1991

Winner-Take-All Markets

Robert H. Frank
Phillip J. Cook

Follow this and additional works at: https://ir.lib.uwo.ca/economicsperg_ppe

Part of the Economics Commons

Citation of this paper:
PAPERS IN POLITICAL ECONOMY

Paper No. 18

"Winner-Take-All Markets"

Robert H. Frank and Phillip J. Cook

The UNIVERSITY of WESTERN ONTARIO
The Political Economy Research Group was established in the faculty of Social Science at the University of Western Ontario in 1988. Its purpose is to foster scholarship, teaching and interdisciplinary research in political economy, with a focus on:

1. the application of economic models and methods to the study of political processes and institutions,
2. the economic impact of political processes and institutions,
3. the influence of economic factors on the formation of public policy and on institutional change,
4. the politics of economic policy making,
5. the political, social, and economic effects of public policy.

Co-directors:
Ronald Wintrobe (Economics)
Robert Young (Political Science)

Board of Directors:
Peter Howitt (Economics)
B.B. Kymlicka (Political Science)
John N. McDougall (Political Science)
Peter Neary (History)
John Whalley (Economics)

Staff:
Jayne Dewar

For further information:
Political Economy Research Group,
Department of Economics,
Social Science Centre,
London, Ontario, Canada N6A 5C2
phone: (519) 661-3877
fax: (519) 661-3292
Winner-Take-All Markets

by

Robert H. Frank, Cornell University

and

Philip J. Cook, Duke University

Economists have long known that small differences in talent or ability can translate into large differences in economic reward. Speaking of high-priced lawyers, Alfred Marshall noted earlier in this century that "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."\(^1\)

More recently, Sherwin Rosen made these observations about the market for classical musicians:

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 on the order of only a few hundred (and much smaller for instruments other than voice, violin, and piano). Performers of the first rank comprise a limited handful out of these small totals and have very large incomes. There are also known to be substantial differences between them and those in the second rank, even though most consumers would have difficulty detecting more than minor differences in a "blind" hearing.\(^2\)

Rosen goes on to point out that similar patterns are observed in other entertainment fields, the arts, professional sports, and high-level medicine. We will refer to the phenomenon described by Marshall, Rosen and others\(^3\) as the "winner-take-all" effect, meaning cases where a handful of the top participants in a market reap a disproportionate share of the total rewards.

This paper is organized in three parts: First, we examine the behavioral and economic causes of winner-take-all effects, and discuss several examples suggesting that these effects have been increasing over time and are by no means confined to celebrity labor markets. Second, we

---

\(^1\) Marshall, 1947, quoted in Rosen, 1981.
\(^3\) See also Frank, 1978.
develop a series of simple models in which we explore the consequences of winner-take-all processes for economic efficiency. And finally, we examine the distributional implications of winner-take-all effects.

I. Sources of the Winner-Take-All Effect

Some insight into the nature, importance, and scope of winner-take-all effects is afforded by an examination of the various factors that give rise to them. The necessary ingredients in all cases include: (1) Indivisibility: Participants are discrete entities that cannot be combined (two tennis players cannot work together to win a US Open singles title; two pretty good novels cannot be combined to form one very good novel); (2) The participants are engaged in a contest where payoffs are determined by rank order rather than (or in addition to) absolute quality; and (3) Payoffs are highly concentrated on the top ranks.

Sometimes these conditions arise as natural features of market structure. Other times, at least some of them are imposed deliberately for the purpose of altering economic incentives. With respect to cases in the latter category, a growing literature has focused on the use of rank-order tournaments as devices for eliciting effort when monitoring is costly.\(^4\) The winner-take-all effects on which we focus here are exclusively of the former category, the often unintended consequence of structural forces in the marketplace. The conditions that give rise to effects of this type include the following:

- "Cloning," or the ability to reproduce the best performer's product at low marginal cost. Prior to the emergence of television, tennis fans watched matches in person. Because of the physical limitations of time and space, the top-ranked players were simply unable to supply all the exhibitions the market wanted. Accordingly, the market for lesser-ranked players

\(^4\)See, for example, Rosen, 1986.
was strong, and the disparities in earnings between them and the top-ranked players were relatively small.

But modern communications technology has changed all that. Once a tennis match is broadcast over national TV, it costs nothing for an additional household to tune in. This property allows the top players to capture virtually the entire viewing audience. Similarly, once the master recording has been made, it costs no more to transcribe the best soprano's performance onto a compact disc than it does her understudy's. Once the book plates have been produced, the writings of a renowned author are no more costly to reproduce than are those of a hack. If the best performers' efforts can be cloned without limit at low marginal cost, there is ever less room in the market for the lesser-ranked talents.

