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THE ECONOMICS OF A "HAPPENING": SPRING SMELT FISHING ON LAKE SUPERIOR

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Introduction

Since the 1960's the word "happening" has come to refer to a coming together of a group of people for a common purpose or event such as the marches on Washington or Woodstock. A similar situation arises in the case of certain recreational activities that occur on an annual basis and which involve the influx of a large number of people into specific locations. One such "happening" occurs each spring when thousands flock to the North Shore of Lake Superior to participate in smelt fishing, one of the rites of spring in the Northland. As with similar events (e.g., spring vacation in Fort Lauderdale and the grunion run on the West Coast), the participants tend to be younger than the residents of the communities near where such activities take place. In the case of the smelt run on Lake Superior, the citizens of Duluth have been disconcerted by the influx of out-of-town smelters and serious consideration has been given to banning the activity.

While any "happening" may have important psychological and sociological significance, it is the recreational version which poses the most interesting economic issues. For instance, in Duluth, the determination by Laundergan [9], that smelters made only nominal purchases in the area reinforced the prevailing local view (e.g., Blubaugh [1]) and gave impetus to the movement to have the smelting activity banned. Recognizing that such an inference was incomplete and unwarranted, the authors undertook a study, which was supported by the Sea Grant Program, to provide a complete accounting of the social costs and benefits of the smelting activity. In addition to reporting on the study's results, which lead to the conclusion that smelting should not be banned, this paper will introduce methods dveloped to disaggregate the benefits and costs involved for various age groups. It will be shown that this approach provides a useful method of analyzing not only smelting, but any "happening," where the benefits tend to accrue to the young while costs are incurred by older people.

Estimation of Benefits

The smelting situation, like most other "happenings," consists of participants (smelters) who receive benefits for which they do not pay and non-participants (residents) who sustain costs for which they are not compensated. These unpaid benefits and uncompensated costs represent positive and negative externalities, respectively, since they occur outside of voluntary exchange or a market. Where such extensive externalities exist, benefit-cost analysis (e.g., Eckstein [6] and Mishan [11]) may be utilized to answer resource allocation questions. This paper will extend this framework in order to answer distributional questions that arise between the various age groups involved. Specifically, the benefits, to be determined in this section, will be evaluated which accrue to each of the various age groups and in the next section, corresponding age specific costs will be determined and compared to the benefits.

In assessing the social benefits of a recreational activity or other free good, it must be recognized that the economic impact of the participants on the commun-

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ity near which the activity takes place are not legitimate benefits from the standpoint of society. For instance, it was noted that the discovery that smelters spent very little in Duluth suggested to some the conclusion that the activity should be banned. In the cost benefit framework, which determines whether an activity is cost beneficial from the standpoint of society and not just the host community, such expenditures (e.g., restaurants, hotels, gasoline, and supplies) are not legitimate social benefits. The reason is that while these expenditures may benefit the host community (Duluth) they do not represent a net social benefit to society, but only a transfer from one area to another. Furthermore, this remains true both for the direct expenditures and the indirect economic effects,[1] which together are often referred to as economic impacts by regional economists.

While such economic impacts are not appropriate in the benefit-cost framework, other aspects of smelting need to be considered and measured. The most obvious tangible benefit would be the food value of the fish taken by smelters since clearly this would be entirely lost[2] if the smelting activity were to be banned. A survey conducted as part of the study suggests that smelt fishermen annually catch smelt which have a value of $560,000 (100,000 × smelter days × 16 pounds/day × $0.35/pound).

While the value of fish caught can be determined from direct market prices, the value of the second, and most important, social benefit must be measured indirectly. This second source of benefits accrues to smelters as a result of participating in a high spirited, "happening" type, activity or event. In analyzing a recreational activity using the benefit-cost framework this benefit of the experience, which is to be measured by participants' "willingness-to-pay", often proves most important. In fact, it can be assumed that smelters will have taken account of the value of the fish caught in determining what they would (or will) be willing to pay if they had been (or are) charged to partake in the activity or happening. In strict economic terms it is necessary to measure this "willingness-to-pay" by estimating the demand relation for smelting and then calculate the consumer surplus from this demand curve.

