

Effects of Selected Changes In Federal Land Use On a Rural Economy



Station Bulletin 604

March 1968

Agricultural Experiment Station

Oregon State University

Corvallis

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COVER: Open-forested regions of Grant County provide excellent summer grazing for cattle.
(*Courtesy U.S. Forest Service.*)

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ACKNOWLEDGMENTS: The authors wish to thank William K. Farrel, Grant County Extension agent; Al Reinertson, manager, Grant County Chamber of Commerce; and personnel of the United States Forest Service, the Bureau of Land Management, the Oregon State Land Board, and the United States Fish and Wildlife Service for their valuable assistance throughout the course of the study.

Effects of Selected Changes in Federal Land Use On a Rural Economy

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Summary and Conclusions

Increasing conflicts over the use of publicly owned lands have created a considerable degree of interest among those concerned with natural resource management. Many questions need answers, not only on the matter of individual firm impact from changes in land resource use, but on the social costs and benefits that result.

The research reported here was concerned with detailing the use of public lands for livestock grazing in eastern Oregon and the study of a smaller area economically dependent upon federal land use in an attempt to show the importance of range livestock grazing and timber production to the economic well-being of the area. Grant County, in central eastern Oregon, was selected as the area to be studied.

Range livestock production in eastern Oregon is an important use of federal lands. In 1964, over 1,500 permits or licenses were issued by the Forest Service and the Bureau of Land Management (BLM) on the 13 administrative units in eastern Oregon. Over 291,000 cattle (over 6 months of age) and horses were grazed for a total use of over 1,219,000 animal unit months. Federal rangeland provided approximately 13% of the annual forage requirement of eastern Oregon cattle and 40% of the necessary forage for all cattle in eastern Oregon during the 4-month grazing season which predominates in much of the area.

The allocation of federal grazing permits is strongly oriented toward the smaller ranches, although the majority of total use is made by the larger ranches: 75% of the permittees (those who own fewer than 400 breeding cows) were allocated 38% of the forage; 25% of the permittees (those who own more than 400 breeding cows) were allocated 62% of the forage.

An input-output model was constructed for Grant County to show the nature and extent of economic interdependence in a rural economy which is dependent upon several uses of federal lands. The county agriculture is primarily centered on range livestock with over two thirds of the full-time ranchers holding permits for national forest or BLM rangeland. Over three fourths of the logs harvested in the county in 1964 were from national forest lands. These two activities, range livestock production and lumber, accounted for almost 40% of the

total economic activity in the county in 1964. The exports of these two sectors derived a substantial quantity of "basic income" for the area. Basic income is new money which is brought into an economy as a result of exporting locally produced goods.

The Dependent Ranches sector¹ (comprised of ranches with federal grazing permits) exported 83% of its nearly \$4 million gross output, thus generating approximately \$3 million worth of basic income. The Lumber sector exported 90% of its nearly \$14 million gross output which generated \$12.5 million in basic income. These two activities accounted for 75% of the basic income brought into the economy in 1964 (almost \$16 million out of a total of \$21 million).

The importance of federal grazing and lumber can better be illustrated by examining the proportion of each dollar of gross output which was spent in the local economy. The Dependent Ranches sector spent \$0.48 out of every dollar of gross sales for the purchase of intermediate factors (those used in the further production of output). This amounted to \$1,792,539. All other agricultural producers (called Other Agriculture sector) spent \$0.49 out of every dollar for factor purchases, but because the sector's gross output was less than one fourth that of the Dependent Ranches, this amounted to only \$525,295. Thus, over 75% of the purchases of necessary supplies was made by two thirds of the county's ranchers.

The Lumber sector spent \$0.24 out of every dollar of gross output for factor purchases, but because its output was large, this amounted to \$3,304,324 (versus \$2,317,834 for both agricultural sectors).

The two activities (range livestock production and lumber) were responsible for 57% of the interbusiness trade in the county; that is, of the purchases of intermediate factors of production by all of the county's businesses, 57% came from these two sectors.

The Dependent Ranches sector spent \$0.10 per dollar of gross sales for labor and management services, and the Lumber sector spent \$0.30 per dollar of gross sales. Total payments to households by the Lumber sector

¹ Throughout the remainder of this bulletin names of the sectors from the input-output model will be capitalized.

alone amounted to \$4,180,952, which represents 40% of the total household income paid by all other commercial and agricultural firms and government agencies in the county.

In addition to the analysis summarized above, two hypothetical changes in federal land use were simulated to detail the possible impact on the county's businesses and households. The changes were: 1) a 20% reduction in the total quantity of federal grazing in the county; and 2) a 10% increase in the gross output of the Lumber sector.

A recent study sponsored by the Forest Service and the Bureau of Land Management was concerned with changes in ranch income resulting from a 20% reduction in the quantity of federal range use. These data were utilized to arrive at new levels of business activity in the Grant County economy. A 20% reduction in federal grazing would reduce gross income for the entire Dependent Ranches sector by 11%, bringing the new total sector output to \$3,321,665. This reduction of \$399,578 is the direct effect of the reduction in federal land use. It is not the total effect, however. When this reduction is traced through the model and the secondary effects are included, the remaining 13 sectors in the county will have their total output reduced by \$219,048. With this lower gross output, they will in turn purchase fewer inputs from the Dependent Ranches sector. An additional \$5,113 reduction will occur in the Dependent Ranches sector, bringing the total of direct and indirect effects to \$404,691. In total then, a 20% reduction in the quantity of federal grazing in Grant County is estimated to cause a \$623,739 loss of gross business income to the commercial and agricultural businesses of the county.

The reduction in business income, or gross receipts, is not the only reduction which would result. When businesses (commercial or agricultural) are forced to reduce output while maintaining the same labor force as before, average (unit) costs rise. When this occurs, businesses seek ways to reduce expenditures on variable cost items. For most businesses, labor costs are less "fixed" than other variable costs. In agriculture, with family labor as a residual, the return to this factor is extremely variable. As a result, payments to households for labor and management services might be expected to decrease. The computation of an income multiplier reveals the extent of this decreased household income. The Dependent Ranches sector has a household income multiplier of \$1.80; this means that for a \$1.00 decrease in the household income of the Dependent Ranches sector, total county household incomes will decrease an additional \$0.80.

The reduction in payments to the Household sector by the Dependent Ranches sector, as a result of a 20% reduction in grazing, was \$39,563. Multiplying this figure by the household income multiplier of \$1.80 yields a total household income loss of \$71,280.

Therefore, a 20% reduction in federal grazing use is estimated to cause county businesses to experience a decrease in total sales of \$623,739 and to reduce their payments to households in the county by \$71,280.

A 10% increase in the output of the Lumber sector was simulated because better forest management techniques and past conservation measures have supposedly increased the quantity of harvestable timber in the county. This 10% increase in output would amount to \$1,388,667 and raise the total output of the Lumber sector to \$15,275,337. This increase would cause an increase of \$269,631 in the output of the other 13 sectors in the economy. With a greater output in the Lumber sector, the amount of intra-sector trade would increase by \$125,945, bringing the total increase in the gross sales of the Lumber sector to \$1,514,612. The total increase for all county businesses (including the Lumber sector) would be \$1,784,243.