*Network Economies. In many markets, an input or product is rendered more valuable as greater numbers of other consumers use it. A vivid illustration is the VHS technology's defeat of the competing Beta format in home video recorders. The attraction of VHS over the initial versions of Beta was that it permitted longer recording times. Beta has since corrected this deficiency, and on most important technical dimensions it is now widely regarded as superior to VHS. Yet the initial sales advantage of VHS has proved insuperable. Once the fraction of consumers owning VHS passed a critical threshold, the reasons for choosing VHS became compelling—variety and availability of tape rentals, access to repair facilities, the capability to exchange tapes with friends, and so on.

IBM's MS-DOS format capitalized on a similar network economy. Its initial sales advantage gave software writers a strong incentive to write for the IBM operating system. And the resulting software inventory gave people a strong reason for choosing IBM-compatible products even after otherwise superior machines began to appear in the marketplace.

Network economies are by no means confined to issues of technological compatibility. For example, one valuable part of the experience of reading a book is discussing it with a friend who has also read it. If a book has been widely reviewed and discussed in the media, people have much more reason to read it than they would an otherwise identical book that has not received this
attention. Similar considerations apply to movies, plays, music, sports, and a host of other interactive consumption activities.

Arthur (1988, 1989) has described another process by which an initial winner is likely to have a cumulative advantage in subsequent rounds of the contest. When there are competing technologies in a new industry, the rate at which each of them is improved is related to its prevalence in use. An initial advantage can eventually engender an insurmountable lead. Arthur (1989, p. 126) labels this process "lock-in through learning," and cites the nuclear-reactor technology competition of the 1950s and 1960s and the US steam-versus-petrol car competition in the 1890s as examples.

• Increasing marginal rates of substitution in consumption. A traditional assumption of economic analysis is that indifference curves are convex; the more we consume of something, the less we are willing to sacrifice to obtain additional units of it. In many applications, this assumption is well founded. But there appear to be important exceptions, cases where marginal utility seems to rise with consumption. For example, a melody that irritates on first hearing often grows much more appealing after repeated listenings. And certain kinds of foods are aversive on first exposure, only to become favorites after we get used to them. Few smokers report having liked the taste of their first cigarette, and most drinkers of Scotch whiskey say it took them a while to acquire a taste for it.

Such economies of repetition play an important role in shaping society's consumption menu. When an important news story involving the Soviet Union occurs, the MacNeil-Lehrer News Hour almost always interviews Steven Cohen and Marshall Goldman. Arguably there are many others who are just as knowledgeable about Soviet affairs as these gentlemen are. But viewers are now accustomed to hearing from Cohen and Goldman on such occasions, and that alone is a good reason to stick with them.

---

5 For an extended discussion, see Berlyne, 1971.
6 Moshe Adler, 1987, uses this observation to explain the success of chain restaurants.
7 In like fashion, Adler, 1985, has argued that familiarity may cause stars to emerge from groups of competitors with equal talent.
Where diminishing marginal rates of substitution tend to foster product diversity, increasing marginal rates tend to constrain it. Economies of repetition in consumption narrow the list of products and performers from which we choose, suggesting yet another reason why history matters. Economies of repetition also suggest an underlying rationale for the phenomenon of brand loyalties, whose intensity often appears to transcend all narrowly economic measures of costs and benefits.

**Reward by contest.** Winner-take-all effects are sometimes the almost-literal result of winner-take-all contests. Regulated companies, for example, may be viewed as being in such contests with regulatory authorities over the authorization of rate increases. These contests pit the skills of company lawyers and economists against those of the regulators. The stakes of these proceedings are often extremely high, and the result is intense bidding for the economists and lawyers most likely to influence the outcomes. Similar rent-seeking behavior is triggered by decisions about the locations of attractive new facilities (such as the superconducting supercollider), the recipients of broadcast licenses, tariffs and quotas on imports, and so forth (see Buchanan, Tollison, and Tullock, 1980).

In political elections, the value of the prize that is conferred on the winner and his supporters is not much influenced by the size of the victory margin. To the victor belongs the spoils. The present value of these spoils will depend not only on the power of the position, but also on the value of incumbency in reelection campaigns. If the power of incumbency in Congress has been increasing over recent decades, as appears to be the case, then the winner-take-all effect in Congressional politics has been correspondingly intensified.

**Natural limits on the size of the agenda.** In many product markets, we are either unable to, or simply choose not to, keep track of a host of similar competing products. To simplify our lives, we store in mind the relevant details of at most a few products in each category. Where tennis stars battle for limited access to nationally televised matches, products wage a similar

---

8See, for example, Miller, 1956.
battle for access to limited shelf space in the stores. To win that battle, a product must become one of the few that works its way onto the consumer's agenda.

As in the case of political office, the value of being a "winner" in this contest will depend on how much effort is required to maintain that position once achieved. And once again there is a clear advantage to incumbency.

