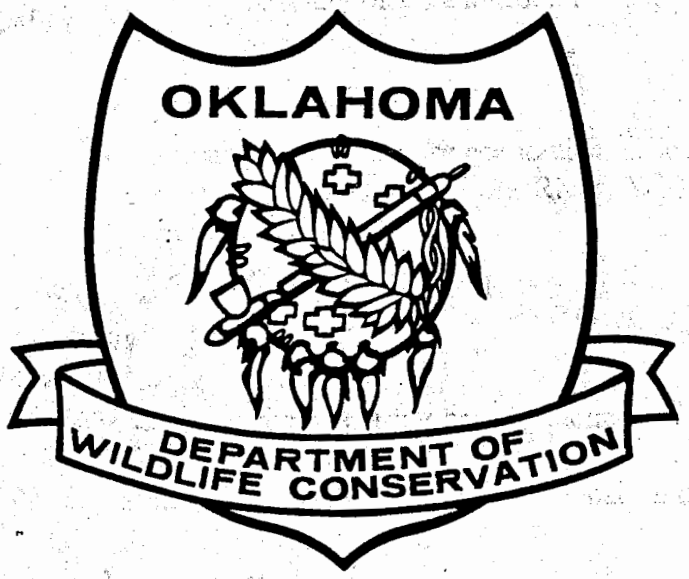
PERFORMANCE REPORT

RESEARCH AND SURVEYS



FEDERAL AID PROJECT NO. F-41-R-16

FACTORS INFLUENCING FISH POPULATIONS IN OKLAHOMA WATERS

JOB 15

ECONOMIC FEASIBILITY OF A YEAR-ROUND TROUT FISHERY BELOW BROKEN BOW DAM

JULY 1, 1993 through JUNE 30, 1994

ANNUAL PERFORMANCE REPORT

STATE: Oklahoma

Project Number: F-41-R-16
Job Number: 15

PROJECT TYPE: Research

PROJECT TITLE: Factors Influencing Fish Populations in Oklahoma Waters

SEGMENT DATES: 1 July 1993 - 30 June 1994

STUDY TITLE: Economic Feasibility of a Year-Round Trout Fishery Below Broken Bow Dam

STUDY OBJECTIVE: To estimate and evaluate the economic and social benefits and costs of the year-round Mountain Fork River (MFR) trout fishery below Broken Bow dam.

I. Job Objectives

1. Estimate and evaluate the regional market based benefits of the trout fishery.

2. Estimate the impact of the trout fishery on local and regional economic development.

II. Summary of Progress

A. Job Objective 1: Estimate and evaluate the regional market based benefits of the trout fishery.

(1) Procedures:

The benefits of the trout fishery in southeastern Oklahoma are nonmarket and market based. Nonmarket benefits are based on the willingness-to-pay concept as discussed in the Principles and Guidelines (U. S. Water Resources Council). As reported under Job Objective 2 in Schreiner, Leslie, Choi, and Lee (1993), nonmarket benefits for the trout fishery were estimated indirectly by the travel cost method (TCM). For the

current report, regional market based benefits are estimated as Job Objective 1. A summary of both nonmarket and market based benefits is also presented.

A schematic of a regional market economy is presented in Figure 1. The market economy is made up of production systems, households which provide resources and consume output, and factor and commodity markets which determine what is produced, how it is produced, how commodity output is distributed, and how resource use is compensated. The regional market economy is constrained by market environments, technology, resources, consumer preferences, distribution of resource ownership, and regulation. Hence, in Figure 1, the components in black are exogenous and the components in blue are endogenously determined. In a regional general equilibrium sense, prices and quantities for all commodities and factors and incomes of households are endogenously determined (see Lee for a fuller explanation of market economies and general equilibrium methods).

When regional household welfare is based strictly on benefits (utility) derived from expenditures in the market economy, prices and incomes determine the level of regional household welfare. Hence, if regional prices and incomes are endogenous then regional household welfare is also endogenously determined (market based welfare is shown in red in Figure 1).

To evaluate a change in welfare, welfare itself must be defined and measured. A description of welfare (satisfaction) of people will never be complete because the sources of satisfaction and related aspects of welfare are diverse and difficult to specify in an empirical context. Elements other than economic efficiency and growth that enter in evaluating welfare change may be important, but they may also be elusive in identifying and measuring because values are not revealed in terms of market preferences. As Shaffer has shown, the conceptual components of a socioeconomic welfare function can be categorized into two types: one is the welfare effects from goods and services with market prices and the other is welfare effects without market prices (Shaffer, pp. 89-90). The former can be referred to as market goods and the latter as nonmarket goods.