County household incomes would increase \$1.17 for every \$1.00 increase in household income of the Lumber sector. The 10% increase in gross sales of the Lumber sector would cause a \$456,013 increase in household incomes in that sector and a subsequent additional increase in the other 13 sectors of \$77,401, bringing the total impact on household incomes in the county to \$553,414.

An indication of which sectors would have the greatest impact on total business and household income was given. Increased tourist business in Grant County would have an impact upon two sectors which have the first and fourth highest business income multipliers, respectively, of the 14 sectors in the economy. The Cafes and Taverns sector has a business multiplier of \$1.60, which indicates that for a \$1.00 change in the output of that sector, total county business income will change an additional \$0.60. The Lodging sector has a business income multiplier of \$1.52. Both of the agricultural sectors are high; the Other Agriculture sector is tied for highest with \$1.60, while the Dependent Ranches sector is third with a business multiplier of \$1.56. Increased output in any of these 4 sectors would benefit total county business income more than would a similar increase in any of the other 10 sectors (the next largest multiplier is \$1.29 in the Construction sector).

In addition to the business income multiplier, a comparison of household income multipliers indicates that these same sectors are the top four in the county. Dependent Ranches is first with an income multiplier of \$1.80, which has been noted earlier. The Other Agricultural sector is next with a household income multiplier of \$1.53, followed by the Lodging sector with \$1.48 and the Cafes and Taverns sector with \$1.26.

Increases or decreases in the output of any, or all four, of these sectors would have a greater impact on business income, as well as household income, than similar changes in any of the other 10 sectors in the county.

While the situation in Grant County has been outlined, an important question is: How closely do the re-

sults approximate the situation in the rest of eastern Oregon? An important point is that the production of livestock or harvested timber is basically the same between and among somewhat similar regions. For example, beef production in Grant County requires approximately the same quantity of the various inputs *per dollar* of output as does beef production in other reasonably similar areas. What will be different is the relative importance of extensive range-livestock ranching operations in the total county agricultural picture and the relative importance of agriculture in the county. Grant, Harney, and Lake counties appear to be somewhat similar in these respects, and thus they might be expected to have fairly similar trade relationships between ranch-

ers and the rest of the economy. Baker, Wallowa, Deschutes, Crook, Wheeler, Malheur, Klamath, and Union counties, in the order given, rank behind those counties indicated as being similar to Grant. Intersectoral relationships found in Grant County would be less likely to represent conditions in the latter counties. The remaining eight counties have such an insignificant public range-beef sector that it is difficult to predict, with any certainty, the likely impact.

The eastern Oregon lumber industry was not studied in the same detail as was the livestock industry; therefore, generalization from the relationships in Grant County is not attempted in this area.

Introduction

Attitudes concerning the use of the vast federal land holdings in the West are undergoing considerable change. Until recently, commercial use of federal lands went unquestioned. There was no general demand for recreation use; lumber, livestock, and mineral extraction were the only active pursuits. With increased interest in outdoor recreation, some people have expressed concern over commercial use of public lands for private gain when these uses in any way conflict with what are considered to be the true "public uses." The extent to which these feelings are reflected in policy decisions has not been determined. However, many proposals have been made to increase the number of areas set aside as wilderness, primitive areas, and other types of single-use tracts.

Federal land comprises a significant portion of the total land area of the West; 65% of the collective land area of the 12 western states (not including Hawaii) is owned by the federal government. These holdings in the West constitute 94% of all federal lands. Oregon, with 52% federal land, is ranked sixth out of the 12 western states in the proportion of federal holdings.

Ninety-five percent of the total federal land is controlled by two agencies: the Department of the Interior with 71%, and the Department of Agriculture with 24%. The Bureau of Land Management (BLM) administers 88% of the land held by the Department of the Interior, and practically the entire amount is in the 12 western states. The vast majority of the BLM lands (excluding the O and C timber lands in western Oregon) is in organized grazing districts, while the remainder consists of widely scattered parcels administered under a separate section of the Taylor Grazing Act. The Forest Service administers over 99% of the land controlled by the De-

partment of Agriculture. Eighty-six percent of this land is found in the 12 western states (1, 18).²

Federal grazing lands have been used in conjunction with privately held land resources for the production of livestock since the settlement of the West. At the inception of the Forest Service, and later the Bureau of Land Management, this use was legitimized by granting grazing permits or licenses. Associated private lands have acquired an artificially high value because federal grazing permits give access to a factor of production which ranchers do not control in the same sense in which they control other factors of production.

Many communities have developed because of the policy of granting the original grazing permits to local users instead of transients. These communities serve as sources of supply and also as market outlets for the ranching sector. Because of this long history, it is not an easy matter to alter use patterns without causing economic loss to commercial and agricultural businesses.

The nature of the forage on most federal lands, and the resulting administration, relegates them to a role of providers of seasonal grazing. They can be used at certain times of the year only, and usually it is not an easy matter to provide substitute forage for the seasons of the year when use of federal lands is greatest. To curtail or deny use of the federal range portion of the ranching operation can often mean that the privately held land resources are much less valuable and perhaps economically worthless in extreme situations.

Timber production is also an important economic activity dependent upon federal land. Almost 58% of the commercial forest land in Oregon is administered

² Italic numbers in parentheses refer to Literature Cited, page 25.

by the federal government, with the Forest Service responsible for 81%. In eastern Oregon, 65% of the logs harvested in 1964 were from Forest Service land (12). Eastern Oregon contains almost 2.5% of the nation's commercial forest land, has over 4.5% of the nation's softwood (ponderosa, sugar, and white pine) timber volume, and produces 6% of the country's softwood lumber (6).

As with livestock, the rural economies of eastern Oregon are quite dependent upon the lumber industry. Over two thirds of the jobs in manufacturing industries in eastern Oregon are with lumber-oriented activities. The lumber industry, unlike the range livestock industry, is relatively labor intensive. A fairly large share of the gross receipts in the lumber industry goes to pay wages and salaries, which, in turn, are spent in the local communities for household and other needs.

Both of these activities, lumber and livestock, are similar in one important respect. They utilize an existing natural resource and turn it into a useable product. The product produced by each, which can be thought of as an intermediate good, is normally exported out of the immediate area and creates what is termed "basic income." This new money is always a significant stimulant to the economic well-being of an area. These two uses are not the only creators of outside income; tourists and recreationists (hunters and fishermen included) who stop in an area also bring new money into a local economy. One cannot specify in advance just what pattern is of the greatest economic advantage to a particular area. There are many areas in the Pacific Northwest, such as Grant County, that are heavily dependent upon the export of raw materials. Most such economies would like to become more self-sufficient; that is, to place greater emphasis on manufacturing and processing. However, such self-sufficiency should not come at the expense of economic efficiency. No doubt there are many economies, such as the one being studied here, that will continue to depend heavily for a significant period of time on the export of raw materials as the main stimulus to economic activity.