- **Avoidance of Regret.** The buyer's demand for a front-rank product or service may also stem from a desire to avoid regret over possible adverse outcomes. Thus, for example, someone who buys the highest-rated brand of tires need not second-guess himself when he has an accident caused by a blowout. Similarly, the manager who hires the blue-chip consulting firm insulates himself from the criticism he would face if a regulatory issue were decided adversely. Sometimes, as noted earlier, choosing the premium consultant may be warranted because of the high stakes of the contested issue. But even when the stakes are not high, managers will often want to be able to say they did everything possible when trying to account to their superiors for an unfavorable outcome.

- **Pure Positional Concerns.** Perhaps the simplest of all sources of winner-take-all effects is the value that consumers assign to rank per se. If the quality of all cars were suddenly to fall by half, the owner of a Rolls Royce would still derive the same satisfaction as before from owning a car of the highest quality. By its very nature, the demand for top rank can be satisfied by only a limited number of products in any given category.

National celebrity labor markets provide the most compelling illustrations of winner-take-all effects, but if these were their only manifestation they would not be a central item on the research agenda. Our preliminary analysis of the sources of winner-take-all effects suggests, however, that the phenomenon is much more widespread. Winner-take-all contests crop up in a variety of arenas and with diverse sets of causes and consequences.

---

9See, for example, Frank, 1985.
An examination of the causes of winner-take-all effects also suggests that such effects have become stronger over time. The growing geographical scope of markets, for example, makes it possible for the best producers to clone their products over an ever wider reach. Revolutionary changes in information and communications technology have contributed to the establishment and strengthening of network effects of a variety of sorts. Moreover, the income elasticities of demand for positional consumption and regret avoidance both exceed unity, which means income growth has strengthened these source of winner-take-all effects over time. In the remainder of this section, we examine several individual cases in which winner-take-all effects do, in fact, appear to have increased for the reasons suggested.

Professional Tennis

An examination of the changes in the sources of revenue that support men’s professional tennis players and the distribution of total earnings by rank between the late 1970s and the late 1980s reveals two salient facts. First, the period has seen a large increase in the number of hours of televised professional tennis matches (the principal device whereby the services of top professionals are cloned). As Figure 1 shows, for example, there were more than three times as many hours televised in 1987 as there were just a decade earlier.

---

10 The results that follow were produced in collaboration with Chadwick Meyer as part of his Cornell Economics Honors Thesis in 1988.

The second salient fact is a striking rise in the relative earnings of top-ranked players. As shown in Figure 2, for example, the ratio of average earnings of top-10 players to average earnings of players ranked 41-50 was almost 30 in 1987, up from roughly 12 in 1980.

Most televised tennis matches involve at least 1 player ranked in the top 10. The exposure received by these players has created a lucrative endorsement market, which for the top players often yields annual earnings of several times their tournament winnings. Endorsement earnings fall off sharply outside the top 10, and few players outside the top 50 receive significant cash income from endorsements.¹¹

¹¹Earnings from exhibition matches are not readily available, and thus could not be included in the earnings data reflected in Figure 2. Fragmentary information suggests, however, that exhibition earnings are even more highly skewed than endorsement earnings. For details, see Chadwick Meyer, 1987.
Increasing Concentration of Top Students in Elite Schools

The top brand names in higher education confer on their graduates a distinct advantage in terms of launching and sustaining successful careers. These schools may provide their students with a larger-than-average increment of human capital. But whether or not this is true, graduates of these schools enjoy reputational advantages with employers and with admissions officers for graduate and professional degree programs.\textsuperscript{12} The schools with the reputation of being most selective with respect to academic ability and demanding with respect to coursework attract a vastly disproportionate number of matriculants from among the best of the college applicants, a process that serves to reinforce the reputations of these schools. The elite schools do not capture all the top applicants because other considerations come into play in college choice, especially distance from home and cost. Both of these factors have become less important in recent decades, however, leading more of the best students to matriculate at the elite schools, thereby further strengthening

\textsuperscript{12}See James et al., 1988.
their reputations and attracting still more of the top applicant pool. This process of cumulative advantage has been further augmented by a shift in recruiting practices in the labor markets for top college graduates; as reductions in communications and travel costs have made geography less important, employers for whom it is important to hire the best students have recruited less actively at local schools and more actively at those with national reputations.\textsuperscript{13} This in turn makes attendance at elite schools even more attractive to top students.

Evidence for an increase in the concentration of top students at elite colleges comes from a series of studies by Richard Spies, who found that the probability of a top college applicant applying to at least one of the elite colleges or universities jumped dramatically between 1976 and 1987.\textsuperscript{14} For students with a combined score of 1300 on the SAT, for example, the probability increased from 23\% to about 38\%, with similar jumps for college applicants throughout the range from 1100 on up.