Basically, how welfare of people is expressed depends upon how their utility (preference) functions are described. A welfare measure should be derived from a utility function and, at the same time, the utility function should include as many components as possible that affect people's welfare. In particular, inclusion of nonmarket goods as components of utility can be critical to improving welfare of people. Examples of nonmarket components of utility are leisure, recreation, pollution (negative utility), and beautiful scenery.

The most widely employed numerical welfare measures derived from utility are the Hicksian compensating variation (CV) and equivalent variation (EV). The concept on which these welfare measures are based is the amount of money an individual is willing to pay or accept to move from one state of equilibrium to another. If nonmarket goods can be expressed in the utility function and if they can be valued, then nonmarket components can also be reflected in measures of welfare and welfare change.

When an exogenous shock occurs in a regional economy in equilibrium, such as an increase in export demand for a certain industry product, all of the economic agents in the region (firms, consumers, governments, commodity and factor markets, etc.) react to the exogenous shock to adjust to a new equilibrium as long as they are interrelated with the impact either directly or indirectly.

If the analysis of welfare change is limited to specific groups of people and/or specific sectors, partial equilibrium analysis may be sufficient. That is, in partial equilibrium analysis, prices and quantities of one or several commodities are allowed to adjust to new equilibrium values in response to an exogenous shock while prices and quantities of other goods and consumer incomes are held constant. On the contrary, a general equilibrium model[1] considers adjustment in all related markets and institutions. Therefore, once welfare measures such as CV and EV are built into a regional general equilibrium model, the model accounts for welfare effects induced by reactions across sectors and institutions composing the regional economy and as affecting the set of regional households.

General equilibrium models also provide relative valuations. For example, general equilibrium models allow interregional labor movement by including migration behavior. It considers opportunity costs of labor in the region and thus provides people the opportunity to choose the location with the higher wage rate adjusted, perhaps, for nonpecuniary benefits of place or type of work. This is important because welfare is largely dependent on income which is mainly determined by wage income.

In sum, if we are to measure regionwide welfare effects of development programs or policies, the advantages of general equilibrium may outweigh the difference between the simplicity of partial equilibrium analysis and the extra resource costs of general equilibrium analysis. Empirically, Thurman and Easley (1992) and Bouchelle et al (1993) have

[1] Shoven and Whalley (1984, p. 1009) state, "Everyone seems to agree that a general equilibrium model is one in which all markets clear in equilibrium."

used both partial and general equilibrium approaches to analyze the welfare effects of a quota-restricted fishery and their results are indicative of the potential underestimation of welfare changes using the partial equilibrium approach.

In the case of the trout fishery in southeastern Oklahoma, let us consider two commodities in the market based economy for McCurtain County (in actual implementation, the economy was described by six commodity categories). Q_2 (Figure 1) is the number of trips taken to the Mountain Fork River (MFR) by McCurtain County households in 1990. Even though recreation trips are considered a nonmarket good, each trip has an associated expenditure (see Choi (1993) for further explanation of trip expenditures). Therefore, in the aggregate any quantity of MFR trips is associated with an aggregate expenditure. Q_1 represents an index of all other commodities consumed by McCurtain County households. Because expenditures on Q_2 and Q_1 represent total expenditures by McCurtain County households (in actual implementation, McCurtain County households were subdivided into three household income classes), what is not expended on MFR trips is expended on Q_1. Household expenditures on Q_2 and Q_1 were observed for 1990 and are represented at point M. Because this is a market based economy (households are free to choose the level of expenditure for each of the two commodities at the corresponding level of total expenditure), U^2 represents the highest market based (utility) welfare level.

The purpose of Job Objective 1 was to estimate the regional market based benefits of the trout fishery. To do this it was necessary to estimate the market based welfare of McCurtain County households without the trout fishery and compare this result with the market based welfare with the fishery. The difference in welfare between the two is attributed to the trout fishery. Analytically, this is described by Figure 2.