Because of this interdependence between the uses of federal lands and the economic well-being of many rural communities, there is need for more information on the

economic importance of these uses in areas where federal lands predominate.

Objectives and Organization of the Study

The objectives of this study were: 1) to depict the extent of grazing of domestic livestock on public lands in Oregon; 2) to ascertain the extent of economic activity attributable to the use of public lands as a source of feed for cattle operations in Grant County, Oregon; and 3), based upon the findings of objective two, to project the impact of adjustments in federal grazing on the total sales of the businesses in this county and the resultant change in household income of the area's residents. In addition, the expected economic impact from an increase in the allowable timber harvest in Grant County will be detailed.

A brief overview of grazing activities in eastern Oregon will be presented. The majority of the material is from the files of the United States Forest Service and the Bureau of Land Management, and it was obtained through the assistance and cooperation of these two agencies. A sample of the ranches in each administrative unit³ was drawn to detail the size distribution and extent of the use of federal lands by ranches of various sizes. Grant County, in central eastern Oregon, was selected as the area in which to concentrate the analytical portions of the study. This county has a substantial acreage of federal land and its economic well-being is dependent upon several uses of this land. Data on business activity and the interdependence of this trade was obtained for the 1964 calendar year. This data was collected through personal interviews with 30% of the county's commercial businesses and through questionnaires mailed to the agricultural producers in the county. Input-output analysis was utilized to quantify the interdependence of economic activity and to project the postulated impact on business and household incomes, both from a change in the quantity of federal grazing in Grant County and from an increase in the allowable timber harvest.

³ Throughout the remainder of this bulletin, a grazing district (BLM) or a national forest (Forest Service) will be referred to as an "administrative unit."

Grazing on Federal Lands

Use of federal lands in eastern Oregon for domestic livestock grazing is quite significant. In 1964 over 291,000 cattle (over 6 months of age) and horses were grazed on the public lands in the 13 administrative units listed in Table 1. There were an estimated 790,000 animal-unit-equivalents in the 19-county area of eastern Oregon on December 31, 1964. These 790,000 animal-unit-equivalents would require approximately 9,480,000 AUM's of feed in a 12-month period.⁴ The two federal agencies issued licenses or permits for 1,219,939 AUM's of grazing for 1964, which represents 13% of the annual requirement for these animal-unit-equivalents. However, because federal range is only a seasonal supply of forage, this figure underestimates the dependence of the ranching community upon the federal range during the season when the majority of this use is permitted—June, July, August, and September.⁵ During this 4-month

⁴ An AUM is the accepted index of forage requirement. An animal unit is considered to be 1,000 pounds of live weight, or a cow and a calf. The quantity of forage consumed by the cow and her calf in one month is an animal unit month of forage, abbreviated AUM. An animal-unit-equivalent is the equating of other classes of livestock to an AUM. Yearling heifers and steers equal .75 animal units, and a bull equals 1.5 animal units. A cow, calf, bull, and yearling would equal 3.25 animal-unit-equivalents.

⁵ Obviously, the grazing season throughout Oregon is not restricted to these exact four months. The sample of 231 permit holders in eastern Oregon indicates a grazing season that averages between 4.1 and 4.5 months in length. Certain regions, such as some in southeastern Oregon, have a grazing season that is 5 to 6 months long, but these are offset in averaging by permits in regions where a 3-month grazing season exists. This 4-month season is also not necessarily 4 consecutive months. Much range

period, the 790,000 animal-unit-equivalents in eastern Oregon would require 3,160,000 AUM's of forage. The quantity licensed by the two agencies (1,219,939) represents 39% of the estimated requirement. Thus it is seen that during the summer grazing season, federal range provided an estimated 40% of the required forage in 1964.⁶

In addition to the above use, over 400,000 acres of Section 15 lands administered by the BLM are leased by the acre rather than by the AUM. Accurate figures on the use of these lands are not available, and they were not included in the rough estimates presented in Table 1. Therefore, it is reasonable to assume that these estimates represent an understatement of the significance of federal grazing lands to eastern Oregon's livestock industry.

Table 2 presents information obtained from the Forest Service and the BLM for 12 of the 13 administrative units (all except Umatilla) listed in Table 1.⁷ The

forage is spring-fall range. It might be used from May 15 to July 15, and then again from August 15 to October 15. In addition, some areas of southeastern Oregon are winter range, and use in these regions might occur during November, December, January, and February. It is reasonable to say, however, that the four months listed are the time of year when the majority of livestock use occurs.

⁶ Although horses are included in the agency figures of use, their number is small enough to have a negligible effect upon the precision of these estimates.

⁷ The Umatilla Forest lies in Washington and Oregon, and difficulty in separating data for Oregon precluded the inclusion of the Umatilla permittees in computing the information contained in Table 2.

Table 1. Number of Grazing Permits Issued, Number of Cattle and Horses Grazed, and AUM's of Use Made by Cattle and Horses, by Administrative Unit, Oregon 1964¹

Forest Service				Bureau of Land Management			
Administrative unit	No. of permits ²	No. of cattle and horses	AUM's	Administrative unit	No. of permits	No. of cattle and horses	AUM's
Wallowa-Whitman ³	119	20,655	113,788	Baker	193	31,597	66,748
Winema	19	2,148	7,411	Burns	187	56,561	246,691
Rogue River	52	2,842	9,126	Vale	302	78,435	399,211
Ochoco	67	6,865	24,391	Prineville	193	17,830	73,641
Malheur ³	129	19,244	77,368	Lakeview	108	34,468	138,861
Fremont	55	11,972	31,352				
Umatilla	76	6,033	25,057				
Deschutes	18	2,480	8,294				
TOTALS	535	72,239	296,787		983	218,781	923,152

¹ Source: Annual grazing statistical reports of the Forest Service and the Bureau of Land Management, 1964.

² The 535 forest permits are term permits only. These differ from the temporary permit in that the rancher is more or less "guaranteed" the term use each year, whereas the temporary permit is an annual arrangement predicated upon forage availability. Total paid Forest Service permits numbered 779. The total of 1,762 permits (779 Forest Service, 983 BLM) is not the number of different ranches with permits, as approximately 40% of the ranches in the sample held permits with both agencies.

³ The portion of the Wallowa-Whitman National Forest south of the Umatilla (see Figure 1, page 10) is administered through the Malheur Forest. Therefore, all figures and references to the Malheur include this portion of the Wallowa-Whitman Forest.

