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A Comparison of Economic Impact Estimates for Changes in the Federal Grazing Fee: Secondary vs. Primary Data I/O Models[1]

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This paper compares estimates of local personal income impacts that could result from increases in the federal grazing fee, using secondary data input/output models (U.S. Forest Service IMPLAN) and five primary data input/output models. The results show that the impacts estimated by the IMPLAN models are usually higher than those estimated by primary data models.

The U.S. Forest Service uses regional input/output (I/O) models to provide estimates of changes in total local income and employment that could result from resource management options. The regional I/O models used by the Forest Service are derived from technical coefficients of a national level I/O model and localized estimates of total gross outputs by sectors. Under the Forest Service approach, the derived regional model is called a secondary data model, as opposed to a primary data model, which is constructed by surveying a sample of businesses and households in the area analyzed.

There is a question as to whether the secondary data approach yields reliable estimates of economic activity at the county or regional level. For example, Lofting notes:

> "Insofar as establishing regional input–output tables is concerned, professional opinion varies from the firm opinion that an exhaustive field survey of regional production units is necessary to obtain meaningful results, to that of being cautiously optimistic that national variables applied to a region may yield sufficiently valid results to be of considerable use in planning policies."

The uniform data base and procedures used by IMPLAN are advantageous for interregional comparisons. As Boster and Martin state:

> "Relative to secondary (second-hand, published) data, primary (first-hand, survey) data are very expensive. Because of the added expense associated with collection of primary data, it is not clear that what is gained by way of improvement over secondary data sources is worth the added cost. In fact, *a priori* assumptions of primary data supremacy are unwarranted: poorly drawn

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[1] This paper is based on two reports prepared for the Forest Service and the BLM by Radtke and Brokken. These reports contain more detail than could be presented here.

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samples, sampling errors, inadequate or poorly trained field workers, and poorly conceived schedules are among possible sources of error to balance against the possibilities of secondary data (especially national model coefficients) being inapplicable to a region."

It is not possible, with the data available, to determine which results are the most accurate. Input/output models in general are nonstochastic; they do not provide a statistical confidence interval. Instead a deterministic estimate of the local economic structure is developed by the input/output methods. Extensive research would be required to determine which method yields the most accurate results. Such research has not been undertaken. However, because of the disparity in costs between the two types of models, and the need for uniformity of method for the interregional comparisons, it would be useful to know how the resulting personal income impact estimates might be expected to compare. The main purpose of this paper is to compare impact estimates obtained using the IMPLAN system with those obtained using the locally developed primary models in five specific applications.

Models Used

The information required in input/output modeling is a matrix of interindustry (or intersector) transactions (output minus inventory depletion).[2] The matrix describes the flow of funds through the economy.

The IMPLAN database consists of two major parts: 1) regional estimates of final demand, final payments, gross output and employment, for 466 industrial sectors; and 2) a national level matrix of technological coefficients.[3] In adjusting the national level data to provide regional models, IMPLAN uses a supply–demand pool approach.[4] This approach assumes that local firms will not buy or sell to firms outside the region unless local supply and demand is exhausted. To the extent that this assumption is invalid, IMPLAN underestimates interregional trade and therefore also leakages.

The size of the impact of a change in any of the sectors depends on the amount of leakage (net imports) in the local economy. Thus, the difference between **total** and **net** imports, which are not included in IMPLAN-based I/O models, would be included in a well-developed primary data model.

Primary data models normally use a technological coefficients matrix developed from surveys of local industries, as a result they provide estimates of **total** (not **net**) interregional trade.

Five primary data models representing areas with large ranching sectors and a high degree of dependency on publicly owned grazing land were chosen for the case studies. The models were for county or multi-county areas of Colorado, Idaho, Nevada, Oregon, and Wyoming for various years indicated in Table 1. Secondary data models were formulated using the Forest Service IMPLAN systems for the same regions. The IMPLAN model used for this study was based on 1977 data; the survey model results were adjusted by the appropriate Producers' Price Index to 1977 price levels. The results are displayed in total personal income, adjusted from 1977

[2] Miernyk provides a basic reference on I/O analysis.

[3] See the IMPLAN manual (Sieverts *et al.*) for further details. The data represents 1977 county-level activity. This is presently being updated to 1982.