Q_2 in Figure 2 again measures the number of trips to the MFR by McCurtain County households and Q_1 measures consumption of all other goods by the same households. T_1 represents the transformation function between production of Q_2 and Q_1 for McCurtain County household consumption with the trout fishery. M_1 represents the distribution of total expenditures between Q_2 and Q_1 that gives the highest market based regional household utility with the trout fishery and is the same as M in Figure 1. This level of regional economic activity, however, is the result of a total of 8,475 trips to the MFR in 1990 as estimated by Choi (1993) and aggregate trip expenditures within the county equal to $655,000. M_1 represents 3,791 trips by McCurtain County households and expenditures equal to $42,700. The remaining 4,684 trips with associated expenditures

of $612,400 were by households outside of McCurtain County and represent export demand for MFR trips.

T_0 represents the transformation function between Q_2 and Q_1 for McCurtain County household consumption without the trout fishery. Choi (1993) estimates the number of MFR trips before establishment of the fishery at 3,483. Although he does not estimate expenditures associated with this number of trips he does estimate aggregate benefits before establishment of the trout fishery. The ratio of benefits before the fishery to benefits with the fishery for 1990 ($89,630 and $956,000, respectively) was incorporated into the trip demand functions for McCurtain County households and export demand (households outside of McCurtain County). The T_0 transformation function is thus the result of a counterfactual simulation of the regional economy without the trout fishery. M_0 is the general equilibrium solution resulting from new market prices and reduced expenditures (incomes) as estimated without the trout fishery. The change in welfare for McCurtain County households is a measure of the difference between M_1 and M_0 or total aggregate expenditures for regional households. Thus McCurtain County household welfare is less without the trout fishery because of fewer trips by county households and because of significantly lower export demand for MFR trips.

A regional general equilibrium model was empirically estimated that reproduced the McCurtain County market based economy with the observed 1990 demand for MFR trips (with the established trout fishery). The model was then run again with the reduced demand for MFR trips without the trout fishery. The difference in regional household expenditures at the new commodity prices represents the change in regional household welfare or the difference between M_0 and M_1 (Figure 2) which is the change in market based welfare due to the trout fishery. In addition to the change in market based welfare for McCurtain County households, there exists the nonmarket based change in welfare (benefits) for the added MFR trips for both resident households and nonresident households.

Figures 1 and 2 may also be used to conceptualize what brought about the change in market based welfare. Conceptually, we could envision the market economy for McCurtain County in Figure 1 before the trout fishery that generated M_0 level of household welfare. At this level of household welfare, production systems regulation, household group regulation, commodity market environment, and factor market environment are exogenous (fixed). However, in Figure 2 these elements are endogenous and the result of the political process. In other words, designation of the Mountain Fork River below the Broken Bow Dam as a year-round trout fishery (see Harper, 1993), periodic release of cold water from Broken Bow Lake, and stocking of rainbow trout represent policy

changes of the political process that brought about changes in market based welfare which moved households in McCurtain County from M_0 to M_1.

The political decisions, however, were not arbitrary. They were based upon an ex-ante social benefit-cost analysis of establishing the trout fishery. An ex-post verification of the social benefit-cost of the trout fishery for 1989, 1990, and 1991 is provided in Schreiner, et al (1993). In other words, the political decisions that brought about a change in welfare from a nonmarket good (increased MFR trips) also brought about a change in market based welfare for McCurtain County households. It is measurement of this latter change that completes Job Objective 1.

The regional general equilibrium model used in the analysis for obtaining Job Objective 1 is not elaborated here but is available in Lee (1993). In general the model focuses on: (1) commodity trade with differentiation between regionally produced and imported goods which implies imperfect substitution in use by all economic agencies; (2) imperfect transformabilities between production for regional and export markets specified by a constant elasticity of transformation function; (3) labor supply which is determined by the labor-leisure relationship and by an exogenously determined migration elasticity; (4) measurement of welfare change for each household income group from exogenous impacts to the region; and finally, (5) incorporation of nonmarket goods in regional consumption.

The geographic area is McCurtain County. The regional economy is aggregated into four sectors based on homogeneity of production, degree of tradability, and availability of data: agriculture, mining, manufacturing, and services. In addition to the commodities, which are actually marketed in the regional economy, this model includes the nonmarket goods of trout fishery (TF) trips to the Mountain Fork River (MFR). Even though these are nonmarket goods, they require market good expenditures for their production. TF trips are divided into trips by regional (McCurtain County) anglers (TFR), that is a regionally consumed nonmarket good by regional households, and trips by anglers from outside the region (TFE), that is a nonmarket good regionally consumed but classified as an export commodity. The nonmarket goods are produced using composite market inputs. Nonmarket good demand is estimated using the simplified travel cost method based upon the expenditure approach (Choi, 1993).