For several reasons, the University of California System is a fruitful context for examining movements of elite students. First, there is widespread agreement on the academic rank ordering of the system's eight campuses: Berkeley is on top, followed closely by UCLA. Second, nonacademic factors play a relatively small role in UC matriculation decisions because tuition is the same at all campuses and because the variation in distance from different campuses is not large. Figure 3 shows the change in the number of elite freshmen (defined as those with SAT verbal scores over 700) matriculating at Berkeley and UCLA in both 1988 and 1980.

\textsuperscript{13}For evidence on this point see Cook and Frank, 1991.

\textsuperscript{14}"Elite" is defined in terms of average SAT scores of the students and total cost of attending for one year. For 1987 the "elite" schools are defined as those with annual cost of $15,000 or more and average SAT scores of 1300. For 1976 the "elite" schools are those with annual cost of $6,000 and 1300 or higher average SAT scores.
Entering Freshmen With SAT Verbal > 700

Figure 3. Elite Students at Berkeley and UCLA, 1980 and 1988.

Between 1980 and 1988, UCLA experienced a relative and absolute decline in the number of elite freshmen; by contrast, both the absolute number and relative share of elite freshmen rose sharply on the Berkeley campus during the same period. The growth in Berkeley's elite population came partly from UCLA and partly from the remaining UC campuses.
We have also found evidence of increasing concentration of members of a nationwide population of highly accomplished science students. Figure 4 shows the number of Westinghouse Talent Search winners attending Ivy League schools during the 1960s, 1970s, and 1980s.

![Bar Chart]

Figure 4. Westinghouse Talent Search Winners Attending Ivy League Schools.

The Publishing Industry

The broadening scope of national and international book markets suggests that winner-take-all effects are also likely to be important in the publishing industry. In the 1950s, most books were sold to the public by independently owned retail establishments. While there was a tendency for these retailers to offer a common core stock of titles, this core was a relatively small share of the total, and the remaining stock tended to differ, often sharply, from one retailer to another. Over
time, the independent retailers have been increasingly displaced by large chains, such as Walden Books and B. Dalton. (See Figure 5.) These chains have centralized purchasing, with the result that bookstores of a given size now tend to offer almost identical stocks of titles.

![Percent of Total Sales]

**Figure 5. Market Share of the Four Largest Book Chains**

This process implies sharply rising skewness in the distribution of payments made to authors over the same period. There is indeed scattered evidence of evidence of such a shift. For example, although the market for little-known authors has continued to stagnate in recent years, the works of best-selling authors have experienced unprecedentedly high demand. In January of 1986, William Morrow and Company gave James Clavell an advance of more than $5,000,000 for rights to his novel, *Whirlwind*. Payments of that magnitude would have been unthinkable in publishing circles just a few years earlier, but have become increasingly common in the years since. Growing skewness in the distribution of payments to authors appears to have been accompanied by increasing dispersion in the distributions of advertising and promotion budgets.
II. The Efficiency Implications of Winner-Take-All Effects

The standard theory of competitive markets identifies conditions under which a general equilibrium is Pareto efficient. In this section we examine the efficiency characteristics of equilibrium in the presence of markets with winner-take-all effects. Will inefficiencies emerge in the winner-take-all case? And if so, what forces prevent Pareto improvements from being brokered by self-interested entrepreneurs?

A complete model for analyzing the winner-take-all effect requires a specification of the rules by which winners are selected, a characterization of the participants with respect to attributes relevant to the contest, and a statement of how the efforts of the participants affect both the magnitudes of the prizes and their respective probabilities of winning. Here we analyze a sequence of simple models to illustrate some of the relevant possibilities.

We begin with a simple two-sector economy that employs a total of $N$ units of a single input, labor. $N_1$ of these units are allocated to sector 1, which exhibits a substantial winner-take all effect. The return to workers in the sector 1 is $w_1$ if they rank among the top $K$ workers in that sector and 0 otherwise, where both $w_1$ and $K$ are invariant to changes in $N_1$. The remaining $N_2 = N - N_1$ units of labor serve in sector 2, where the payoff to each is $w$, $w_1 > w > 0$. This payoff is fixed irrespective of $N_2$. For the sake of concreteness, we may think of sector 1 as the market for professional tennis players; of $K$ as the number of players needed to fill the broadcast hours demanded by the viewing public; of $w_1$ as the revenue (per each of the top $K$ players) from the sale of those broadcast services; and of sector 2 as the market for ordinary production workers.