Table 2. Characteristics of Eastern Oregon Cattle Ranches Having Federal Grazing Permits on BLM and Forest Service Lands, 1964¹

(Twelve Administrative Units)

Ranch size (1)	Number of breeding cows owned (2)	Number of permits (3)	Average number of cows owned per permittee (4)	Average number of animal units licensed per permit (5)	Average number of animal units licensed as a percent of cows owned (5) ÷ (4) (6)	Average number of AUM's per permit (7)	Percent of total permits in each size group (8)	AUM's of use made by each size group ² (3) × (7) (9)	Percent of total federal use made by each size group (10)
Small	0-199	743	96	64	67	273	52	202,839	18
Medium	200-399	333	271	159	59	666	23	221,778	20
Large	400-999	272	607	334	55	1,486	19	404,192	36
Extra large	≥1,000	94	1,573	671	43	3,038	6	285,572	26
TOTALS ..		1,442					100	1,114,381	100

¹ Figures are for a sample of term permit holders on the 12 forests (Umatilla excluded) listed in Table 1 and all permit holders on 5 eastern Oregon BLM districts.

² The total AUM's of the four size groups is less than the actual use of 1,194,882 AUM's. Most of the error is due to the restriction to term permits only on national forests, whereas the 1,194,882 AUM's includes all paid permitted use for the area in 1964. Another possible source is that average use of sampled ranches was obtained for each of the four size groups, and some error resulted when this average was multiplied by the number of permittees in each group.

size breakdown was obtained by recording the numbers of breeding cows reported as owned by each permittee on his annual grazing application. The number of permits is derived from Table 1 and includes all BLM permittees and term permit holders on all forests except the Umatilla.

Column 6 of Table 2 indicates an inverse relation between the size of the ranch and the proportion of breeding stock licensed on the federal range. Considerably fewer livestock from the larger ranches are permitted on the federal range than from the smaller ranches. Probably the primary reason for this situation is the upper limit restriction on the number of livestock which are allowed to graze the national forest; no permit holder can graze more than 600 cattle. The upper limit was 300 cattle until several years ago, and the full effects of the increased limit have not been realized. There is no upper limit on BLM ranges.

Column 8 indicates the proportion of grazing permits held by each of the four size groups. Over 50% of the permits are held by ranches which are considered by some to be uneconomical (17). Depending on the region, a ranch is considered marginal unless it has 200 to 250 cows.

The allocation of federal grazing use to the various size ranches is illustrated in Column 10 of Table 2. The small and medium-size ranches held 75% of the grazing permits in 1964, yet used only 38% of the forage licensed for that year. The large and extra-large ranches held 25% of the permits, yet were licensed for 62% of the forage. It becomes evident that the vast majority of the permits are held by the smaller ranches, but the major grazing use is made by the larger ranches.

Table 3 is a compilation of secondary data and is intended to help illustrate the various aspects of eastern Oregon counties, primarily land ownership and agricultural attributes. Those counties with a large percentage of Forest Service or BLM lands, and with their major agricultural product value comprised of the sale of cattle and calves, are the ones where the more extensive, range-livestock ranching operations predominate. The information in Table 3 will be utilized when discussing the effects of possible changes in federal land use.

Consideration is given next to an eastern Oregon county where both range-livestock and timber production are dependent upon federal lands.

Table 3. Federal and State Land Ownership, Value of Agricultural Products Sold, Value of Livestock and Livestock Products Sold, and Value of Cattle and Calves Sold, Nineteen Eastern Oregon Counties, 1964¹

	Baker	Crook	Deschutes	Gilliam	Grant	Harney	Hood River	Jackson	Jefferson	Klamath	Lake
Forest Service (Acres)	644,953	434,792	966,846	0	1,557,265	516,739	210,346	427,823	268,902	1,615,549	1,025,918
(Percent).....	33	23	50	-	54	8	63	24	23	42	19
BLM (Acres) ²	301,416	493,290	430,645	32,038	172,485	3,988,344	276	43,007	26,162	188,752	2,545,501
(Percent)	15	26	22	4	6	62	Trace	2	2	5	48
State Land Board (Acres)	9,994	25,242	24,381	1,650	4,950	217,069	1,010	2,262	433	13,867	89,346
(Percent) ..	Trace	1	1	Trace	Trace	3	Trace	Trace	Trace	Trace	2
Other (Acres) ⁵	1,017,397	953,876	515,408	741,352	1,165,780	1,762,328	126,928	1,329,788	852,663	2,004,552	1,632,035
(Percent)	52	50	27	96	40	27	37	74	75	53	31
Total (Acres)	1,973,760	1,907,200	1,937,280	775,040	2,900,480	6,484,480	338,560	1,802,880	1,148,160	3,822,720	5,292,800
Value of all agr. prod. sold, 1964 (Dollars) ³	8,061,000	7,219,000	4,835,000	5,732,000	4,113,000	5,763,000	6,156,000	14,326,000	16,471,000	24,033,000	5,000,000
Value of all livestock and live- stock prod. sold—1964 ³ (Dollars)	5,200,000	3,983,000	3,682,000	1,148,000	3,865,000	5,236,000	621,000	6,135,000	2,777,000	11,388,000	4,110,000
Percent of value of agric. prod. sold which was from live- stock and livestock products..	77	55	76	20	94	91	10	43	17	47	82
Value of all cattle and calves sold—1964 (Dollars) ³	4,993,000	3,439,000	1,668,000	990,000	3,552,000	4,860,000	119,000	2,460,000	2,290,000	9,300,000	3,704,000
Percent of value of livestock and livestock prod. sold which was from cattle and calves ..	81	86	45	86	92	93	19	40	82	82	90
All cattle on farms—1964 ⁴	96,000	59,000	33,000	22,000	59,000	109,000	5,000	55,000	33,000	114,000	83,000

	Malheur	Morrow	Sherman	Umatilla	Union	Wallowa	Wasco	Wheeler	Area Totals	State Totals	Area as percent of state
Forest Service (Acres)	3,831	136,176	0	401,924	617,827	1,139,037	209,747	165,021	10,342,696	15,001,833	69
(Percent).....	Trace	10	-	19	48	56	14	15			
BLM (Acres) ²	4,613,167	47,082	41,182	34,764	6,452	19,089	35,845	85,524	13,109,021	13,299,411	99
(Percent)	73	4	8	2	Trace	1	2	8			
State Land Board (Acres)	262,898	104	1,317	1,612	1,189	2,172	2,237	3,951	665,684	771,304	86
(Percent) ..	4	Trace	Trace	Trace	Trace	1	Trace	Trace			
Other (Acres) ⁵	1,436,904	1,134,398	488,701	1,629,540	675,012	873,622	1,279,851	833,984	20,454,119	32,569,052	63
(Percent)	23	86	92	79	52	42	84	77			
Total (Acres)	6,316,800	1,317,760	531,200	2,067,840	1,300,480	2,033,920	1,527,680	1,092,480	44,571,520	61,641,600	72
Value of all agr. prod. sold, 1964 (Dollars) ³	34,403,000	7,681,000	6,687,000	31,962,000	9,781,000	4,937,000	8,291,000	1,818,000	207,179,000	428,990,000	48
Value of all livestock and live- stock prod. sold—1964 ³ (Dollars)	13,560,000	1,982,000	724,000	11,382,000	4,116,000	3,378,000	2,503,000	1,431,000	88,221,000	178,500,000	49
Percent of value of agric. prod. sold which was from live- stock and livestock products..	39	26	11	36	42	68	30	79	42	42	
Value of all cattle and calves sold—1964 (Dollars) ³	8,400,000	1,510,000	613,000	8,178,000	2,979,000	2,458,000	1,669,000	1,134,000	63,316,000	77,749,000	81
Percent of value of livestock and livestock prod. sold which was from cattle and calves ..	62	76	85	72	72	73	67	79	72	44	
All cattle on farms—1964 ⁴	186,000	34,000	12,000	108,000	45,000	47,000	38,000	26,000	1,164,000	1,599,000	73

¹ All acreage figures for federal land as of June 30, 1961. Source: "Federal Land in Oregon," W. B. Carolan Jr., M.S. Thesis, Department of Natural Resources, OSU, Oct. 1962. All acreage figures for state land as of June 30, 1964. Source: Biennial Report of the Oregon State Land Board, 1962-64.