Factor markets include labor, capital, and land. Households are disaggregated by three household income (1990) class size groups: low (household income less than $20,000); medium (household income between $20,000 and $40,000); and high (household income greater than

$40,000). The complete social accounting matrix (SAM) used in elaboration of the regional general equilibrium model is in Lee (1993, pp. 114-116).

(2) Results:

The counterfactual simulation reduces the demand for Mountain Fork River (MFR) trips (and associated trip expenditures) from the 1990 level to the level prior to implementation of the trout fishery. If demand for MFR trips deceased for both regional (McCurtain County) and outside anglers, it would result in a welfare loss of $608,537 to the McCurtain County households (Table 1).

Among household groups, welfare loss is $287,652 (47.3 percent) for high income households, $245,849 (40.4 percent) for medium income households, and $75,036 (12.3 percent) for low income households. Welfare change from decreased demand for MFR trips by county anglers (-$56,941) is much smaller compared to that for outside county anglers (-$558,080).

When compared to the base level of expenditure, the welfare change did not exceed one percent of total household expenditure for any of the household income groups. Welfare change is the highest for high income households (-0.73 percent), followed by medium income households (-0.19 percent), and lowest (-0.05 percent) for low income households. The overall result is that the MFR trout fishery accounts for less than 0.2 percent (0.19) of the total household welfare (expenditure) of McCurtain County households.

Market and nonmarket based benefits for 1990 are combined and shown in Table 2 with appropriate distributions. The first division is between McCurtain County household benefits (or local benefits) and national benefits. Local benefits are market based and nonmarket based. Market based are the same as those shown in Table 1 and include the estimated change in welfare of McCurtain County households. The nonmarket benefits are the estimates of willingness-to-pay as reported in Schreiner, et al (1993) adjusted for 1990 price level. For McCurtain County households, the market based benefits are about 41 percent greater than the nonmarket based benefits.

National benefits include only nonmarket based benefits. National market based benefits would exist to the extent that previously unemployed resources (labor, land, and capital) are now employed because of the trout fishery. Similarly, if the fishery served an international market that created an adjustment in use of domestic resources there may exist higher real rates

of return to resources and thus greater market based benefits. These possibilities undoubtedly would be very limited in the case of the trout fishery but were not investigated in this study.

National nonmarket based benefits are the same as reported in Schreiner, et al (1993) adjusted for 1990 price level. Distribution of gross benefits are in accordance to residence location of the anglers. Costs are public costs of operation of the fishery and include stocking of the trout. Opportunity costs are those benefits associated with trips to the MFR prior to establishment of the fishery. Further discussion of net national benefits is included in Schreiner, et al (1993).

B. Job Objective 2: Estimate the impact of the trout fishery on local and regional economic development.

(1) Procedures:

Impact of the trout fishery on local and regional economic development is discussed in terms of impact on commodity markets, factor markets, and households. These results are directly available from the regional general equilibrium model and the counterfactual simulation of reducing the demands for trips to the MFR. Conclusions, policy implications, and limitations of the study provide the final discussion on local economic development impact.

(2) Results:

Changes in commodity markets of the McCurtain County regional economy from decreased demand for MFR trips are presented in Table 3. Changes in the variables are expressed in terms of an index with the base (1990) value equal to one.

Output decreased slightly in the manufacturing and services sectors and increased slightly in the agriculture and mining sectors. Nonmarket goods decreased by the ratio (0.093) assumed for the counterfactual scenario of MFR trips before and after establishment of the trout fishery. Regional supply decreased in manufacturing and services and maintained the base level in agriculture and mining. Exports increased for agriculture and mining by 0.2 percent, but did not change for services and manufacturing.

Composite price decreased slightly (0.1 percent) for services because of strong linkages to trip expenditures. This resulted in a decrease in composite price of trout fishery trips (TFE and TFR) and by the same amount. Other sectors did not change in composite price. Decreased

demand for MFR trips brings about decreased imports in all sectors of McCurtain County.