Model 1

To start with the simplest case, suppose all workers in the winner-take-all sector have the same probability of winning the prize, $K/N_1$. Suppose also that workers are risk neutral. The
equilibrium condition for labor allocation across sectors is that the expected wage in the winner-take-all sector equal the wage in the production sector.\footnote{Strictly speaking, the relevant constraint is the inequality \((K/N_1)w_1 \geq w\). To simplify the exposition we assume the existence of sufficiently many workers in the system that the equality constraint constitutes an acceptably close approximation.}

\[ (K/N_1)w_1 = w, \]  \hspace{2cm} (1)

which solves for

\[ N_1 = K \left( \frac{w_1}{w} \right). \]  \hspace{2cm} (2)

Employment in the production sector will thus be given by

\[ N_2 = N - K(w_1/w). \]  \hspace{2cm} (3)

Total output for this simple economy is given by

\[ GNP = Kw_1 + [N - K(w_1/w)]w = Nw. \]  \hspace{2cm} (4)

Note that the result of open competition for the top slots in the winner-take-all sector is to dissipate the entire product of that sector. GNP takes the same value as it would if the winner-take-all sector didn't exist. Our model 1 economy is similar to models of rent seeking in the government sector, and similar as well to dual labor market models for developing countries.\footnote{See, for example, Buchanan, Tollison, and Tullock, 1980; and Harris and Todaro, 1970.}
Model 2

Moving to a more realistic case, suppose now that the probability of being one of the top K workers in the winner-take-all sector depends partly on talent. Using $T_i$ to denote the $i$th worker's exogenously given talent, $i=1,...,N$, we assume that a worker in sector 1 makes it into the top $K$ in that sector with probability $p(T_i, N_1)$, with $\partial p/\partial T_i > 0$ and $\partial p/\partial N_1 < 0$.

Again assuming risk-neutrality, equilibrium now obtains when workers have distributed themselves across sectors so that

$$p(T^*, N_1)w_1 = w,$$  \hspace{1cm} (5)

where $T^*$ is the talent level of the least talented worker in sector 1. This condition says that the expected return to the least talented worker competing in sector 1 must be the same as his sure return in sector 2. Thus, if talent is distributed according to the density function $f(T)$ shown in Figure 6, workers with $T > T^*$ will go to sector 1, while those with $T < T^*$ go to sector 2.

![Figure 6. The Talent Density and Critical Talent Value, $T^*$](image)

The number of workers in sector 1 will thus be given by

$$N_1 = N [1 - F(T^*)].$$  \hspace{1cm} (6)
Example of Model 2

To see how heterogeneity of talent affects allocative efficiency, we examine specific functional forms for \( p(T_i, N_1) \) and \( f(T_i) \). The probability function \( p(T_i, N_1) \) could take a variety of possible forms. The most extreme form would be \( p(T_i, N_1) = 1.0 \) for the K most talented workers, and 0 for all others. Here, talent not only matters, it is the only thing that matters. Less extreme forms allow other factors to influence the probability of being in the top K. Using \( \mu_{T^*} \) to denote the average talent value of the \( N_1 \) workers in sector 1 (see Figure 6), one such probability function is the following:

\[
p(T_i, N_1) = g(T_i/\mu_{T^*}) (K/N_1),
\]

(7)

where \( 0 \leq g \leq N_1/K, \ g' > 0, \) and \( \int_{T^*}^{\infty} g \, dF = \int_{0}^{T^*} dF. \)

If the \( T_i \) are uniformly distributed on \([0,1]\), \( \mu_{T^*} \) will be given by

\[
\mu_{T^*} = (1+T^*)/2,
\]

(8)

as shown in Figure 7, and \( g \) takes the simple form \( g = T_i/\mu_{T^*} \).

![Figure 7. A Uniform Talent Density](image)

Figure 7. A Uniform Talent Density
Using these forms for the $f$ and $p$ functions, the probability that a worker with talent $T_i > T^*$ will be among the top $K$ workers in sector 1 is given by

$$p(T_i, T^*) = \left( \frac{T_i}{\mu T^*} \right) \left( \frac{K}{N_1} \right) = \left[ \frac{2T_i}{(1+T^*)} \right] \left[ \frac{K}{(1-T^*)N} \right]. \quad (9)$$

For the least talented participant in the winner-take-all sector, $T_i = T^*$, and so:

$$P(T^*, T^*) = \left[ \frac{2T^*}{(1+T^*)} \right] \left[ \frac{K}{(1-T^*)N} \right]. \quad (10)$$

The equilibrium condition thus becomes:

$$\left[ \frac{2T^*}{(1+T^*)} \right] \left[ \frac{K}{(1-T^*)N} \right] w_1 = w, \quad (11)$$

which reduces to

$$NwT^* + 2T^*Kw_1 - Nw = 0. \quad (12)$$

For the illustrative values $K=10$, $w=$$10,000/yr$, $w_1=$$1,000,000/yr$ and $N=2000$, we have:

$$T^* = 0.618; \quad N_1=(1-T^*)2000=764; \quad \text{and} \quad N_2=1236.$$

The total value of output for this version of the Model 2 economy is given by

$$\text{GNP}_2 = $10,000,000 + $12,360,000 = $22,360,000/yr. \quad (13)$$

The corresponding value of GNP in the Model 1 economy, where all contestants have an equal probability of landing in the top $K$ slots in sector 1, is
\[ GNP_1 = Nw = \$20,000,000/yr. \] (14)

