A Welfare Economic Analysis of the Potential Competition Between Hunting and Cattle Ranching

William E. Martin, J. Craig Tinney, and Russell L. Gum

Comparable empirical estimates of the market and nonmarket values of range cattle production and hunting activity on the same land are developed in the welfare economic framework of consumers' surplus, producers' surplus, and the corresponding Hicksian consumer welfare measures.

The values are compared to illustrate possible trade-offs that would occur under potential conflict among users of the land resource. The welfare distribution issue is examined both in terms of aggregate and individual compensation that could occur between the alternative users.

In a recent article outlining problems and solutions in estimating demand for and value of rural outdoor recreation, Gum and Martin (1975) conclude: "Given that decisions about alternative uses of natural resources are being made everyday, that one of these alternative uses is the nonpriced good of outdoor recreation, [and] that reasonable estimates of the demand for and value of outdoor recreation can be made on a rather large-scale basis, ... a very practical conceptual problem remains. Exactly how may the prices and values derived for this nonpriced good be compared to the prices and values estimated for market priced uses of the natural resource base such as use for timber, grazing, and water runoff?" (p. 566). They argued that the time has come to relax the search for improved methods of estimation and to concentrate on interpretation of the estimates in studies of resource allocation.

This paper is a contribution to the interpretation issue. The purpose is to generate comparable values of a land resource used in two potentially conflicting production activities: cattle ranching and hunting. Since the transformation function for the two products from the given resource remains unsolved, the purpose of the paper is not to prescribe the optimum combination of products to produce, but rather to describe the values of the two activities in an "as is" situation to the consumers of the activities. Such information should prove useful to policymakers in terms of specifying the magnitude of the potential conflict among users of the land resource.

The question of comparable values for cattle ranching and rural outdoor recreation on a given land base is of particular interest in Arizona where so much of the state is under public ownership and is to be managed for the public good. Only 17.6 percent of Arizona lands are in private ownership. Federal and state agencies which have a management interest in the public lands include the U.S. Forest Service, the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs, the Arizona State Land Department and the Arizona Department of Game and Fish. Of major interest in each agency is the allowable level of cattle grazing,

William E. Martin is Professor of Agricultural Economics, University of Arizona; J. Craig Tinney is Agricultural Economist, Natural Resources Economics Division, Economics, Statistics and Cooperatives Service, USDA; and Russell L. Gum is Agricultural Economist, Natural Resources Economics Division, Economics, Statistics, and Cooperatives Service, USDA, and Adjunct Professor of Agricultural Economics, University of Arizona.

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the level at which game species should be encouraged, and the level of public access for hunting and other recreational activities.

Concepts

Economic Value

A market good's gross value can be described for any given time period as price times quantity. Outdoor recreation often is a nonmarket good with an observable quantity but a zero price. Obviously, however, its value is not zero for that given time period. Thus, the question of comparable values is raised.

Statistical demand schedules may be estimated for market goods, showing the alternative quantities that would be purchased at alternative prices. Demand schedules for nonmarket goods, such as outdoor recreation, now can be developed through a variety of procedures. Examples include the Clawson-Hotelling approach, the household production function approach, the Pearse approach, and bidding games. But the question of what quantity to choose so as to select an associated price remains since the only observed quantity was at zero price.

Some earlier authors, including Brown, Singh and Castle and later on Martin, Gum and Smith, argued that the quantity question could be solved by choosing that quantity which would yield the nondiscriminating monopolist value; that is, the maximum value that could be extracted by a single monopolistic owner of the resource charging a single nondiscriminating price. The advantage of this procedure is that a single price times quantity value can be estimated, and that this value presumably would be somewhat comparable to values generated by privately produced market goods. The disadvantages are obvious — why use a monopolist's price for a public good when comparing that price to the price of a good in a competitive market? Further, and more importantly, one is really looking for values to be used in welfare analysis where the assumption of monopoly for all alternative products is inappropriate. The alternative to the nondiscriminating monopolist value is the value of consumers' surplus.