Changes in factor markets for the McCurtain County economy are shown in Table 4. The wage rate decreased by 0.2 percent and is the same across all sectors because of intersectoral mobility of labor assumed in the model. Rental price of capital (rate of return) decreased for manufacturing and services, increased for mining, and did not change for agriculture. Rental price differed by sector because of the assumed fixed capital stock by sector. This result is consistent with short to intermediate-run analysis when plant and equipment capacity is fixed. Rental price of land for agriculture decreased slightly.

Labor demand increased for agriculture and mining by 0.2 percent and 0.3 percent, respectively, and decreased for manufacturing and services by 0.1 percent and 0.2 percent, respectively. Labor outmigrated from McCurtain County to the rest of the country by 0.19 percent of the initial total labor supply of McCurtain County.

Factor incomes decreased for all primary factors. Labor, capital, and land income decreased by 0.3 percent, 0.5 percent, and 0.2 percent, respectively. This result is consistent with the overall decrease in resource demand because of the decrease in demand for MFR trips. This result leads to the decrease in Q_2 and Q_1 of Figure 2 and the shift in the transformation function from T_1 to T_0.

Household income groups in McCurtain County are affected by the decreased demand for MFR trips as shown in Table 5. Each household group showed a decrease in household income with the high income class showing the largest decrease (0.5 percent), followed by the medium income class (0.2 percent), and the low income class (0.1 percent). These results are consistent with the result of the welfare losses.

High income households reduced commodity consumption for regional and imported goods from all sectors except agriculture. The decreases of commodity consumption by high income households is more significant compared to the other household income groups. Consumption for imported commodities decreased for all household income groups except for commodities from agriculture. Consumption for regionally produced goods by low and medium income household groups increased for almost all sectors, but decreased for the high income group except for commodities from agriculture. These results depend upon the demand parameters included in the regional equilibrium model.

La. . supply for each household income group which is determined by the leisure-labor choice increased by 0.2 percent for the low and medium income groups and increased by 0.3 percent for the high income group. This is the result of a marginal decrease in wage rate and hence the marginal willingness to decrease leisure time and increase work time of those households remaining in McCurtain County. This result tends to increase the amount of labor migration that occurs because of willingness of households to supply more labor and demand less leisure.

The effect on welfare as shown in Table 5 is the same as that shown in Table 2 except it is expressed in an index form. In other words, when the welfare index of 0.9927 for high income households is subtracted from 1.0 the result is equal to the loss in welfare shown in Table 2 (0.73 percent or 0.0073 absolute level). The welfare index in Table 5 shows the welfare loss by each household income group or the loss in expenditures at the new equilibrium commodity price levels. For the low and medium household income groups the welfare loss was slightly less than the income loss. However, for the high income household group, welfare loss was more than the income loss.

(3) Discussion and Conclusions:

Discussion

The overall objective for this year was to determine the economic impact of the Mountain Fork River trout fishery on the local economy. This impact is identified as the regional market based benefits of the trout fishery. The benefits are identified as market based because they arise out of changes in commodity and factor markets operating at the local or regional level. That is, because of increased expenditures due to establishment of the trout fishery, the local economy will produce more goods and services and will employ more resources and generate more income. The people who benefit are those that are involved directly and indirectly in the commodity and factor markets associated with angler expenditures.

Market based benefits contrast with nonmarket based benefits of the MFR trout fishery. The latter benefits were estimated and reported in previous annual reports. Nonmarket based benefits were estimated indirectly using the travel cost method. These benefits accrue to anglers who choose to make trips to the MFR for purposes of trout fishing. Thus nonmarket based benefits accrue to local anglers as well as anglers coming from other locations.

Estimation of the market based benefits requires a model of the local economy that empirically identifies the effects of the trout fishery. A regional general equilibrium model was estimated for McCurtain County that included trip demand functions for anglers residing in McCurtain County and for anglers from other locations. Results of the model for 1990 were contrasted with a counterfactual simulation with reduced demand for MFR trips that would have existed in the absence of the trout fishery.

Results

(a) McCurtain County households in 1990 would have a reduction in welfare equivalent to $608,537 with the absence of the trout fishery. About 9.4 percent of this reduction would come about through fewer trips of resident anglers and 90.6 percent would come about through fewer trips of non-resident anglers. This reduction in welfare is distributed among three household income class size groups with the highest income class size having the highest proportional reduction and the lowest income class size having the lowest proportional reduction.