The U.S. Forest Service IMPLAN software system is very inexpensive to use and is available for use by other public agencies.

[4] Net exports were estimated employing a supply-demand pool approach. Schaffer and Chu, and Czamanski and Malizia provide excellent descriptions of the supply-demand pool approach to balancing the table of transactions, and more generally, to nonsurvey techniques for developing I/O transaction tables.

TABLE 1. Total Personal Income Coefficients from Primary Data Models and IMPLAN[a] (Numbers in Parentheses Are Same Coefficients Derived from Corresponding IMPLAN Models).

Type of Change	Resulting Total Personal Income Change in $				
	Colorado[b]	Idaho[c]	Nevada[d]	Oregon[e]	Wyoming[f]
Per AUM Dollar	0.1638 (0.4699)	0.2120 (0.4417)	0.1809 (0.4321)	0.4668 (0.3471)	0.2433 (0.4048)
Per AUM	4.15 (12.01)	6.15 (12.80)	5.24 (12.52)	12.86 (9.90)	6.74 (11.22)
Per Construction Dollar	0.0496 (0.7100)	0.4577 (0.7042)	0.3533 (0.6219)	0.4457 (0.6120)	0.2959 (0.6329)
Per Household Income Dollar	1.1437 (1.84)	1.2991 (1.668)	1.1658 (1.5942)	1.1882 (1.5616)	1.1761 (1.6400)
Per Local Government Dollar	0.4718 (0.8300)	0.6518 (0.6851)	0.5261 (0.5958)	0.5933 (0.5206)	0.6854 (0.6500)

[a] See text for explanation and interpretation.
[b] Moffat, Routt, and Rio Blanco counties, based on 1974 (McKean and Weber).
[c] Blaine County, based on 1979 (Long and Meyer).
[d] Humboldt and Lander counties, based on 1976 (Fillo, Radtke, and Lewis).
[e] Grant County, based on 1979 (Obermiller).
[f] Big Horn County, based on 1974 (Lewis and Taylor).

to 1982 prices by the Consumers' Price Index (Tables 1–4).

Estimated total permitted grazing in animal unit months (AUMs) on federal lands is the sum of total Forest Service and Bureau of Land Management (BLM) permitted grazing for the region.

Two hypothetical fee increases were tested. The first was an increase from $1.40, which is the fee charged in 1982, to $2.00. The other fee tested was the smaller of a) the average private grazing land lease rate in each of the five states, or b) $8.00 per AUM. The maximum values by states were: $7.70 for Oregon, $7.98 for Idaho, $5.70 for Nevada, and $8.00 for Utah and Colorado.

Both the Forest Service and the BLM return a share of grazing fee receipts to the local area. The distribution of grazing fee receipts is as follows: the Forest Service returns 50 percent to the local area through the rangeland maintenance and improvement program (this money is assumed to go to the local construction sector). Local governments receive 25 percent for county roads and schools, and the remaining 25 percent goes to the federal treasury. For the BLM grazing districts the corresponding percentages are 50 percent, 12.5 percent and 37.5 percent. The transfer of funds back into the local economy is reflected in this impact analysis.

Assumed Rancher Responses to Grazing Fee Increases

The economic impact of increases in grazing fees on ranchers' incomes and on local community income depends partly on the way in which the ranchers respond to the increased grazing fee in the short-run. For the purposes of the present analysis, and in order to give a wide range of impact estimates, two responses are assumed. Minimum impacts on community income are expected if the ranchers simply absorb the costs of the fee increase by accepting lower returns from their operations, with no adjustment in their operation.

Larger impact estimates result if ranchers are assumed to reduce production in response to the grazing fee increase (purchase fewer AUMs of grazing and produce fewer animals for sale). This type of response is referred to as the herd adjustment response. The reduction in herd size would not be proportional to the reduction in use of federal AUMs because use of nonfederal forage resources remains unchanged.

For example, suppose a ranching area with a total of 10,000 cows is 50 percent dependent on federal range; i.e., out of a total of 120,000 AUMs of feed, 60,000 AUMs comes from federal range. At a fee of $8.00 per AUM, half (30,000) AUMs of federal AUMs are assumed not to be utilized. This amounts to a 25 percent reduction in total feed utilization in the area. Consequently, there is a total reduction in the number of beef cows of 25 percent. This assumes that private forage sources can be substituted for federal range on a one-to-one rate in terms of AUMs. Substitution occurs even though the two forage resources may not be "perfect substitutes" in the technical sense; e.g., hay is **not** the same as dryland pasture, but this analysis is based on the assumption that the operator can reorganize to limit the herd size reduction to be equal to the reduction in total forage availability.