Consumers' Surplus

Given that economic values are desired to measure benefits in a social cost-benefit calculation, Mishan concludes that most contemporary economists would agree that the concept of consumers' surplus yields the relevant economic value for both market and nonmarket goods. What is sought is not a simple price times quantity, but rather the value of a price-quantity *change*, expressed in terms of additions to or subtractions from consumers' income, required to return the consumer to his original utility position or to maintain his new utility position. These values are measures of net income impacts, and are clearly better measures of "economic value" than simple gross values of price times quantity.

Hicks (1943) identified four ways of defining consumers' surplus, each giving one value for a price rise and another value for a price fall. These measures, as defined and illustrated in Currie *et. al.* (1971), are compensating variation (CV), compensating surplus (CS), equivalent variation (EV) and equivalent surplus (ES). As Randall states:

> The *equivalent* measures are defined as the amount of compensation, paid or received, which would bring the consumer to his *subsequent* welfare level *if the change did not take place.*
>
> The *compensating* measures are defined as the amount of compensation, paid or received, which would keep the consumer at his *initial* welfare level *after the changes had taken place.*

The *compensating* measures assume that the consumer has a right to his initial welfare position. The *equivalent* measures assume a right to the subsequent welfare position. Further, the *variation* measures are defined to allow the consumer to make optimizing adjustments in response to the price change while the *surplus* measures are defined with the quantity of the good taken constrained.

Unfortunately, none of these concepts can

be observed and measured in the real world. However, the simple Marshallian consumers' surplus (the integral under the ordinary Marshallian demand curve, lying above the price line for market priced goods) can be estimated, as demand schedules can be statistically estimated. The question is then, what is the relationship among the four measures of consumer surplus defined by Hicks (CV, EV, CS, ES) and the simple Marshallian consumers' surplus? It can be shown [Randall] that for normal goods: EV for a price rise = CV for a price fall; and CV for a price rise = EV for a price fall. For a price rise, ES<EV<simple Marshallian consumers' surplus<CV<CS. For a price fall, ES>EV>simple Marshallian consumers' surplus>CV>CS.

In the past, differences in values between the four measures and the simple Marshallian measure of the area under the demand curve usually were presumed to be small, but no one really knew the exact relationship. Many, if not most, analysts were confused and unwilling to accept the simple Marshallian measurement of consumers' surplus as satisfactory. However, recent work by Willig promises to remove much of the confusion and allows superior estimates of EV and CV.

The Rehabilitation of Consumer Surplus

Willig offers explicit formulas for estimating CV and EV as a function of the Marshallian measure of consumers' surplus defined as the area under the ordinary demand curve and between two prices. Further, he shows that where A = consumer's surplus area under the demand curve and between the two prices (positive for a price increase and negative for a price decrease), CV = compensating variation corresponding to the price change, EV = equivalent variation corresponding to the price change, m^o = consumer's base income, and n = a single constant estimate of the income elasticity of demand over a region under consideration,

then

$$CV \approx A + \frac{nA^2}{2m^o} \text{ and } EV \approx A - \frac{nA^2}{2m^o}.$$

Further, where the consumer's income elasticity is in the range of ±1.0, and "if the surplus area under the demand curve between the old and new prices is 5 percent of income [or less], then the compensating variation is within 2 percent of the measured consumer's surplus."

Thus, as a practical matter, the simple Marshallian measure is usually adequate to compare two estimates of surplus value, since it is rare for income elasticities to be greater than ±1.0 or for 5 percent of a person's income to be spent on a single commodity. In addition, it is difficult to estimate a statistical demand function to a degree of precision such that a 2 or 3 percent change in value would have real meaning.

Of course, Willig's results, strictly interpreted, apply only to an individual consumer — not to a group of consumers. Still, in the interest of some approximate statement, if one can assume that the indifference maps of individuals in the affected group are not radically different, the surplus of the group may be estimated. Our estimates for beef and recreation, produced on the same Arizona land base follow.