(b) Nonmarket based gross benefits attributed to the MFR trout fishery were estimated at $926,020 of which $432,780 accrued to McCurtain County anglers. The remaining $493,240 gross benefits accrued to non-resident anglers. Net national benefits (gross benefits minus costs) attributed to the MFR trout fishery in 1990 equaled $770,940.

(c) Commodity markets are only marginally affected by the MFR trout fishery. Regional sector output, regional commodity supply, exports, imports, and commodity composite price all change by less than one percent.

(d) Factor markets are similarly only marginally affected by the trout fishery. Wage rate, rental price of capital (rate of return), land rent, labor demand and factor income all change by less than one percent. Labor migration is less than 0.2 percent of total labor supply.

(e) McCurtain County households in the aggregate are only marginally affected by the market based results of the trout fishery. Income, commodity consumption, labor supply, and welfare all change by less than one percent in the aggregate. Even though McCurtain County household welfare in the aggregate changes by $608,537

this represents only 0.19 percent of aggregate household expenditure in 1990.

Conclusions

(a) McCurtain County has gained substantially from the MFR trout fishery. Anglers who utilized the fishery in 1990 gained nonmarket benefits equal to about $433,000. Market benefits from the fishery equaled about $609,000 in 1990 and were broadly distributed among households within the county. Households gained from marginally higher wage rates and higher rates of return to capital and land resources.

(b) Small natural resource projects such as the MFR trout fishery should not be looked to for providing major economic development benefits. The MFR trout fishery changed welfare of McCurtain County households in the aggregate by less than 0.2 percent when compared to aggregate expenditures for the same households. However, these market based benefits are net additions to households' welfare levels and should be viewed in that context.

(c) National net benefits of the trout fishery are positive based on evaluation of nonmarket goods provided by the fishery. In accordance with criteria in the Principles and Guidelines (U. S. Water Resources Council), this is sufficient justification for establishing the fishery. The fact that market and nonmarket benefits accrue to local households is of importance at that level but are useful in justifying the project only as they contribute to national net benefits.

III. Publications

Lee, Han-Sung. "Welfare Measures of Rural Development: A Regional General Equilibrium Analysis Including Non-Market Goods." Unpublished Ph.D. Dissertation, Oklahoma State University, Stillwater, 1993.

TABLE 1

WELFARE CHANGES (CV) FROM DECREASED MOUNTAIN FORK RIVER TRIP DEMAND, MCCURTAIN COUNTY, OKLAHOMA, 1990

Household Income Group	Without TFR[a]		Without TFE[b]		Without TF[c]	
	Welfare Change[d]		Welfare Change[d]		Welfare Change[d]	
	($)	(%)	($)	(%)	($)	(%)
Low	-7,309	-0.01	-68,630	-0.05	-75,036	-0.05
Medium	-22,935	-0.02	-225,508	-0.17	-245,849	-0.19
High	-26,697	-0.07	-263,943	-0.67	-287,652	-0.73
Total	-56,941	-0.02	-558,080	-0.17	-608,537	-0.19

a Demand decrease for county anglers.

b Demand decrease for outside anglers.

c Demand decease for county and outside anglers.

d Welfare change compared to base level of expenditures for each household group.

TABLE 2

MARKET AND NONMARKET BASED BENEFITS OF THE MOUNTAIN FORK RIVER TROUT FISHERY, 1990

Level	($)
McCurtain County Household Benefits	
Market Based[a]	
Low Income	75,036
Medium Income	245,849
High Income	287,652
Total	608,537
Nonmarket Based	
All Households[b]	432,780
National Benefits	
Market Based	
Not Estimated	
Nonmarket Based	
Gross Benefits[b]	
McCurtain County Residents	432,780
Other Oklahoma Residents	189,040
Residents of Texas	271,570
Residents of All Other States	32,630
Total	926,020
Costs[c]	
Operation	69,070
Opportunity Costs	86,010
Total	155,080
Net Benefits	
Total	770,940

a Table 1

b Table 8 of Schreiner, et al (1993). Data adjusted to 1990 price level.

c Table 11 of Schreiner, et al (1993). Data adjusted to 1990 price level.