In both the Model 1 and Model 2 economies, the maximum possible GNP is achieved by allocating K workers to sector 1 and the remaining N-K workers to sector 2. For the assumed values of N, w, w_1, and K, the result is

\[ GNP^* = Kw_1 + (N-K)w = \$29,900,000. \] (15)

Total product in both the Model 1 and Model 2 economies falls considerably short of this optimal value because in both cases the "losers" in sector 1 produce no output. The size of the prize in sector 1 makes it worth their while to remain there, but the economy as a whole reaps no benefit.\(^{17}\) Note also that the shortfall is greater in Model 1. Because each worker in sector 1 has an equal shot at the top prize in Model 1, the entire surplus from sector 1 in dissipated in that model. Heterogeneity of talent explains why some of the sector 1 surplus survives in Model 2. Because the least talented worker in sector 1 has the same expected earnings as in sector 2, all other workers in sector 1 have higher expected earnings. But while heterogeneity of talent mitigates the allocative efficiency problem, it remains severe even in the particular Model 2 economy examined here, for which the probability of winning was proportional to talent.

**Allocative Efficiency when Success Depends on Effort**

In both of the above models, the worker's decision is simply whether or not he should participate in the WTA sector, given a private (and social) opportunity cost of w. In some settings, however, the participation decision is not binary; rather, participants must decide how much effort

\(^{17}\)The central point is of course much the same if the losers in the winner-take-all sector earn w_2, where 0<w_2<w, as illustrated by the case of aspiring actors who earn their living waiting tables or driving taxicabs.
to expend in the competition, given that winners are determined by relative effort as well as by talent and luck.

The efficiency implications of such contests depend on the rules and circumstances. To illustrate, consider the following simple model in which two equally talented contestants are vying to outrank one another. Suppose that a fixed reward $R$ goes to the winner and that the other contestant gets zero. In the first instance, suppose that each contestant's probability of achieving top rank is equal to his respective share of total investment. We call this the "lottery model" because the relationship between investment and winning probability is like the relationship between the number of lottery tickets bought and the probability of winning a lottery. Letting $A$ and $B$ denote the investments of the two contestants, the expected reward for the first contestant is given by

$$E_A(A,B) = [A/(A+B)]R - A.$$

Assuming Nash-Cournot behavior, the first-order condition for maximum expected return for the first contestant is given by

$$dE_A/dA = [RB - (A+B)^2]/(A+B)^2 = 0,$$

which solves for the optimizing value of $A$ conditional on $B$:

$$A^* = (RB)^{1/2} - B.$$

Because the problem is symmetric, the value of $B$, conditional on $A$, is given by $B^* = (RA)^{1/2} - A$. In equilibrium, it follows that

Thus, in the lottery model of the payoff probabilities, each contestant will invest one quarter of the total reward in an effort to achieve top rank. In the aggregate, half of the potential reward is thus dissipated in the contest. In a market with N contestants, a total of \([N-1]/N\)\(R\) will be dissipated.

The game takes on a very different complexion if top rank goes with probability 1 to the contestant with the largest investment. It is now formally equivalent to the so-called "entrapment" game, whereby a dollar bill is auctioned off to the highest bidder, subject to the proviso that both he and the second-highest bidder remit their respective bids to the auctioneer. Needless to say, the outcome of this game is very sensitive to the behavioral assumptions each player makes about his rivals. In actual experiments involving students with modest incomes, it is not uncommon for the winning bid to be as high as $5.

In any given winner-take-all market, the incentives to invest in achieving front rank will lie between the extremes given by the lottery and entrapment cases. As long as we assume that total output in the winner-take-all sector is fixed, however, the investments in both cases will be excessive from a social welfare standpoint. Deodorant and soft drink producers know perfectly well that only a handful of products will survive in their respective categories. The contestants who land in the winner's circle are assured large rewards. From society's point of view, however, the question of which firms make it is much less important than it is to the contestants themselves.

One assumption that ensures the wastefulness of competitions of this sort is that the payoff does not depend on the number of people competing for the top prize. It is likely, for example, that in the battle between the IRS and corporate tax attorneys, the social value of legal services would not fall significantly if there were only half as many people competing for the top tax attorney positions. In the first place, the average value of the top K members of a random sample of size N grows at a sharply diminishing rate for most distributions. The set of competitors for top corporate tax positions is large to begin with, and would continue to be large even at half its current size. So the top ten percent of the smaller set will be almost as good as the top ten percent of the
larger set. And in any event, it is by no means clear that an absolute decline in the effort or ability of persons pursuing careers in tax law would reduce the social value of output in that sector.