² Public Domain only—does not include O & C land.

³ Source: OSU Extension Service.

⁴ Source: OSU Extension Service; numbers as of Jan. 1, 1965.

⁵ Includes private, city, and small isolated tracts of federal lands (Postoffice, etc.).

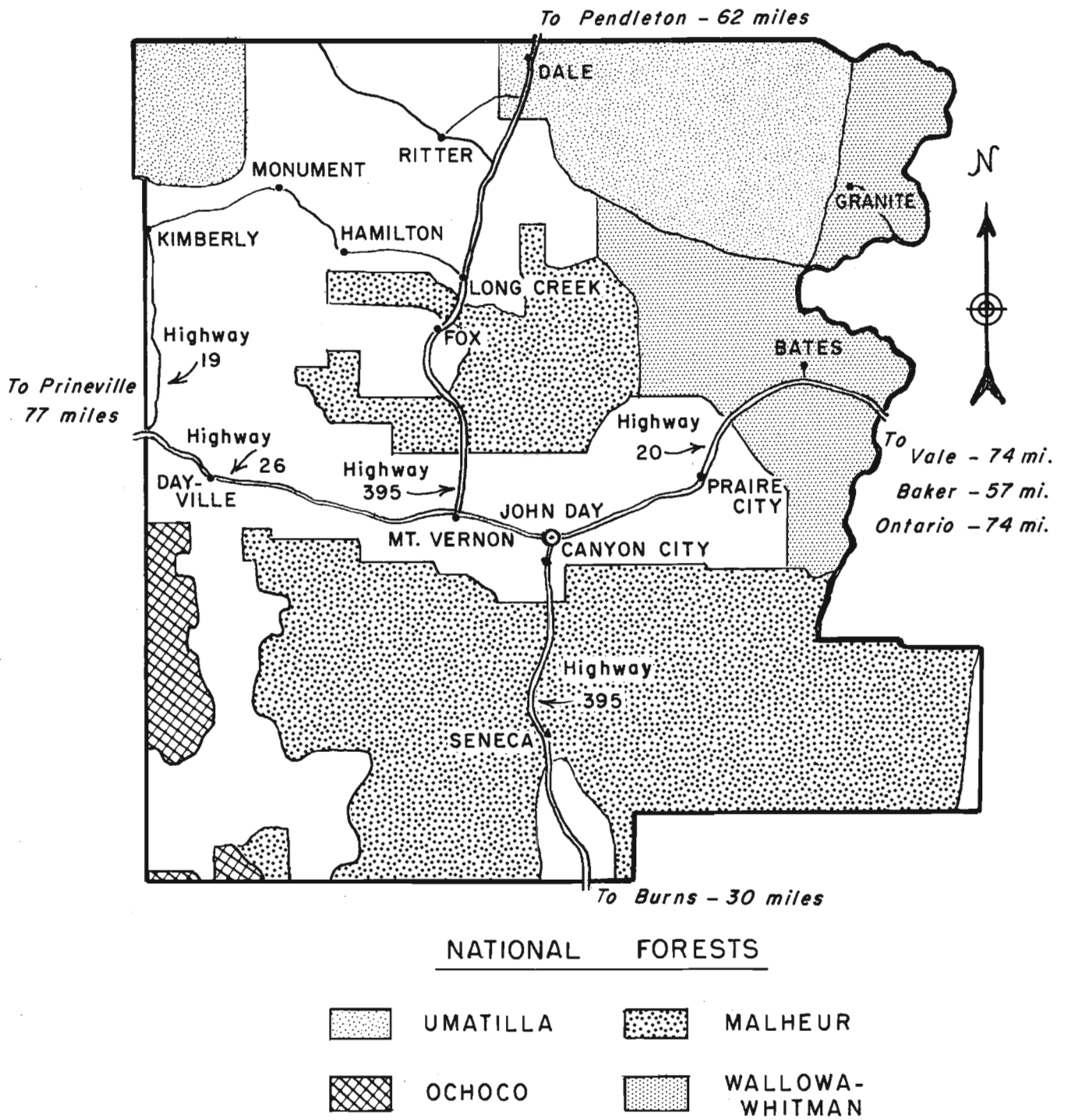


Figure 1. Map of Grant County, Oregon.

The Input-Output Model

To analyze the relationship between production on federal lands and its impact upon the local economy, it was found necessary to select a smaller area in eastern Oregon in which a more detailed analysis might be conducted. Grant County, in central eastern Oregon, was chosen for this purpose. Certain economic and physical attributes of the county made it a logical choice. First, federal grazing and timber lands comprise approximately 60% of the total land area of Grant County. The county lies in a transition zone between the desert of southeastern Oregon and the more mountainous northeastern portion of the state, and thus, although timber production and grazing are important activities, there is a great potential for recreational development. Third, unlike some of the other eastern Oregon counties, the use of federal lands is not predominantly grazing or timber production, but a balance of both uses. Grazing is a very important activity, yet total gross receipts in the lumber industry in 1964 were nearly three times larger than total agricultural receipts.

Grant County (Figure 1) is situated at the southern end of the Blue Mountains and encompasses practically the entire principal watershed of the John Day River. Most of the eastern boundary follows the crest of the Blue Mountains; these mountains are also the origin of the John Day River. The main fork of the John Day leaves the mountains just east of Prairie City and then follows Highway 26 west, and later Highway 19 north, to where it leaves the county at Kimberly. This narrow river valley, 75 miles in length, forms the only significant area in the county in which irrigated agriculture is practiced.

The total land area of the county is 4,532 square miles. The population, all rural by United States Census

standards, is sparse and shows signs of becoming more so. The population density of the county was 1.7 persons per square mile (July 1, 1965) and was fourth out of the 36 Oregon counties for lowest population density. The 1960 Census listed 7,726 people in the county, while the figures for July 1, 1965, listed 7,600 (13).

The principal towns in Grant County and their population in 1960 are: John Day—1,520; Prairie City—801; Canyon City (county seat)—654; Mount Vernon—502; Long Creek—295; Dayville—234; and Monument—214. Other communities are Bates, Seneca, Fox, Ritter, Kimberly, Granite, Hamilton, and Dale. Towns with published population figures account for 55% of the county's population. The remainder of the people live in the smaller communities or on widely scattered ranches (16).