Calculation of Impacts

Total impacts on "local personal income" (income) resulting from changes in final demand or output, depend on the size of the direct, indirect, and induced coefficient for the sector that is affected by the change.

Definitions for the income coefficients for a specific sector (column entry) are as follows:

Direct Income Coefficient: An element of the household row of the matrix of technical coefficients (A matrix).

Indirect Income Coefficient: an element of the household row of the $[I-A]^{-1}$ matrix of direct and indirect requirements (households exogenous) minus the direct income coefficient.[5]

Induced Income Coefficient: an element of the household row of the $[I-A]^{-1}$ matrix of direct and indirect requirements (households endogenous) matrix minus the comparable element of the $[I-A]^{-1}$ matrix (households exogenous).

Total Income Coefficient: the sum of the direct, indirect, and induced income coefficients which is equal to the comparable element of the household row of the $[I-A]^{-1}$ (household endogenous) matrix.

To utilize the total personal income coefficients, the sector's total gross output change, adjusted for trade margins as appropriate, is multiplied by the total personal income coefficient.

Minimum Response

Under the first assumed response to grazing fee increases, negative impacts on total personal income result from the multiplier effect of reduced expenditure by ranchers' households. Total reduced household expenditures are calculated as the product of total permitted grazing in each region times the change in grazing fee.

The primary data models used in this study provided the household income coefficient directly; calculation of negative community impact is made by multiplying the change in demand by the household income coefficient. IMPLAN models

[5] $[I-A]^{-1}$ refers to the algebraic manipulation of the technical coefficients matrix, which is subtracted from an identity matrix and inverted to derive the matrix of direct and indirect requirements. Households may be either endogenous or exogenous to the $[I-A]^{-1}$ matrix. If the household sector is included in the model (households endogenous) the model is referred to as "closed" with respect to households. A matrix of technical coefficients that does not include a households sector (households exogenous) is referred to as "open" with respect to households.

do not provide a comparable coefficient directly, since households are exogenous. The household income coefficient is calculated separately in the IMPLAN system.

Herd Adjustment Response

Calculation of negative community impacts under the second assumption is somewhat more complex. In this case, negative impacts on the community result from two sources: first, from the reduction in ranchers' household income due to higher costs for the AUMs still purchased; and second, from the effect of the ranching sector's reduced purchases from other sectors due to reduced herd size. The primary data models give a direct income coefficient from the ranching sector. An adjustment must be made to account for the fact that reductions in use of public forage would not cause reductions in use of privately owned forage resources and associated interindustry purchases (or intraindustry requirements) of hay and pasture. This interindustry impact must then be added to the impact of the accompanying reduction in ranchers' household incomes, which is due to the payment of higher fees for the remaining AUMs of federal grazing. This household impact is calculated in the same way as under the first assumption, although it is of smaller magnitude because of the reduction in grazing purchases.

Using IMPLAN, the procedure for calculating the household income portion of a negative impact is the same as under the first assumption. The additional impact of the reduction in use of AUMs is made analogously to the procedure described above for the primary data models.

In addition to the negative impacts of increased grazing fees, positive impacts resulting from the portion of grazing fee receipts which are returned to the local communities must be calculated. These positive impacts will be the same under either rancher response assumption, but calculation will vary somewhat between the two types of models. The primary data models give coefficients for local government (county roads and schools portion) and for the construction sector (rangeland improvement portion). As before, direct application of the coefficients yields the desired impact estimates. IMPLAN models do not have a local government sector, so the fee receipts returned to the local government were indirectly estimated. Rangeland improvement funds are treated as payments to the construction sector in IMPLAN.

TABLE 2. The Number of Counties, Sectors, and Population in the IMPLAN Models.

