of R^* . Differentiating r :

$$(A3) \quad \frac{\partial r}{\partial z} = \frac{z}{c^2} (2c - zc_z).$$

In order for R^* to be positively related to z , $\frac{\partial r}{\partial z}$ must be positive, so $2c > zc_z$, or, with $\xi_{c,z}$ the elasticity of c with respect to z , $\xi_{c,z} < 2$. Since the elasticity of C with respect to q is 2, and the elasticities of c and C with respect to z are identical, the condition $\xi_{c,z} < 2$ requires z to have a smaller impact on C than does q . Differentiating $\frac{\partial r}{\partial z}$ with respect to z :

$$(A4) \quad \frac{\partial^2 r}{\partial z^2} = \frac{1}{c^2} \left[2c - z^2 c_{zz} - \frac{2zc_z}{c} (2c - zc_z) \right]$$

The first term in brackets in eq.(A4) is positive, and, for $\frac{\partial r}{\partial z} > 0$, the third term in brackets is negative. Thus, c increasing with z at a decreasing rate--- $c_{zz} < 0$ ---is neither necessary nor sufficient for revenue to increase at an increasing rate with z , that is for $\frac{\partial^2 r}{\partial z^2} > 0$.

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