Land ownership in the county is divided among the Forest Service with 1,557,265 acres (54%), the Bureau of Land Management with 172,485 acres (6%), the State of Oregon with 4,950 acres (.002%), with the remaining 40% divided among private ownership as well as other small federal holdings. The Bureau of Land Management holdings are not in a grazing district but are classified as Section 15 lands and consist of small, widely scattered parcels that are leased to adjacent livestock operators.

Comparing Table 4 with Table 2 reveals the nature of grazing permits on the Malheur National Forest as compared to the other 11 administrative units sampled. The average number of cows owned by each permittee in each size group is extremely close (Column 4, Table 4).

The number of livestock permitted as a percent of breeding cows owned is significantly lower on the Malheur Forest than for the rest of eastern Oregon. For ex-

Table 4. Characteristics of Grant County Ranches With Grazing Permits on the Malheur National Forest, 1964¹

Ranch size (1)	Number of breeding cows owned (2)	Number of permits (3)	Average number of cows owned per permittee (4)	Average number of animal units licensed per permit (5)	Average number of animal units licensed as a percent of cows owned (5) ÷ (4) (6)	Average number of AUM's per permit (7)	Percent of total permits in each size group (8)	AUM's of use made by each size group ² (3) × (7) (9)	Percent of total federal use made by each size group (10)
Small	0-199	47	94	44	47	181	36	8,507	12
Medium ..	200-399	37	276	97	35	416	29	15,392	22
Large	400-999	34	522	250	48	811	26	27,574	41
Extra large	1,000+	11	1,580	424	27	1,551	9	17,061	25
TOTALS		129					100	68,534	100

¹ Because the majority of the Wallowa-Whitman National Forest within the boundaries of Grant County is administered by the Malheur Forest, the figures here pertain to permittees on the Malheur Forest proper and to those on that portion of the Wallowa-Whitman Forest which is administered as part of the Malheur. See footnote 3, Table 1, page 7.

² There were 165 paid permits on the Malheur Forest in 1964, of which 129 were term permits. Therefore, the computed total use of 68,534 AUM's is less than the total permitted use of 77,368 AUM's.

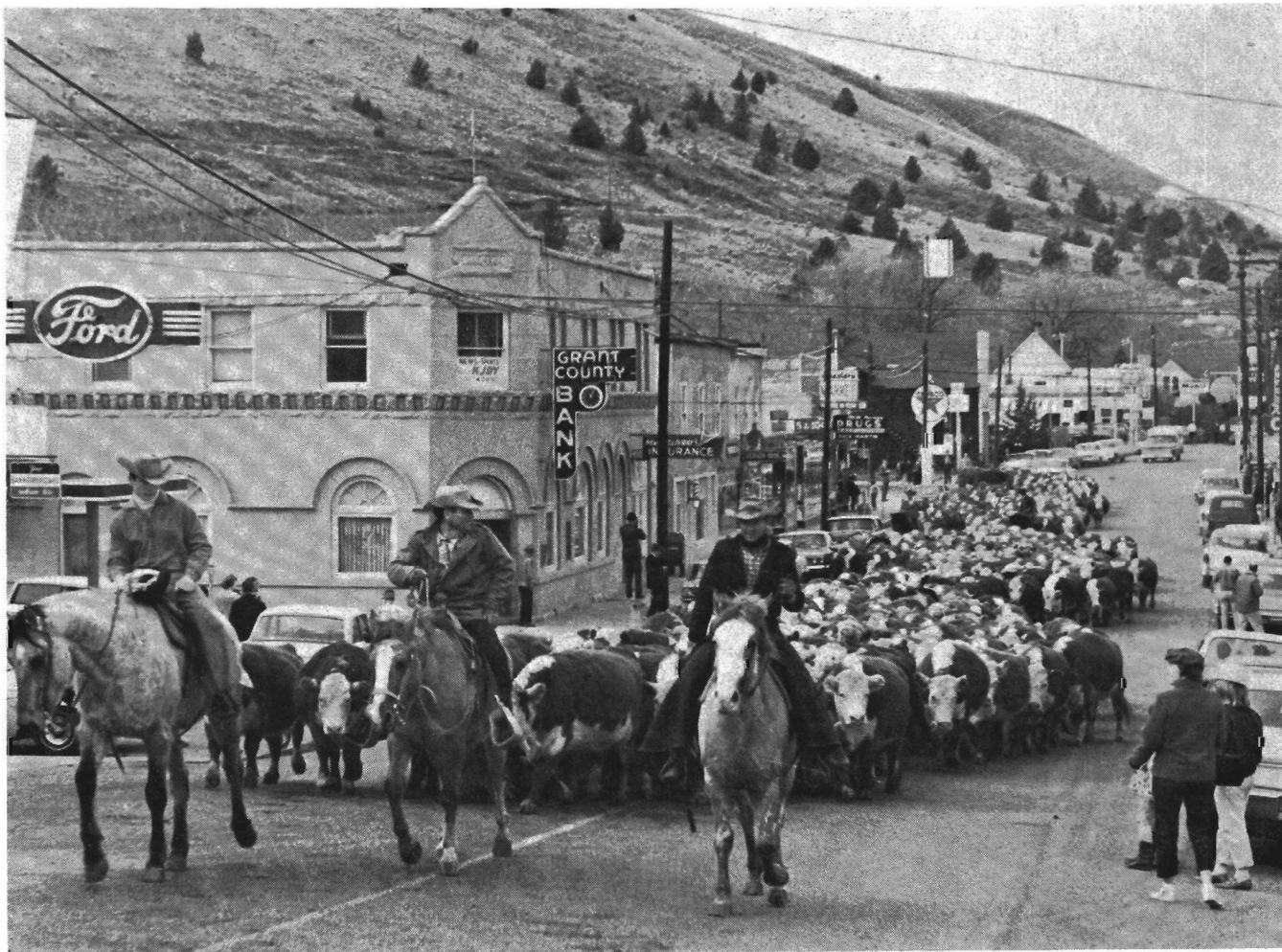
ample, medium-sized ranches over all of eastern Oregon were licensed for 59% of the cows owned, whereas those in Grant County had licenses for only 35%. The comparable figures for extra-large ranches are 43 and 27%, respectively. Average number of AUM's per permit is also less on the Malheur, with the two largest size groups licensed for approximately half of the AUM's used by their respective counterpart in the entire eastern Oregon region.

The allocation of grazing permits on the Malheur Forest is less oriented toward the small ranch than is the case for all of eastern Oregon. Only 36% of the permits are held by small ranches. The two middle-size groups are larger than for the entire region, and the extra-large group is 50% larger (6% versus 9% for the Malheur Forest). The proportion of grazing use made by each of the four categories is quite close to averages for the region. Less use is made by the small ranches on the Malheur Forest and more by the two middle-size groups. The extra-large group has approxi-

mately the same proportion of total use allotted to it (26% versus 25%).