Changes in Consumers' Surplus from a Reduction in Arizona Beef Production

Beef calf production on Arizona land is not for final consumption. The calf only becomes a product for final consumption after being fed and converted to beef. If we assume there are no substitutes for feeder cattle in beef production, the Arizona calf crop can be evaluated in terms of its retail beef yield.[1] It is assumed that all saleable beef calves convert to choice steers of the average slaughter

[1] Schmalensee argues that under conditions of pure competition consumers' surplus related to a change in an input price is identical at the derived demand and the consumer demand level. Under nonpure competition, consumers' surplus is underestimated at the derived demand level. For both ease of estimation and direct interpretation of the results, we estimate consumers' surplus at the consumer demand level where it is directly comparable to consumer demand for hunting.

weights as reported in "Livestock and Meat Statistics" [U.S. Department of Agriculture].

In 1970, Arizona retail beef yield represented 0.67 percent of total U.S. retail beef production. This percentage declined to 0.54 in 1975. A posited one hundred percent reduction in Arizona beef production is small enough that a linear demand curve for retail beef can be assumed over the segment describing the price-quantity change. A single estimate of price flexibility is used to measure the change in price resulting from a change in quantity.

Past estimates for price flexibility of retail beef as summarized by Ginn, include: Schultz, −2.44; Working, −0.89; Fox, −1.06; Brandow, −1.15; and George and King, −1.55. The differing values could be a function of either different model specification, or the change in the demand for beef over time, or both. The estimate used in this report, −1.71, was derived from a national fed beef demand curve estimated by the authors.[2]

The estimate of change in quantity of U.S. retail beef resulting from a total reduction of the Arizona beef calf crop was made as follows. Number of total U.S. cattle slaughtered [USDA] and Arizona cattle slaughtered [Archer] were converted to pounds of retail beef by assuming an average conversion rate of liveweight to retail weight of 2.25 to 1 [Uvacek] applied to estimates of the average liveweight of animals slaughtered [USDA]. Total 1970 U.S. production of retail beef was 16,262.84 million pounds. The Arizona component was 108.56 million pounds.

The estimate for price flexibility of retail beef multiplied by the percentage change in quantity, yields the percentage change in price of beef. The actual price for 1970 is adjusted by the percentage change to yield the alternative price. The alternative average retail price of beef ($.997 per pound) is the price that would have occurred, without Arizona's calf production. The actual price was $.986 per pound.

The total change in consumers' surplus for fed beef, associated with the price change occurring in response to a complete reduction in Arizona beef calf production, was computed as follows:

$$\Delta CS = \Delta P(Q - \Delta Q) + \tfrac{1}{2}\,\Delta P \cdot \Delta Q$$

Where ΔCS = change in dollars of consumers' surplus; ΔP = change in average U.S. retail price per pound of beef; Q = pounds of U.S. retail beef production including Arizona production; and ΔQ = pounds of Arizona retail beef production.

ΔCS was estimated as $178.29 million.[3] Estimates of changes in consumers' surplus associated with each of the seven Arizona Department of Game and Fish Regions (Figure 1) were made in proportion to the percent of the state total calf production within each region [Arizona Agricultural Statistics].

Changes in Consumers' Surplus from Reduction in All Hunting Activities in Arizona

Outdoor recreation on the same lands that

[2]It is assumed that price flexibility is simply the inverse of price elasticity of demand. Houck discusses problems which arise from such an assumption. Where the derivative dP/dQ from $P = f_1(Q)$ is the reciprocal of dQ/dP from $Q = f_2(P)$, the assumption is correct. Demand functions are generally more complex, including other shift variables. However, Houck goes on to say that if the cross effects of other products are zero, then the reciprocal of the price elasticity is a good estimate of the flexibility. Conversely, if significant cross effects exist, then the reciprocal of the price elasticity is greater than true price flexibility. Mathematically,

$$|Pf_i| \leq \left|\frac{1}{E_i}\right|$$

where E_i is price elasticity of demand, and Pf_i is price flexibility of demand. Thus, estimated price flexibility of demand for beef and subsequently the estimated change in consumer surplus from a reduction of Arizona beef are maximum values.

[3]Estimates will vary by year, depending on actual relative prices and quantities. Only the estimate for 1970 is shown here. Values rise to $238.15 million in 1975, even though Arizona's relative share in total quantity falls, because of the rise in average retail beef price from $.986 per pound in 1970 to $1.460 per pound in 1975.