In other cases, however, a reduction in the number of competitors may produce significant reductions in the output of the winner take all sector. For this to happen, the value to society that is produced in the winner-take-all sector must depend on the absolute quality of the top performers in that sector-- as, for example, it surely does in scientific research, where cutting the number of aspiring Nobel laureates by half might eliminate or delay important discoveries.

Using the same assumptions as the simple two-person lottery model outlined above, except that the reward to the winner now depends on the magnitude of his investment, we have:

\[ E_{A}(A,B) = \frac{A(A+B)}{A} R(A) - A, \]  

(20)

where \( R'(A) > 0. \)

One result of this change in the payoff function will be to induce greater effort, in the sense that each of the participants will end up investing more for a given (final) payoff \( R^* \) than is true when \( R \) does not depend on effort. Another important difference is that we cannot conclude (as we could in the simpler model) that the contest will, from a social perspective, result in excess total effort. In some circumstances, the total effort will be less than optimal. An important element of future research will be to calculate "breakeven" values of \( R'(A) \), the values for which private incentives lead to socially optimal effort levels, and to compare these with estimates of \( R'(A) \).

The high-stakes segment of the legal profession is a good illustration of a winner-take-all sector in which the social value of the prize depends at least partly on talent and effort. Well defined property rights, for instance, are an important precondition for economic activity, and it is clear that in some cases the efforts of talented patent attorneys lead to a more sharply defined set of rights. Yet the function of many other talented patent attorneys is to discover ways of subverting this very same set of rights. Thus, as in the legal profession at large, the activities of some
practitioners cause output tp grow, while the activities of others cause it to decline. The sign of the net effect is an empirical question. A recent cross-country comparison suggests that, in the terms of our model, \( R'(A) \) for the legal profession as a whole is less than the breakeven value, which means that the effect of having more lawyers is, on balance, to diminish output.\(^\text{18}\)

This is an especially troubling finding in view of the fact that much of the increased competition for admission to elite schools, discussed earlier, reflects an attempt by top students to enhance their prospects for admission into leading law schools. Starting salaries for the graduates of these law schools have escalated sharply over the last two decades, as has the total number of students entering the legal profession (see Figure 8). During that same period, there has been a sharp decline in the likelihood of students entering doctoral studies. The ratio of doctorates to bachelor's degrees granted by American universities, which was 0.064 in 70-71, is now less than 0.04.\(^\text{19}\) To the extent that winner-take-all incentives are one of the underlying causes of these shifts, there is no presumption that they have been desirable from an efficiency standpoint.

---

\(^{18}\)See Murphy, Shleifer, and Vishny, 1991.

\(^{19}\)See Ehrenberg, 1991. The change in this ratio actually understates the true shift because the proportion of foreign nationals among doctoral students in American universities has increased during recent decades, especially in engineering and the sciences, and many of these students do not remain in the United States.
In economic contests that lead to excessive effort, allocative efficiency can be pursued either by placing direct limits on effort or by modifying the total payoff and the rules for dividing it among contestants. There are a variety of private and public arrangements engendered by dissatisfaction with the results of allowing free entry and unlimited effort in various contests. Examples include the following:

- Sports leagues impose a variety of limits on effort by contestants. Limits have been applied to team rosters, compensation for team members, the number of practices, the kinds of people eligible to participate on teams, the protective equipment that must be worn, and, of course, the behaviors that are acceptable during the game itself. Similarly, campaign finance rules now limit the amount of spending permitted by candidates for the Presidency.²⁰

²⁰Limits on campaign spending are justified in part by the belief that fund raising may prostitute candidates, distorting their positions on policy issues or forcing them to make commitments that do not square with their sense
Some schools require their students to wear uniforms, a practice that has been supported in part by the argument that it eliminates competition for status on the basis of clothing expenditures. Indeed, many forms of conspicuous consumption have been the object of strict limits in a number of cultures, both historically and in the present. A different approach has been to impose special taxes on items that are seen as signals of financial status, as in the luxury tax on diamonds.

Most societies regulate safety in the workplace and also employ both public and private forced savings programs. Among the many possible effects of such programs, one is to limit the extent to which people can employ either the monetary rewards from risky jobs or their retirement savings to bid for positional consumption items.\(^{21}\)

IV. Implications for Distribution Policy

Winner-take-all effects have implications not only for efficiency but also for distribution. The marginal productivity theory of factor payments has never pretended to justify market income distributions on ethical grounds. Even so, many find it at least ethically acceptable that individuals be rewarded in proportion to their efforts and abilities. Winner-take-all effects suggest, however, that market-determined pay distributions will be much more highly skewed than the underlying distributions of effort and ability. And this realization may affect the extent to which society tries to alter market distributions in the name of fairness.