TABLE 3

CHANGES IN COMMODITY MARKETS IN MCCURTAIN COUNTY REGIONAL ECONOMY FROM DECREASED DEMAND FOR TRIPS WITHOUT THE TROUT FISHERY (INDEX WITH BASE = 1.000)

Sector	Output	Regional Supply	Exports	Composite Price	Imports
Agriculture	1.001	1.000	1.002	1.000	0.999
Mining	1.002	1.000	1.002	1.000	0.999
Manufacturing	0.999	0.997	1.000	1.000	0.997
Services	0.999	0.998	1.000	0.999	0.997
TFR[a]	0.093	0.093	NA	0.999	NA
TFE[b]	0.093	NA	0.093	0.999	NA

a Trout fishery trips by county anglers.
b Trout fishery trips by outside county anglers.

TABLE 4

CHANGES IN FACTOR MARKETS IN MCCURTAIN COUNTY REGIONAL ECONOMY FROM DECREASED DEMAND FOR TRIPS WITHOUT THE TROUT FISHERY (INDEX WITH BASE = 1.000)

Category	Wage Rate	Rental Price of Capital	Rental Price of Land	Labor Demand	Migration[a]	Factor Income
Sector						
Agriculture	0.998	1.000	0.998	1.002		
Mining	0.998	1.001	NA	1.003		
Manufacturing	0.998	0.997	NA	0.999		
Services	0.998	0.996	NA	0.998		
Factor						
Labor					-0.0019	0.997
Capital						0.995
Land						0.998

a Represents the ratio of migration compared to the initial level of labor supply.

TABLE 5

EFFECTS ON HOUSEHOLD GROUPS IN MCCURTAIN COUNTY FROM DECREASED DEMAND FOR TRIPS WITHOUT THE TROUT FISHERY (INDEX WITH BASE = 1.000)

	Income	Commodity Consumption			Labor Supply	Welfare
		Regional Goods	Imported Goods	Total		
Low Income Household	0.999				1.002	0.9995
Agriculture		1.001	1.001	1.001		
Mining		1.000	0.999	0.999		
Manufacturing		1.002	0.999	0.999		
Services		1.002	0.999	0.999		
TFR[a]		0.093	NA	0.093		
Medium Income Households	0.998				1.002	0.9981
Agriculture		1.001	1.001	1.001		
Mining		0.999	0.999	0.999		
Manufacturing		1.001	0.998	0.998		
Services		1.001	0.997	0.999		
TFR[a]		0.093	NA	0.093		
High Income Households	0.995				1.003	0.9927
Agriculture		1.000	1.000	0.999		
Mining		0.996	0.996	0.996		
Manufacturing		0.997	0.994	0.995		
Services		0.997	0.994	0.995		
TFR[a]		0.093	NA	0.093		

a Trout fishery trips by county anglers.