Since the smelting activity requires access to common property resources, a fishery located at a number of river mouths, these resources do not command a price. The estimation of a demand curve cannot be based upon the usual direct econometric techniques (e.g., Wold and Jureen [17]) since neither time series (i.e., various year) nor cross-sectional (i.e., various smelting locations) data are available where varying fees for smelting have been levied. Consequently, it is necessary to use an indirect method of demand estimation. One such technique involves surveying users and asking them what they would have to be paid if they were to sell their right to smelt for one year. The weakness of this approach is that it requires the user to consider and respond to a hypothetical situation (i.e., of various possible fees). The second is more widely accepted in resource or recreation economics (e.g., Burt and Brewer [2], Cicchetti, Fisher, and Smith [3], Krutilla

[1] Such indirect effects are usually determined by taking the direct effects, sometimes referred to as final demand, and inflating them using industry specific multipliers derived from an input-output table for the region being studied.

[2] This assumption is valid for smelt since currently they are not being depleted and so recreational smelt fishermen do not "compete" with commercial fishermen for smelt. For other species (e.g., lake trout) this might not be true and so the entire value of fish caught by recreational fishermen could not be considered as a social benefit.

and Knetsch [8], Merewitz [10], and Vickerman [16]. This technique has been applied specifically to evaluate a fishery by Ellefson [7], Pearce [12], and Smith and Kavanagh [14]), because it relies on direct, not hypothetical, observation. This approach was advanced by Clawson and Knetsch [4], though various authors (e.g., Burt and Brewer [2] and Cicchetti, Fisher, and Smith [3]) attribute the procedure originally to a suggestion made by Harold Hotelling in 1947 to the U.S. National Park Service in an unpublished letter. In essence, this procedure involves using travel costs as surrogates for prices in estimating the demand relation.

In the study of smelting both approaches were employed, but most of the analysis will be based on the "travel cost" method since it is the more widely accepted procedure. Surveys of smelters and non-smelters (residents of Duluth) were conducted as part of the study and a hypothetical question was posed asking what smelters would accept to give up their right to smelt for a year. The mean response for smelters was $114.16, which represents one measure of the value smelters attach to partaking in the activity. If multiplied by the total number of smelters it would be possible to measure the social benefits of smelting from this question. It is interesting to note that when non-smelters were asked the same question the mean response was only $41.11. This dramatically indicates the vast difference between the two groups in their perception of the other's position. It suggests that in most "happenings," or any form of recreation (e.g., snowmobiling or backpacking), the non-participants considerably underestimate the value that participants attach to their participation in the activity.

The second, and more widely used method for determining benefits, involves inferring or estimating a demand relation for smelting from observation of declining participation rates from various locations (87 counties of Minnesota) which are more distant from the activity site (Duluth). After inflating the sample results to the estimated[3] total number of smelter days (100,000), a participation rate for each county (Q_{PR}) was arrived at by dividing the (inflated) number of smelters from each county by the population of each county. Following the Clawson procedure a regression equation was then estimated:

$$(1)\quad Q_{PR} = .1036 - .000508D \qquad R^2 = .21$$
$$(5.28 \quad (-4.79) \quad \text{(t-value)}$$

which can be termed the participation rate demand relation or curve which estimates how participation rates decline with distance (a proxy for price).

In order to obtain the demand equation for Duluth (or any other county or area) it is necessary to multiply equation (1) through by the population of Duluth, 100,578. The result is:

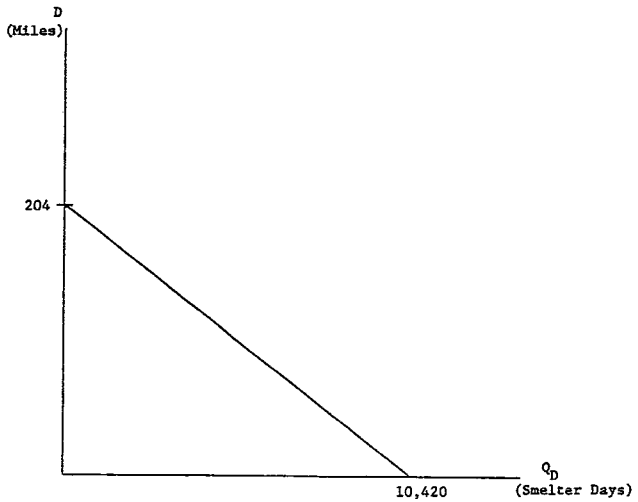
$$(2)\quad Q_D = 10{,}420 - 51.1D$$

which can be interpreted as representing what number of people in Duluth would smelt (Q_D) if the site were located at various distances (D). That is, this is Duluth's demand for smelting which has been graphed in Figure 1 (with D on the Y axis). The D intercept indicates that no one from Duluth would smelt if the smelting site

[3] The estimate of total number of smelter days was arrived at using a multiple regression model based on time series traffic count data and was confirmed by local Minnesota Department of Natural Resources field officers. For details of the traffic count model see Raab and Steinnes [13].

were further away than 204 miles (i.e., demand would be zero at a price of 204 miles).