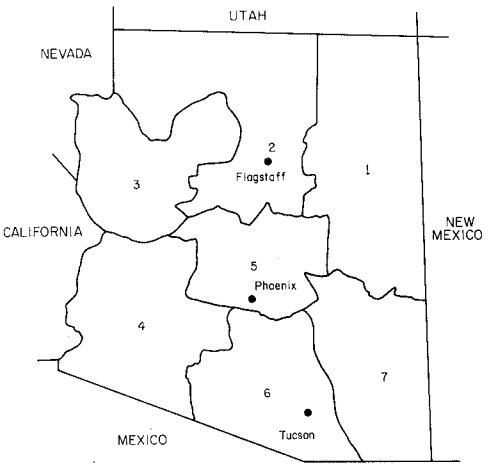

Figure 1. Arizona Game and Fish Department Regions, 1970.

produce beef calves is a direct final consumption activity. Improved, Clawson-Hotelling type individual household demand functions were estimated by Martin, Gum and Smith for 1970 from a sample of 2,926 recreators. Demand functions were estimated for each of eight types of hunting, fishing and general outdoor recreation activities for each of the seven Arizona Department of Game and Fish Regions.

Given that the demand curves are numerically specified for all quantities of use from zero to that quantity actually observed in 1970 (see Table 1 for an example), consumers' surplus may be numerically estimated under any portion of the curve [Gum and Martin, 1975]. Since the aggregate demand curve (Table 1) was estimated as the horizontal sum of all the individual demand curves, aggregate consumers' surplus is the sum of the individual consumer's surplus. Because we are positing a complete reduction to zero trips of all hunting activities, the estimate of consumers' surplus is the total area under the demand curve between the vertical and horizontal axes. We concentrate on hunting because it is the outdoor recreation activity most competitive to cattle ranching.

Regional Comparison of Consumers' Surplus Values

Estimates of total consumers' surplus generated by Arizona beef production and all hunting activities for 1970 are presented in the first two columns of Table 2 for each Game and Fish Region. The relative size of change in consumers' surplus from Arizona cattle production overwhelms the consumers' surplus estimates from hunting in all areas. Regions 5 and 6 have the largest estimates for hunting. These two regions encompass the most densely populated areas in Arizona; Region 5 contains the Phoenix metropolitan area and Region 6 contains Tucson.

Consumers' Surplus Values per Square Mile

The preceding analysis, however, does not consider the intensity of value per land unit used in the activities of beef calf production and all hunting. Columns three and four of Table 2 contain mean consumers' surplus values for Arizona beef calf production and all hunting on a square mile basis. The calf production estimates are calculated as average calf production per section of grazing land times the average consumers' surplus value per calf ($302). Average value per calf is estimated as statewide consumers' surplus for beef calf production divided by the calf crop for 1970. The consumers' surplus values for all hunting activities are the total values divided by huntable area.

High per-section values for calf production

TABLE 1. Demand for Deer Hunting in Arizona Game and Fish Region 1, 1970.

Added Cost Per Trip[a] ($)	Number of Trips
0	24,250
5	20,176
10	17,484
15	14,722
20	13,186
25	12,083
30	11,089
35	9,826
40	8,420
45	6,357
50	5,925
60	4,063
70	1,466
74	0

Source: Martin, *et al.*,

[a]Added cost per trip may be interpreted as an entry fee or use fee imposed above the normal variable costs of a trip.

in Regions 1 and 2 reflect the high carrying capacity of the rangelands within these regions. For example, in the central plateau of Region 2 only 32 acres per animal unit are required, while in the desert of Region 4, 170 acres are needed for each animal [Dickerman and Martin]. The corresponding consumers' surplus values for hunting in these regions are not particularly high, even though these regions are considered excellent for hunting.

Region 5, which contains Phoenix, generates a consumers' surplus value for all hunting of $1,115 per square mile. This high value is generated by the high demand for hunting activities in this region, although its hunting quality is considered less than that of Regions 1 and 2. The corresponding calf production values are low in comparison, reflecting a need for about 91 acres per animal unit and an average calf productivity of about 3 calves per section per year.