State	Counties	IMPLAN Sectors	1980 Population
Colorado	3	82	30,500
Idaho	1	70	9,841
Nevada	2	79	14,510
Oregon	1	53	8,210
Wyoming	1	70	11,829

Results

The coefficients from the primary data models and from IMPLAN are listed in Table 1. These coefficients are interpreted as follows: starting with the first column under the Colorado model, the first coefficient, 0.1638, shows the amount in dollars that total personal income in the three county areas would go up or down if all expenditures associated with grazing on federal lands went up or down respectively, by a total of one dollar. The coefficient in the third row, $4.15, shows the effect on total personal income of a change by one AUM of grazing on federal land.

Similar interpretations can be developed for the remaining categories. The numbers in parentheses show the corresponding impacts generated by the IMPLAN model.

TABLE 3. Summary of Total Local Economic Impact as a Result of Grazing Fee Increases.* Several Primary Models and IMPLAN.

Grazing Fee	Area	Primary Data Models	IMPLAN	Ratio of IMPLAN over Primary Data Models
		.... $		
(a) Minimum Response				
$2.00	N.W. counties, CO	220,000	340,000	1.5
	Blaine County, ID	50,000	60,000	1.2
	Humboldt & Lander co., NV	130,000	170,000	1.3
	Grant County, OR	50,000	60,000	1.3
	Big Horn County, WY	70,000	80,000	1.1
$8.00	N.W. counties, CO	2,390,000	3,770,000	1.6
	Blaine County, ID	570,000	710,000	1.2
	Humboldt & Lander co., NV	960,000	1,240,000	1.3
	Grant County, OR	480,000	640,000	1.3
	Big Horn County, WY	730,000	930,000	1.3
(b) Herd Adjustment Response				
$2.00	N.W. counties, CO	280,000	540,000	1.9
	Blaine County, ID	80,000	120,000	1.5
	Humboldt & Lander co., NV	220,000	380,000	1.7
	Grant County, OR	110,000	110,000	1.0
	Big Horn County, WY	100,000	140,000	1.4
$8.00	N.W. counties, CO	2,106,000	4,460,000	2.1
	Blaine County, ID	580,000	970,000	1.7
	Humboldt & Lander co., NV	1,140,000	2,210,000	1.9
	Grant County, OR	890,000	820,000	0.9
	Big Horn County, WY	780,000	1,150,000	1.5

* Impacts represent reductions in total personal income from wages, salaries, business, and proprietorship as a result of grazing fee increases.

Among the primary data models, there is relatively close similarity in impact coefficients for local government, household income, and construction. However, the income coefficient on construction expenditures for Big Horn County, Wyoming, is lower than for the other primary data models. One possible explanation is that the coal development in this area is fairly new and, therefore, there are more purchases from outside the region by the construction sector of Big Horn County than in the other locations.

Among the primary data models, the impact per AUM of federal grazing is similar for the Colorado, Idaho, Nevada, and Wyoming models, but much larger for the Grant County, Oregon, model. In contrast, the IMPLAN model shows greater impacts for Colorado, Idaho, Nevada, and Wyoming, than for Grant County, Oregon. The main explanation for the lower IMPLAN coefficient for Grant County, Oregon, is that there is a lower level of interindustry activity owing to the lack of diversity of the economy, which has only 53 sectors compared to 70 or more sectors for the other models (Table 2). The impact coefficients tend to be smaller in models where the number of sectors identified in the IMPLAN data base are fewer, i.e., when the economy is less diverse. The number of sectors in IMPLAN results from the number of sectors with nonzero employment among the 466 possible sectors. This is not a universal rule, however, as size of the impact also depends on the type of industries involved. In some cases, interindustry purchases may be minimal and in other cases, a significant proportion of

TABLE 4. Summary of Percentage Local Economic Impact as a Result of Grazing Fee Increase.* Percentage of 1980 Total County Income. Several Primary Data Models and IMPLAN.