FIGURE 1. Duluth Demand for Smelting



Given the demand relation, equation (2) or Figure 1, there are two alternative ways of measuring willingness to pay or the value of smelting[4] for Duluthians. The first is the consumer surplus method which determines the area under the Duluth demand curve in Figure 1. This area equals 1,062,840 miles and represents the distance each smelter in Duluth would travel if each smelter were to be required to travel as far individually as he would be willing to. The consumer surplus may also be interpreted as the revenue a discriminating monopolist might generate from such a demand relation. An alternative way to measure the value of smelting is to determine the price (or Mileage D) which a nondiscriminating monopolist might charge. This is the distance (D) which maximizes $D \cdot Q_D$, or in a standard demand relation, the price that maximizes total revenue. Given the linear specification of equation (2) this will always be half of the consumer surplus and so only measures of consumer surplus will be made.[5]

[4] For further discussion of the difficulties in interpreting these measures or values, see [4].

[5] The choice of a simple linear specification of equation (1) results in a somewhat low R^2 and a significant t-value, which is not unusual in cross-section regression analysis. While a nonlinear and/or multiple regression specification would improve the "fit" (i.e., R^2), the loss in interpretation and simplicity would be substantial. For example, in order to estimate the consumer surplus, equation (1) would have to be integrated using numerical analysis (see, for example, Steinnes and Snow [15]). It will be seen that disaggregating equation (1) by age does improve the explanation and yet retain the illustrative simple linear specification.

Since it has been determined that by having smelting in Duluth the people in Duluth who smelt "save" 1,067,840 miles of travel which they would be willing to undertake in order to smelt, it remains to convert these miles "saved" into dollars. It is these dollars that are to be considered as benefits in the benefit-cost framework. In order to illustrate these benefits for different travel costs (per mile), Table 1 has been prepared. It shows that at a conservative 5c/mile the benefits are $53,142, while at 25c/mile they amount to $265,710. Since the underlying demand relation is linear it would be possible to reevaluate benefits for alternative assumptions of total smelter days (rather than 100,000) by multiplying the benefits by ratio of the alternative assumption of smelter days to 100,000. It should be noted that the D variable is one-way distance but we have not doubled the miles "saved." This is to offset another assumption which is that smelters on the average make a two day trip. Hence, mileage per smelter day is the one-way distance. Alternative assumptions regarding days per trip and/or persons per vehicle could also be evaluated using the same estimated regression equation (1).

TABLE 1. Economic Benefits of Smelting for Duluthians (based on 1,067,840 miles)

Travel Cost (Per Person)	Value*
5¢/mile	$ 53,142
10¢/mile	106,284
15¢/mile	159,426
20¢/mile	212,568
25¢/mile	265,710

* Based on assumption of 100,000 total smelter days and 2 smelter days per trip.

The above analysis has only attempted to calculate or estimate the value of the smelting experience for Duluthians. Obviously, it follows that some additional consumer surplus accrues to smelters from other areas of the state (up to 204 miles away). It is possible to extend the method (e.g., see Merewitz [10]) in order to measure the statewide benefit or value of the Duluth recreational smelt fishery. However, in this paper only the Duluth benefits (and costs) will be considered though the conclusion, that benefits exceed costs, would not be affected if the extension were made.

Since it was suggested earlier in the paper that the distribution of these benefits does not accrue equally to all Duluthians, an attempt will now be made to estimate benefits for five different age groups. The choice of these age groupings was dictated by the available data. The approach employed is tc estimate a separate participation rate demand relation (like equation (1) using 87 counties as observations) and Duluth demand relation (like equation (2)) for each age group and then calculate the consumer surplus for each curve or relation. The decision to estimate separate relations, rather than a relation with dummy variables, was based on testing and accepting an assumption that the slopes (i.e., regression coefficients for D) are different for each group.