Producers' Surplus Values of Cattle Ranching

Thus far, the analysis has focused only on comparisons of consumers' surplus values generated by beef calf production and hunting. The fifth column of Table 2 presents estimates of producers' surplus resulting from a complete reduction in beef production. These estimates are equivalent to the annual average market value of cattle-producing land per square mile.

The annual average value of all lands for ranching is the annual equivalent at 6 percent interest of the average sale price of all ranches, including the rights to public land permits as well as deeded land, as developed by Martin and Jefferies and updated to 1970 conditions. Whole ranches were selling for the average annual price per square mile (1 section or 640 acres) shown in column 6 of Table 2.

The equivalence of producers' surplus and ranch sale prices is shown as follows. Economic reasoning dictates that the cattle producer would use land to the point where his marginal cost of producing cattle, which describes the supply curve for Arizona beef cattle, equals the price received for cattle. The area above this supply curve and below the price line at the intersection of the supply curve with the demand curve represents the annual economic rents (profits) accruing to the cattle producer for each unit of land in production. The area contained below the supply curve and to the left of its intersection with the demand curve is the value of the human and physical resources used in production. The cattle producer would not produce more than the equilibrium quantity since to do so would incur a loss.

Thus, the area above the supply curve and below the price is the annual value of the land to cattle producers and when compounded becomes the land sale price. This area is also the annual Marshallian producers' surplus. That is, it measures the resource owner's gain from placing his productive factors in the chosen occupation at the existing factor price, given the prices his factors would earn in all other occupations. This measure is the counterpart of consumers' surplus and measures the potential loss to the

TABLE 2. Total and Per Square Mile Consumers' Surplus and Producers' Surplus Values for Arizona Beef Calf Production and All Hunting Activities, by Arizona Department of Game and Fish Regions, 1970.

Region	Total losses in Consumers' Surplus from an Elimination in		Per Square Mile Losses in Consumers' Surplus from an Elimination in		Per Square Mile Losses in Producers' Surplus from an Elimination in	Total Per Square Mile Losses in Producers' and Consumers' Surplus from an Elimination in
	Beef Production	All Hunting Activities[a]	Beef Production[b]	All Hunting Activities	Beef Production[b,c]	Beef Production[b]
	------Millions of Dollars------		----------Dollars----------		-------Dollars-------	-----Dollars-----
1	39.57	2.87	5,719	487	424	6,143
2	35.85	6.83	6,307	404	290	6,597
3	11.94	.64	2,528	75	d	d
4	10.69	2.21	1,164	231	140	1,304
5	19.60	9.87	2,227	1,115	355	2,582
6	37.45	7.40	4,530	880	352	4,882
7	23.18	4.61	3,792	346	558	4,350
Totals	178.29	34.43				

[a]Source: Martin, *et al.*,

[b]Values are mean values. Individual parcels will differ in value depending on grazing condition or hunting conditions within the Region.

[c]Source: Martin, *et al.*, Developed from Dickerman and Martin.

[d]Not estimated.

cattle ranch owners with the posited reduction in beef calf production.[4]

In reality, the supply curve of ranch land also includes speculative costs as well as land costs related simply to "land fundamentalism"; that is, value of the land to the ranch investor as a consumption good [Smith and Martin]. These two values also may be considered products, and contribute to the value of producers' surplus. Thus, the total annualized sale value of ranch land is the measure of producers' surplus.

Total Surplus Values

Consumers' surplus values of beef calf production reflect the productivity value of the land to final consumers. Average market values reflect demand for cattle ranches by individual investors in addition to those consumers' surplus values accruing to the final consumer of beef. The sum of producers' surplus and consumers' surplus is shown in the last column of Table 2. Producers' surplus accrues only to cattle producers as profits above variable costs, whereas consumers' surplus accrues to all beef consumers, including cattle producers. The total economic benefit to society per square mile for land in cattle production is understated by the value of range permit fees (see footnote 4) and producers' surplus values accruing to those feedlots, processors and marketing firms that would be affected by the reduction in cattle. Societal loss is overstated to the degree other livestock producers would benefit by the price rise.