The agriculture of Grant County is primarily concerned with livestock; 94% of the total value of all crops, livestock, and livestock products is derived from livestock and livestock product sales. Over 92% of the receipts from the sale of livestock and livestock products came from the sale of cattle and calves. The value of crops sold was only \$248,000 and consisted primarily of hay, wheat, barley, and oats (14).

The forested areas of the county are characterized by slightly acid, well-drained, brown soils, while the soil of the foothill-grass region is dark brown, nearly neutral, and well drained. This type of soil and vegetation makes up about one fifth of the area of the county and is concentrated along the western edge of the county and up the John Day River Valley. The majority of the forested regions are covered by ponderosa pine, with lesser amounts of larch along the crest of the Blue Mountains. Range vegetation is primarily low sage-



Cattle production is the largest source of agricultural dollars generated in Grant County. (Courtesy Grant County Chamber of Commerce.)

brush and grass, although there are considerable amounts of grass understory in the ponderosa regions.

The climate of the area is one of mild extremes with an average summer temperature of 66 degrees and an average winter temperature of 36 degrees. The average summer precipitation is 1.53 inches, and the average winter precipitation is 4.68 inches. Most of the winter precipitation comes in the form of snow (13).

The Grant County Economy

An input-output model permits the tracing of money as it moves through a given economy so that inferences can be made concerning the economic interdependence of the various activities within the economy. The interested reader is encouraged to see Chenery and Clark or Miernyk for a more complete, yet reasonably simple, exposition of the theory of input-output analysis (3, 9, 10).

The first step in constructing an input-output model for an area is the aggregation of all business activity into sectors. Usually these sectors correspond to our traditional concept of an industry; the firms all produce a somewhat homogeneous product using approximately the same inputs. There were 12 commercial business sectors and 2 agricultural sectors; one for cattle ranches dependent upon federal range (Dependent Ranches) and the other for all other agricultural activities in the county (Other Agriculture).⁸

Systematic random sampling was utilized to draw a sample of approximately 30% of the commercial business firms (79 out of 288) which were then visited during the summer of 1965. Information was obtained on gross sales, sectoral distribution of sales within Grant County, exports, investment purchases, and other data used in the construction of the transactions table.

The agricultural producers were sent a questionnaire by mail. The Dependent Ranches sector returned 42% of their questionnaires (61 out of 143) and the Other Agriculture sector returned 18% (15 out of 82). Through knowledge of the relative sizes of sampled to unsampled firms, both in the agricultural sectors and the 12 commercial sectors, it was possible to expand the sample data to arrive at figures for the county's businesses as a whole.

The transactions table for Grant County is presented as Table 5. The same "industries," or sectors, appear along both the top and the left side. Those listed across the top made purchases from those listed along the side and similarly those along the side sold to the sectors listed across the top of the table. The figures in the cells represent money flows (in exchange for goods and services) from sectors across the top to sectors along the side. Thus sector 1, Dependent Ranches, purchased \$42,713 worth of goods and services from itself (intra-sector trade), \$41,529 worth of goods and services from

the Other Agricultural producers, nothing from the Lumber or Mining sectors, \$1,680 worth from the Lodging sector, nothing from the Cafes and Taverns sector, \$197,982 worth from the Agricultural Services sector, and so on down the first column. It should be pointed out that these dollar flows represent only intermediate goods in strict economic usage; all purchases are used as an input in the productive process of the industries listed across the top. There are no purchases by, say, ranchers for their personal use. Only business expenditures are recorded.

Not only can purchases by the respective sectors be traced down the columns, but each sector's sales can be described by reading across the row in question. Again using Dependent Ranches as an example, sales were \$42,713 of intrasector trade, \$76,373 received from the Other Agriculture sector, \$42,570 received from the Lumber sector, and so on across Row 1 in Table 5. The first 14 rows and the first 14 columns in the table represent the processing sector of the larger table and are similar to a double-entry type of bookkeeping system wherein every sale and purchase is accounted for.

Row 15, Households, represents the amount of money paid to individuals by firms in sectors listed across the top of the table in exchange for labor and entrepreneurial services. Row 16, labeled Government, represents the amount of money received by both local (county or city governments) and state and federal agencies in the form of taxes, fees, licenses, and so forth from the respective businesses across the top of the table. The Imports row, 17, is the amount of "leakage" from the economy in the form of imported products and services by the sectors named across the top of the table. The magnitude of these imports indicates the degree to which the Grant County economy is not self sufficient. Row 18, Depreciation and Negative Inventory Change, shows the magnitude of the amount allocated for the year by the respective businesses for capital consumption (depreciation) and the extent of net depletion of previously accumulated raw materials, intermediate goods, and finished products. Row 19, Total Input, represents the sum of all of the entries in each column. It will be noticed that this figure for a given sector is identical with the corresponding sector's total output entry in Column 19. The Imports figure is the only entry, except for total output of the Mining sector and its wage payments, that was not obtained directly through interviews. In the long run, total income must equal total expenditures; therefore, the sum of all entries in each column was subtracted from the respective sector's output in order to derive Imports as a residual.

Referring now to Column 15, Households, the entries in this column pertain to purchases made by households from the respective businesses listed across the left side of the table. Column 16, Government, reflects the value of goods and services purchased by local, state, and federal government agencies from the respective sectors along the left side of the table. Column 17, Ex-

⁸ See Appendix Table 1 for a list of types of businesses in each sector.

Table 5. Transactions Table Showing Interindustry Flows in Dollars, Grant County, Oregon, 1964

		PURCHASES									
SALES		Dependent Ranches (1)	Other Agriculture (2)	Lumber (3)	Mining (4)	Lodging (5)	Cafes and Taverns (6)	Agricultural Services (7)	Automotive (8)	Communi- cation and Transpor- tation (9)	Profes- sional (10)
	(1) Dependent Ranches	\$ 42,713	\$ 76,373	\$ 42,570	\$ 0	\$ 572	\$ 0	\$ 1,716	\$ 0	\$ 0	\$ 0
	(2) Other Agriculture	41,529	17,278	1,722	0	0	0	0	0	0	0
	(3) Lumber	0	0	1,154,776	0	0	0	0	0	0	0
	(4) Mining	0	0	0	0	0	0	0	0	0	0
	(5) Lodging	1,680	1,200	4,488	0	0	0	0	0	1,200	0
	(6) Cafes and Taverns	0	0	0	0	0	0	0	0	0	0
	(7) Agricultural Serv- ices	197,982	37,926	45,000	30,000	15,000	0	0	0	0	0
	(8) Automotive	991,910	201,120	1,088,086	10,089	85,280	22,570	8,554	1,113,889	104,497	0
	(9) Communication and Transportation	1,735	517	43,750	692	4,044	3,586	3,076	99,497	21,855	12,415
(10) Professional	73,321	41,243	11,670	0	2,670	2,370	0	7,700	2,970	450	
(11) Financial	113,816	30,256	72,036	0	1,566	1,566	0	0	9,396	0	
(12) Construction	33,829	5,839	3,440	1,720	0	5,760	0	0	200	0	
(13) Products	181,571	63,926	749,265	5,876	47,326	347,846	5,302	65,929	49,429	17,428	
(14) Services	112,453	49,617	87,521	0	33,015	37,746	114	16,746	900	4,272	
Summation	\$1,792,539	525,295	3,304,324	48,377	189,473	421,444	18,762	1,303,761	190,447	34,565	
(15) Households	363,792	190,650	4,180,952	70,907	72,700	233,161	36,000	800,805	457,309	544,832	
(16) Government	463,636	126,216	167,374		30,262	6,682	3,600	37,906	102,289	8,835	
(17) Imports	380,556	35,537	5,798,908		11,741	87,716	316,638	5,819,541	229,091	438,514	
(18) Depreciation and Neg. Inv. Changes	720,720	188,600	435,112		111,424	14,497	9,000	65,264	109,317	83,372	
(19) Total inputs	\$3,721,243	\$1,066,298	\$13,886,670	\$ 358,000	\$ 415,600	\$ 763,500	\$ 384,000	\$8,027,277	\$1,088,453	\$1,110,118	