The participation rate regression equations for the five age groups are:

Age Group 1 (Under 18 Years):

(1.1) $Q_{PR1} = .027 - .000135D \qquad R^2 = .19$
(4.95) (−4.53) (t-value)

Age Group 2 (18-25 Years):

(1.2) $Q_{PR2} = .51 - .00251D \qquad R^2 = .19$
(4.99) (4.54) (t-value)

Age Group 3 (25-40 Years):

(1.3) $Q_{PR3} = .163 - .000795D \qquad R^2 = .22$
(5.50) (−4.97) (t-value)

Age Group 4 (40-55 Years):

(1.4) $Q_{PR4} = .078 - .000372D \qquad R^2 = .24$
(5.87) (−5.19) (t-value)

Age Group 5 (Over 55):

(1.5) $Q_{PR5} = .030 - .000149D \qquad R^2 = .21$
(5.31) (−4.84) (t-value)

These equations were then multiplied by the Duluth population (in each age group) to arrive at Duluth demand equations for each age group (like equation (2)):

Age Group 1:

(2.1) $Q_{D1} = 886 - 4.35D$

Age Group 2:

(2.2) $Q_{D2} = 5044 - 24.7D$

Age Group 3:

(2.3) $Q_{D3} = 2311 - 11.25D$

Age Group 4:

(2.4) $Q_{D4} = 1572 - 7.5D$

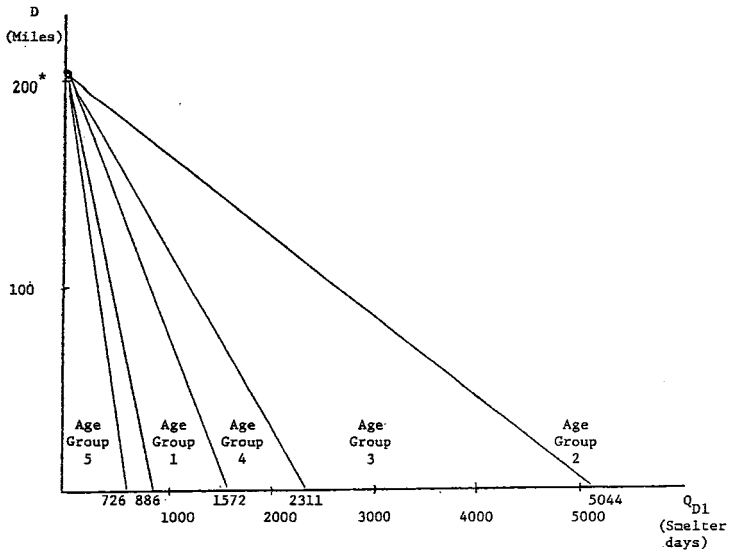
Age Group 5:

(2.5) $Q_{D5} = 726 - 3.6D$

These are the various Duluth demand relations for each age group and are graphed in Figure 2 (with D on the Y axis as in Figure 1).

In order to estimate the value of smelting for each age group in Duluth, it is necessary to calculate the area under each curve in Figure 2 (i.e., the consumer's surplus for each group). This has been done and the results are in Table 2. The total benefits here are 1,080,852 miles, which is quite close to the total arrived at by using Figure 1, 1,067,840 miles. What is revealed by Table 2 is that clearly most of the benefits (i.e., 515,528 miles saved) accrue to Age Group 2, 18-25 years, which is as expected. That is, smelting is a "happening" type activity valued by the young more than the old. Of course, these benefits or consumer surpluses measured in miles "saved" could be converted to dollars as in Table 1.

FIGURE 2. Duluth Demands for Smelting (by age groups)



* These intercepts are slightly different for each age group but range between 201 and 210. There was no attempt made to standardize the intercepts.

Estimation of Costs and the Benefit Cost Analysis

The estimation of costs is not as difficult because they are explicit amounts. These costs, commonly called spillover costs (e.g., in Coase [5]), would include: 1) congestion which results from large numbers of out-of-town smelters converging on the North Shore communities; 2) the accumulation of garbage and debris left at the smelting site; 3) the property damage which takes place. Since no dollar amount can be established for these problems, they can be evaluated by the public efforts expended in preventing them. The government efforts in the form of increased law enforcement, provision of sanitation facilities, and trash & garbage clean-up, were $19,164 for all of the Minnesota shore of Lake Superior according to figures provided by the Minnesota Department of Natural Resources; the Duluth area share of the expenditures was approximately $7,910. In addition, the social costs of resident property damage must also be calculated. Through a survey of residents in the smelting area, it was estimated that the out-of-pocket damage to Duluth's property is $9,189 and so the total estimate of costs to Duluth area residents based upon the above stated assumptions totals $17,099. These costs must now be combined with benefits to obtain the trade-off between local benefits and total costs.

Cost-benefit analysis is usually used only to analyze the question of efficient resource allocation. In the benefit-cost framework if the benefits clearly exceed the costs then the activity, carried on at the present level or expanded, is justified. The allocation question in benefit-cost analysis, however, does not normally address the distribution of the benefits and costs. In order to analyze the age distributional effects of a "happening," this paper will determine benefits, costs, and a benefit-cost ratio for each age group.