The demand for hunting has no associated supply curve. Thus, there is no associated producers' surplus. The total economic benefit to society for land used for hunting is understated by degree that demand for hunting by Arizonans would cause congestion in

[4]Arizona cattle ranches are typically a mix of public and private lands. Since permit fees on public lands are below their marginal value product, the difference is capitalized into the sale price of the whole ranch including the permit rights. In the middle 1960's, permit fees were roughly 25 percent of their estimated MVPs [Martin and Jefferies]. Thus, our producers' surplus estimate measures the "potential loss to the ranch owners." The estimate understates the producers' surplus loss to society by the value of the permit fees.

other hunting areas, and by any loss in producers' surplus accruing to firms producing or selling hunting related goods.

The Relationship of Consumers' Surplus and Compensating and Equivalent Variations

The empirical estimates of Marshallian consumers' surplus for hunting and cattle production are compared to the Hicksian measures as follows. First, as less of each commodity is produced, prices are predicted to rise. Further, in both cases, if consumers can be considered to have a right to their initial welfare position before the price rise and are allowed an optimal response to the price change, the correct measures of consumers' surplus are the measures of compensating variation — the amount of compensation the consumers would be willing to accept in order to stay at their initial welfare level after the changes in price and quantity have taken place.

For a price rise, and for a normal good with a positive income elasticity, the compensating variation is greater than simple Marshallian consumers' surplus. Compensating variation may be estimated using the Willig approximation if the income elasticity and consumer base income are known.

Compensating Variation for Beef

The consumers' surplus for beef is spread over the total U.S. market. Total U.S. personal income for 1970 was $798,949 million [U.S. Bureau of the Census]. Given an income elasticity for fed beef of 0.78 (authors' estimate), a rather high estimate compared to competing estimates such as the 0.29 of George and King, the simple Marshallian measure of $178.29 million (see Table 2) is increased by only $15,516. If the estimate for the whole state is affected so little, each regional estimate would be affected by only two or three thousand dollars.

Compensating Variation for Hunting

The simple Marshallian estimates for all hunting activities are almost all smaller than the adjusted estimates for beef production. What of the adjusted estimates for all hunting activities?

The surplus for hunting in Arizona is spread over 21.8 percent of all Arizona households [Gum, *et al.*] If one assumes that hunters earn 21.8 percent of Arizona personal income, or $1,399 million, and an income elasticity of as high as 1.0, the total estimate of simple Marshallian consumers' surplus of $34.43 million (Table 2) would be increased by only $0.42 million — a greater deviation than for beef but still only a one percent change. In fact, the estimates of demand for hunting [Martin, Gum and Smith] from which the original consumers' surplus estimates were derived rarely showed income to be statistically significant, in which case the income elasticity is zero.[5] With zero income elasticity the Marshallian measure and compensating variation are identical.

The Distribution Issue

These estimates illustrate that comparable values can be generated for market and nonmarket goods. They show that in total value terms the use of Arizona lands is more valuable for beef production than for hunting. However, the welfare distribution issue must be faced.

The $178.29 million loss in consumers' surplus because of reduced beef production would be spread over some 208 million people [1970 U.S. population; USBC]. Thus, the individual loss would average about 86 cents per person per year. The loss in producers' surplus would accrue to some 1,000 Arizona cattle ranchers. Total producers' surplus for the state has not been estimated, but when one notes that producers' surplus per square mile per year ranges from $140 to $558 (Table 2), with corresponding typical ranch sizes of 67 square miles and 19 square miles [Dickerman and Martin], the annual average loss in producer's surplus would be

[5]See Gum and Martin (1977) for discussion of the relationship between income and hunting participation.

about $10,000 per ranch household or perhaps about a third of that value per person.[6]

On the other hand, the $34.43 million loss in consumers' surplus because of reduced hunting opportunities would be borne by only 176,500 people, an average annual loss in consumer's surplus of about $195 each.[7]

The possible political ramifications of the distribution of consumers' and producers' surpluses may be seen by examining Tables 3 and 4. Table 3 shows that, in the aggregate, consumers could fully compensate hunters not to hunt and still retain $143.9 million in consumers' surplus. Alternatively, they could compensate the ranchers to continue producing beef and retain $168.3 million in surplus. Or, consumers could fully compensate both hunters and ranchers and still be $133.9 million ahead.