According to John Rawls, a distribution is fair if the institutional arrangements that gave rise to it would have been freely chosen by self-interested individuals behind a veil of ignorance.\(^{22}\) Rawls argued that such individuals would choose rules that would permit inequality in the interest of raising the total value of output, but only up to a point. In his view, additional inequality would be chosen if and only if it increased the income of society's poorest member. Although Rawls's

\(^{21}\) For a discussion of this interpretation, see Frank, 1985, chapter 7.

\(^{22}\) Rawls, 1971
critics have characterized this particular feature of his argument as requiring implausibly risk averse preferences on the part of the hypothetical social contractors, there is general consensus that rules chosen behind a veil of ignorance would impose substantial constraints on inequality.

The widespread existence of winner-take-all effects sharply reinforces this conclusion. The pronounced bifurcation in market rewards to those inside and outside the winner's circle constitutes a high-stakes lottery that very few people would enter voluntarily. If the issue were decided behind a veil of ignorance, only minimal risk aversion would be required to generate rules calling for substantial redistribution.

There is an additional ironic twist in the case of social efforts to smooth winner-take-all effects. In the Rawlsian context, increases in equality are in general associated with reductions in the total value of output. In the case of winner-take-all effects, by contrast, the effect of distributional smoothing may actually be to enhance efficiency.

By way of illustration, consider again our two-sector economy that employs a fixed quantity of a single input, labor, where the top K workers in sector 1 receive $w_1$, and the remaining $N_1-K$ receive 0. Both $w_1$ and the absolute number of winners are invariant to the quantity of labor allocated to that sector. The payoff in sector 2 is again $w$, where $w_1 > w > 0$.

For simplicity, assume all workers are of equal talent (our Model 1 economy again), so that labor will move to sector 1 until the expected payoff there is equal to $w$. Now suppose that $w_1$ is taxed at the rate $t$, such that $w_1(1-t) > w$. The effect of this tax will be to shift labor to sector 2, where it will increase aggregate output at the rate of $w$ per unit. There will be no offsetting decline in the total value of output produced in the first sector.

With a tax rate $t$ imposed on $w_1$, the equilibrium condition becomes

$$\left(\frac{K}{N_1}\right) [w_1(1-t)] = w$$

which solves for

$$N_1' = K[(w_1(1-t))/w]$$
and

$$N_2' = N - K[(w_1(1-t))/w].$$  \hspace{1cm} (23)

The total value of output for the economy is now given by

$$GNP = Kw_1 + (N - K[(w_1(1-t))/w])w = Nw + Kw_1t.$$ \hspace{1cm} (24)

For the illustrative values, $N=2000$, $K=10$, $w_1=1,000,000/yr$, and $w=10,000/yr$, we have the relationship shown in Figure 9.

![Graph showing GNP vs. Tax Rate on WTA earnings](image)

**Figure 9. GNP vs. Tax Rate on Winner-Take-All Earnings**

The model just discussed assumes that the output of the winner-take-all sector is the same irrespective of the number of people who compete for the top positions. As noted earlier, however, similar conclusions will often obtain even in models in which output in the winner take all sector is positively related to the number of competitors.

Most societies have in fact adopted a variety of practices that diffuse the concentration of top prizes. In college and professional football and basketball, television revenues from the regular
season broadcasts are shared equally by teams that are members of the relevant "clubs." On a broader scale, the progressive income tax, and wealth and inheritance taxes, place limits on the top prizes. These measures are often defended on equity grounds, but they are also desirable from the perspective of allocative efficiency if they reduce effort to achieve high rank in what is largely a zero sum game.

Concluding Remarks

Winner-take-all effects are both a widespread and growing feature in modern economies. In the contests to reach the top of the pyramid in investment banking, corporate law, entertainment, sports, and a host of other fields, these effects lead invariably to intensive rent seeking and, in many cases, to an inefficient allocation of resources.

Economists and other social scientists have traditionally emphasized that proponents of egalitarian tax policies confront an agonizing tradeoff between equity and efficiency. We have argued, however, that winner-take-all effects call this claim into question. Indeed, taxation of the highest rewards in many specific winner-take-all markets is more likely to enhance efficiency than to impede it.

In view of their growing incidence and importance, winner-take-all effects merit high priority on the economics research agenda.

---

23 In recent years, the schools with the strongest football records have broken away from the NCAA television agreement to form a league of their own, the CFA. More recently, Notre Dame signed an independent contract for the broadcast rights to its football games. In each case the effect has been to concentrate television revenues in the hands of a smaller number of participants.
Bibliography