Grazing Fee	Area	Primary Data Models	IMPLAN
(a) Minimum Response		Percent	
$2.00	N.W. counties, CO	−0.05	−0.08
	Blaine County, ID	−0.07	−0.08
	Humboldt & Lander co., NV	−0.21	−0.27
	Grant County, OR	−0.09	−0.12
	Big Horn County, WY	−0.09	−0.12
$8.00	N.W. counties, CO	−0.53	−0.84
	Blaine County, ID	−0.73	−0.90
	Humboldt & Lander co., NV	−1.47	−1.91
	Grant County, OR	−0.93	−1.23
	Big Horn County, WY	−1.01	−1.29
(b) Herd Adjustment Response			
$2.00	N.W. counties, CO	−0.06	−0.12
	Blaine County, ID	−0.10	−0.16
	Humboldt & Lander co., NV	−0.33	−0.59
	Grant County, OR	−0.21	−0.21
	Big Horn County, WY	−0.14	−0.19
$8.00	N.W. counties, CO	−0.48	−1.00
	Blaine County, ID	−0.74	−1.23
	Humboldt & Lander co., NV	−1.86	−3.47
	Grant County, OR	−1.71	−1.57
	Big Horn County, WY	−1.09	−1.60

* Impacts represent reductions in total personal income from wages, salaries, business, and proprietorship as a result of grazing fee increases.

income from business activity may be retained (spent) in the community.

The impacts estimated by the IMPLAN models are larger than those generated by primary data models with the exception of Grant County, Oregon, and Big Horn County, Wyoming. In the Grant County primary data model, the estimated impacts of changes in federal grazing shown in the first two rows are higher than for the other four primary data models as well as the IMPLAN model. A possible explanation for the fact that the Grant County primary data model coefficient is much larger than other primary data coefficients is that the Grant County survey model found greater community interindustry purchases than are found in the other areas. Another possible explanation is that ranching related labor expenses are 30 percent of all ranching expenses for the Grant County survey model. For the other primary data models as well as for IMPLAN, the percentage that is paid for labor (households) is about ten percent.

The results in terms of the impact on total personal income of systematic increases in grazing fees are shown in Table 3(a) for the minimum response assumption. The same results for the herd adjustment response assumptions are shown in Table 3(b). The additional negative impact under this assumption includes the reduction in ranching related expenditures that result from a reduction in cow numbers.

In terms of total impact, it is estimated that the northwest counties of Colorado would realize the greatest negative impact (a total of $4,460,000 as estimated with

IMPLAN with the herd adjustment response assumption at the $8.00 grazing fee level, Table 3(b)). However, because the economy of Humboldt and Lander counties, Nevada, is fairly small and dependent on federal grazing, it is estimated that this area would experience a greater percentage decrease (Table 4 gives the results in terms of percent of total local personal income).

In both the Colorado and Nevada areas, the estimated impacts (under the herd adjustment response) based on income coefficients from the IMPLAN model are approximately twice as high as those estimates that are based on income coefficients from the primary data models (Table 3(b)).

Conclusion

The purpose of this study was to compare estimates of local economic impacts using a specific secondary input/output model (U.S. Forest Service IMPLAN) and primary data input/output models that could result from increases in the federal grazing fee. The results based on local income coefficients derived from IMPLAN are compared to the results based on local coefficients derived from five primary data models. The five primary data models are for Big Horn County, Wyoming; Grant County, Oregon; Humboldt and Lander counties, Nevada; Blaine County, Idaho; and three counties in northwest Colorado.

The results show that the impacts estimated by the IMPLAN models were higher than those estimated by primary data in models in four of five cases. The differences between IMPLAN and primary data model estimates range from a negative ten percent difference in the Grant County area to a 110 percent difference for the northwest Colorado area. The Grant County survey model is the only one whose estimates are greater than the estimates obtained with IMPLAN. All other estimates of the IMPLAN models are greater than the survey model estimates.

IMPLAN models, because of the trade estimating procedures, understate the amount of imports and exports of the various sectors in the model. This is due to the assumption, in the supply-demand pool technique for estimating net exports, that local firms will not buy or sell to firms outside the region unless local supply and demand is exhausted. Leakages from imports which are not included in IMPLAN formulations may be included in a well-developed primary data model. Greater amount of leakages results in smaller impacts. Our results are consistent with Schaffer and Chu's conclusion that "supply-demand pool techniques, . . . assuming maximum possible local trade, may be used to provide estimates of upper limits on cell values."

The advantage IMPLAN provides is that economic impact estimates can be developed very quickly at low cost. With limited time and budget, use of secondary data models are frequently the only feasible way to estimate and compare the impacts of national policy changes on local communities. IMPLAN provides a **uniform method** for estimating local income impacts for counties anywhere in the United States.

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