TABLE 2. Economic Benefits (in miles) of Smelting for Duluthians by Age Group.

Age Group	Consumer Surplus* (In Miles)
1	90,230
2	515,528
3	237,253
4	164,638
5	73,203
Total for all Age Groups	1,080,852
Total Based on Figure 1	1,067,840

* Based on assumption of 100,000 total smelter days and 2 smelter days per trip.

In terms of smelting, the total benefits to Duluthians have been estimated as being in excess of $150,000 while the costs have been estimated at less than $20,000. Clearly the total social benefits to Duluthians of the smelting activity greatly exceed the total social costs. Thus, the activity should be carried on at least at its present level or greater levels if society is going to achieve an efficient use of the existing resource. The specific numbers involved are contained in Table 3 along with the overall benefit-cost ratio of 9.48.

While the overall benefit-cost ratio provides a clear answer to the allocation issue, it does not reveal the differences among age groups in benefits and costs which is typical of "happenings". Hence, Table 3 also provides an age breakdown of benefits (from the last section) and costs. The property damage breakdown by age was determined from a survey of homeowners in Duluth. This same age distribution was also used to allocate public costs among the age groups on the assumption that most of such costs are collected by the property tax and the age distribution of such taxes would match the age distribution of homeowners. The only difficulty with the procedure is that no costs are allocated to the lowest age group (0-18) since they are not homeowners.

As is apparent from Table 3, the youngest two age groups have the highest benefit-cost ratio as was anticipated. Likewise, the ratios of middle-age groups (26-40 and 41-55) are relatively low, but still greater than one. Perhaps most surprising is the high benefit-cost ratio for the oldest age group (over 56) which suggests this group is one of the largest beneficiaries of the smelting activity. Aside from this latter group, the age results reveal what is believed to be a typical pattern for a "happening" — the benefits accrue to the young and the costs are borne by the old. The results confirm that the opponents of the smelting activity are those who benefit least, while the supporters or participants who benefit most tend to be younger. Usually the latter group is ineffective in arguing their case even though there is economic justification for continuing the activity.

Conclusion

An attempt has been made in this paper to measure certain individual, as opposed to business, benefits of smelting which have not been considered or properly measured in the perennial debate as to whether smelting is good or bad for Duluth. It is believed that the distinction between "consumer surplus" benefits

TABLE 3. Benefit-Cost Analysis of Smelt Fishing

Age Group	(Under 18)	(18-25)	(26-40)	(41-55)	(Over 56)	Overall
Benefits:*						
(%)	8.35	47.70	21.95	15.23	6.77	100
(Dollars)	$13,535	$77,329	$35,588	$24,696	$10,980	$162,128
Costs:+						
(%)	0	4.4	25.4	69.45	.75	100
Property Damage	0	$ 402	2,332	6,386	69	$ 9,189
Public Costs	0	$ 348	2,009	5,494	59	$ 7,910
Total Costs	0	$ 750	$ 4,341	$11,880	$ 128	$ 17,099
Benefit-Cost Ratio	∞	103	8	2	86	9.48

* The benefits are derived from the demand relations estimated in the last section and using 15c/mile.

** The property damage costs are based on damages for each age group as determined from a survey of Duluth homeowners.

and economic impacts is often not understood when states or localities consider banning "happening" type events. The results suggest that banning smelting is unjustified on economic grounds and it remains for Duluth or the state to determine if and to what extent smelters should be assessed for the benefits they derive by a tax or some other means.

One primary result of this paper has been the econometric estimation of the demand relations for recreational smelting, which not only provides a means of valuing the recreational experience (as has been demonstrated in this paper by valuing consumer surplus) but can also prove useful in evaluating possible tax or licensing schemes.

In addition, the estimation of demand (and consumer surplus) for various age groups has verified in economic terms that it is the young age group (18-25 years) which values the smelting "happening" most highly. It follows that they stand to be the biggest losers if the activity should be banned, but to date they have been relatively silent in the local debate over smelting. Most discussion or opposition to smelting has been initiated by property owners, which is understandable given they tend to be in the older age groups and so receive relatively little of the recreational value of smelting and incur most of the costs. Such an age disparity between benefits and costs is characteristic of a "happening" and provides an economic rationale for the sides taken by the different age groups in disputes which often arise as to whether a "happening" should be banned or allowed to take place.

[6] Alternatives would be to allocate public cost on a per capita basis or on the basis of income. The former would allocate more costs to the young while the latter would allocate less to this group than the procedure adopted.

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