Ranchers could not afford to pay either hunters not to hunt, or consumers to accept a higher price for beef. To pay both groups from their $10 million producers' surplus, would result in a $202.7 million deficit.

Hunters have an intermediate aggregate position. They could easily buy the ranchers out in order to hunt, but they could not afford to bribe the consumers to accept the high price for beef.

Thus, in the aggregate, consumers appear to have the most to lose if the land were used exclusively for hunting. The aggregate loss to the ranchers would be only one-eighteenth as much. However, ranchers and consumers both have the same interest in greater quantities of beef produced. Hunters could be a potent force against the ranchers but could not face down consumers.

Table 4 presents a different picture. Because of the distribution of consumers' and producers' surpluses among individuals, the potential for political action shifts from consumers to ranchers. As an individual, the consumer faces an annual loss of only 86 cents — far too little to create much individual interest. The individual hunter faces a substantial loss and could be expected to engage in political activity if such activity were required to retain hunting privileges. The rancher and his family have by far the most to lose as individuals and could be expected to mount fierce resistance to any loss of land to hunters.

[6]Analysis of Table 4 will show that implications are not sensitive to this rather arbitrary assumption about ranch households.

[7]In 1970, there were approximately 539,845 household units in Arizona. Of these, 21.8 percent were "hunting households." The mean "household-trip" for hunting was about 1.5 people [Gum, *et al.*,].

TABLE 3. Potential for Annual Aggregate Compensation for Use of Arizona Lands, 1970[a].

Compensation Received by:	Compensation Paid by: Hunters	Ranchers	Consumers
	----------Millions of Dollars----------		
Hunters	-	−24.4	+143.9
Ranchers	+24.4	-	+168.3
Consumers	−143.9	−168.3	-
Total	−153.9	−202.7	+133.9
Total Consumers' Surplus Available for Compensation	34.43	10.00	178.29

[a]Each entry shows the net position of the group paying compensation in order to maintain their original welfare position, after compensation was actually paid.

TABLE 4. Potential for Annual Individual Compensation for Use of Arizona Lands, 1970[a].

Compensation Received by:	Compensation Paid by: Hunter	Rancher	Consumer
	----------Dollars----------		
Hunter	-	+3,138.34	−194.24
Rancher	−3,138.34	-	+3,332.48
Consumer	+194.24	+3,332.48	-
Total	−3,139.20	+3,137.48	−3,527.48
Total Consumer's Surplus Available for Compensation	195.00	3,333.34	00.86

[a]Each entry shows the net position of an individual paying compensation to an individual in order to maintain their original welfare position, after compensation was actually paid.

Conclusions

Reasonably comparable estimates of market and nonmarket values can be made when one considers *changes* in prices and quan-

tities; that is, one may estimate the potential gains or losses in aggregate welfare. Thus, one would expect increased use of nonmarket value estimates as policy inputs. The recent work of Willig has been especially important in the development of our ability to interpret the estimates in a conceptually correct manner.

In this paper, the value of all hunting in Arizona was compared to the value of all range beef cattle production in the same area. In the aggregate, the value of beef production is over 5 times as large as that for hunting. However, when the distribution of the values was considered, hunters are shown to have the economic potential for vigorous political activity should a real conflict between ranching and hunting develop.

Only as further research is completed on the production possibilities frontier between cattle ranching and hunting on a given land base, can the actual economic conflicts be correctly specified and a societal optimum suggested. Even then, when one considers the distributional effects of such potential changes, the goodness or badness of such changes depend on one's individual view of the goodness or badness of the results in terms of on whom the change falls. One can, however, use these distributional estimates to judge the potential for possible political activity by the affected individuals and groups.

References

Archer, T. "Performance of Cattle in Arizona Feedlots by Source of Feeders." Report No. 15, Department of Agricultural Economics, College of Agriculture, The University of Arizona, Tucson. Oct. 1976.

Arizona Agricultural Statistics. Annual publication, Arizona Crop and Livestock Reporting Service, Phoenix, Arizona. 1971.

Brandow, G. E. *Interrelationships Among Demands for Farm Products and Implications for Control of Market Supply.* Bulletin 680, Pennsylvania State University Agricultural Experiment Station, University Park. Aug. 1961.