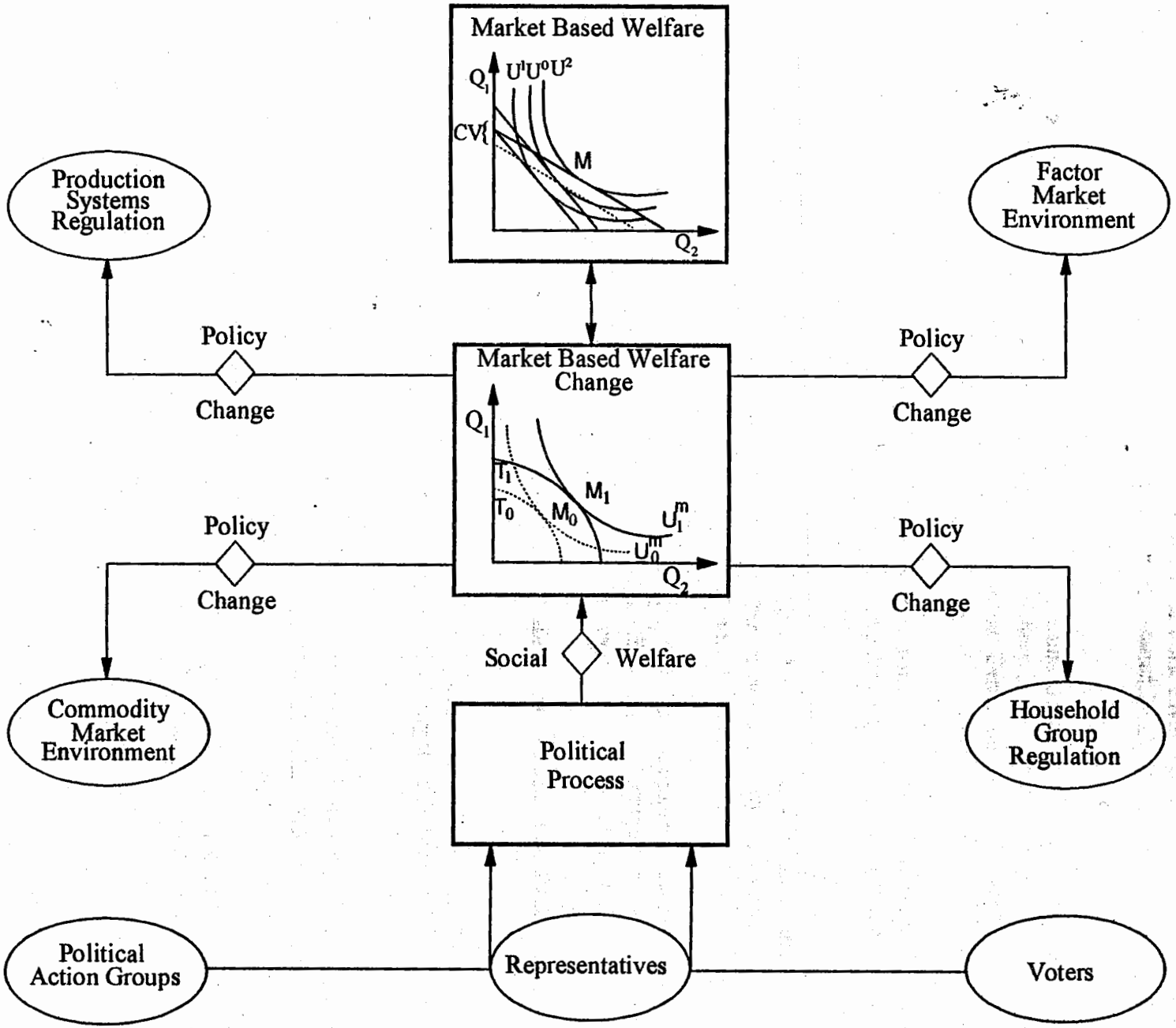


Figure 2. Comparison of Maket Based Welfare with and without the Trout Fishery

References

Choi, Se-Hyun. "Economic Analysis of the Mountain Fork River Trout Fishery in Southeastern Oklahoma Using Travel Cost Method." Unpublished Ph.D. Dissertation, Oklahoma State University, Stillwater, 1993.

Harper, Jack L. Fish Research and Surveys for Oklahoma Lakes and Reservoirs, Evaluation of Year-Round Put-and-Take Rainbow Trout Fishery in the Mountain Fork River. Annual Performance Reports, 1990-1992. Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

Lee, Han-Sung. "Welfare Measures of Rural Development: A Regional General Equilibrium Analysis Including Non-Market Goods." Unpublished Ph.D. Dissertation, Oklahoma State University, Stillwater, 1993.

Bouchelle, E., E. Thunberg, C. Adams, and J. Seale, Jr. "A General Equilibrium Welfare Analysis of North Atlantic Swordfish Quotas." Paper presented at the Southern Agricultural Economics Association meetings, Tulsa, OK, Jan. 31 - Feb. 3, 1993.

Schreiner, Dean F., David M. Leslie, Jr., Se-Hyun Choi, and Han-Sung Lee. Economic Feasibility of a Year-Round Trout Fishery Below Broken Bow Dam. Annual Performance Report, 1993. Oklahoma Department of Wildlife Conservation, Oklahoma City, OK.

Shaffer, R. Community Economics: Economic Structure and Change in Smaller Communities. Iowa State University Press, Ames, IA, 1989.

Shoven, J. B. And J. Whalley. "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey." Journal of Economic Literature, Vol. 22:pp. 1007-1051, 1984.

Thurman, W., and J. Easley, Jr. "Valuing Changes in Commercial Fishery Harvests: A General Equilibrium Derived Demand Analysis." Journal of Environmental Economics and Management, Vol. 22:pp. 226-240, 1992.

U. S. Water Resources Council. "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." Washington, DC: U. S. Government Printing Office, March 10, 1983.