Brown, W. G., A. Singh, and E. M. Castle. *An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery.* Bulletin 78, Agricultural Experiment Station, Oregon State University, Corvallis. Sept. 1964.

Currie, John Martin, John A. Murphy and Andrew Schmitz. "The Concept of Economic Surplus and Its Use in Economic Analysis." *The Economic Journal,* LXXXI (1971): 741-799.

Dickerman, A. R., and W. E. Martin. "Organization, Costs and Returns for Arizona Cattle Ranches." File Report 67-6, Department of Agricultural Economics, University of Arizona, Tucson. Sept. 1967.

Fox, K. A. *The Analysis of Demand for Farm Products.* Technical Bulletin 1081, U.S. Department of Agriculture, Washington, D.C., 1953.

George, P. S., and G. A. King. *Consumer Demand for Food Commodities in the United States with Projections for 1980,* Giannini Foundation Monograph Number 26. University of California, Davis. March 1971.

Ginn, B. A. "Projected Beef Consumption and Response." Western Livestock Marketing Information Project, Denver, February, 1977.

Gum, Russell L., William E. Martin, Arthur H. Smith and C. Duane Depping. *Participation and Expenditures for Hunting, Fishing and General Outdoor Recreation in Arizona.* Research Report 270, University of Arizona Agricultural Experiment Station, Tucson. 1973.

Gum, Russell L., and William E. Martin. "Problems and Solutions in Estimating the Demand for and Value of Rural Outdoor Recreation." *American Journal of Agricultural Economics* 57 (1975): 558-566.

Gum, Russell L. and William E. Martin. "Structure of Demand for Outdoor Recreation." *Land Economics* 53 (1977): 43-54.

Hicks, J. R. "The Rehabilitation of Consumer's Surplus," *Review of Economic Studies* 8 (1940-41).

_____. "The Four Consumer's Surpluses, " *Review of Economic Studies* 11 (1943): 31-41.

_____. "The Generalized Theory of Consumer's Surplus," *Review of Economic Studies* 13 (1945-46).

Houck, F. P. "The Relationship of Direct Price Flexibilities to Direct Price Elasticities." *Journal of Farm Economics,* 47 (1965): 789-792.

Martin, W. E., R. L. Gum, and A. H. Smith, *The Demand for and Value of Hunting, Fishing, and General*

Rural Outdoor Recreation. Technical Bulletin No. 211, University of Arizona Agricultural Experiment Station, Tucson. June 1974.

Martin, W. E., and G. L. Jefferies. "Relating Ranch Prices and Grazing Permit Values to Ranch Productivity." *Journal of Farm Economics* 48 (1966): 233-242.

Mishan, E. J. *Cost-Benefit Analysis*. Praeger Publishers, New York. 1976.

Randall, Alan. "Evaluating Non-Market Goods and Services: Some Conceptual Considerations," Staff Paper 51, Department of Agricultural Economics, University of Kentucky, Lexington. July 1977.

Schmalensee, Richard. "Another Look at the Social Valuation of Input Price Changes," *The American Economic Review* 66 (1976): 239-243.

Schultz, H. *The Theory and Measurement of Demand*. University of Chicago Press. 1938.

Smith, A. H., and W. E. Martin. "Socioeconomic Behavior of Cattle Ranchers, with Implications for Rural Community Development in the West." *American Journal of Agricultural Economics* 54 (1972): 217-225.

U.S. Bureau of the Census. *Statistical Abstract of the United States: 1972*, U.S. Government Printing Office, Washington, D.C., 1972.

U.S. Department of Agriculture. *Livestock and Meat Statistics*. Statistical Bulletin Number 522, Statistical Reporting Service, Supplement, Washington, D.C., 1975.

Uvacek, E. *What's the Best Way to Buy Beef?* Bulletin Number L-701, Texas A&M University of Agricultural Extension Service, College Station. March 1967.

Willig, Robert D. "Consumer Surplus Without Apology," *The American Economic Review* 66 (1976): 589-597.

Working, E. J. *Demand for Meat*. Institute of Meat Packing, Chicago 1954.