Table 5. Transactions Table Showing Interindustry Flows in Dollars, Grant County, Oregon, 1964 (Continued)

	PURCHASES								Total Output (19)
	Financial (11)	Construction (12)	Products (13)	Services (14)	Households (15)	Government (16)	Exports (17)	Capital Formation and Positive Inventory Change (18)	
(1) Dependent Ranches	\$ 572	\$ 715	\$ 11,583	\$ 572	\$ 1,430	\$ 54,641	\$3,084,097	\$ 403,689	\$3,721,243
(2) Other Agriculture	0	0	574	5,740	492	48,034	836,869	114,060	1,066,298
(3) Lumber	0	0	0	0	43,200	3,000	12,567,000	118,694	13,886,670
(4) Mining	0	0	0	0	0	0	358,000	0	358,000
(5) Lodging	0	4,350	0	0	27,960	66,600	306,050	2,000	415,600
(6) Cafes and Taverns	0	0	0	0	457,600	0	305,900	0	763,500
(7) Agricultural Services	0	0	0	0	15,000	0	0	43,092	384,000
(8) Automotive	78	72,793	32,914	29,329	2,603,201	552,632	902,578	207,757	8,027,277
(9) Communication and Transportation	4,723	9,605	108,931	14,865	201,631	33,146	513,889	10,496	1,088,453
(10) Professional	900	2,400	24,026	8,550	746,882	119,870	62,596	2,500	1,110,118
(11) Financial	0	12,528	15,439	6,264	53,244	126,720	0	480,000	922,831
(12) Construction	0	8,600	3,440	0	139,627	376,155	25,783	175,742	780,135
(13) Products	3,909	83,861	633,955	43,033	7,260,812	283,039	1,787,672	182,306	11,812,485
(14) Services	385	1,335	36,888	0	557,693	8,689	50,861	4,584	1,002,819
Summation	10,567	196,187	867,750	108,353	12,108,772	1,672,526	20,801,295	1,744,920	
(15) Households	134,040	130,227	1,097,451	403,399		1,622,440			
(16) Government	27,965	3,624	371,218	36,627					
(17) Imports	749,019	429,877	9,138,001	355,059					
(18) Depreciation and Neg. Inv. Changes	3,240	20,220	338,065	99,381					
(19) Total inputs	\$ 922,831	\$ 780,135	\$11,812,485	\$1,002,819					\$45,339,429

SALES

ports, shows the magnitude of "basic income" generated by each of the industries listed along the left side of the table. The column labeled Capital Formation and Positive Inventory Change represents first the amount of investment expenditures that were spent in purchasing capital items from the sectors along the left side of the table and, secondly, the extent of accumulation of raw materials, intermediate goods, and finished products by the sectors along the left side of the table. Column 19, Total Output, shows the gross output of each of the sectors along the left side.

These two portions of the table form the second and third major parts of the transactions table. Rows 15 through 18 represent the "payments," "value added," or primary inputs portion and reflect the purchase of inputs not produced by firms within the processing part of the model. In a static model such as the one utilized in Grant County, the use of existing capital stock represents a primary input, just as does the use of land and labor. Thus, the total payment to primary factors by each sector corresponds approximately to the value added in production.

Columns 15 through 18 represent the "final demand," or final use of goods and services, categorized by major type of usage. The sum of the items in this portion is approximately equal to "Gross County Product." In a national model, this sum would correspond to Gross National Product (GNP).

TRADE COEFFICIENTS

While the dollar flows depict the purchasing and selling patterns of the economy's sectors, a more illustrative picture of interdependence is presented in Table 6. This is the table of trade coefficients which were computed as follows: To get the trade coefficients for Column 1, divide each dollar entry (cell) in the column by the total output of Sector 1. For Column 2, divide each cell entry by the total dollar figure for the Other Agriculture sector. For example, the trade coefficient for cell 1,1 (first row, first column) would be \$42,713 divided by \$3,721,243 or .011478. For cell 2,1 (second row, first column) it would be \$41,529 divided by \$3,721,243 or .011160. For cell 1,2 (first row, second column) it would be \$76,373 divided by \$1,066,298 or .71624.

The coefficients in, say, Column 1 represent that portion of total output of the Dependent Ranches sector which was spent in the purchase of business inputs from the sectors listed along the left side of the table. These coefficients represent the degree of dependence of a sector upon all other sectors of the economy. To determine the input mix of an industry, merely read down its respective column. Using Dependent Ranches as an example, it is seen that for every dollar of output of the sector, its member firms purchased \$0.01 (0.011478) worth of inputs from the other ranches in the same sector; \$0.01 (0.011160) worth of inputs from the Other Agriculture sector; \$0.0005 (0.000451) from the Lodging

sector; \$0.05 (0.053203) worth of inputs from the Agricultural Services sector; \$0.27 (0.266553) worth of inputs from the Automotive sector, and so on down Column 1. This process can be repeated for any of the sectors listed across the top of the table. The sum of the first 14 rows in Table 6 is referred to as the "intermediate goods coefficient" for that sector. The Lumber sector's intermediate goods coefficient is .237951 which indicates that for every dollar of gross receipts of that sector, \$0.24 was spent in Grant County for goods and services used in production.

ECONOMIC INTERDEPENDENCE

With the mechanics of reading the tables out of the way, it is now possible to discuss some of the characteristics of the Grant County economy as revealed by the transactions table (Table 5) and the trade coefficients table (Table 6).

Referring first to Table 5, it is seen that the majority of the cells in the first seven columns are either empty or contain relatively small entries. This occurs because the first six sectors are largely exporters, and the seventh is a large importer that in turn sells to very few of the other sectors in the economy. The two agricultural sectors export the majority of their output (cattle) to the feedlots of other counties or states (except for some intraindustry trade and a few minor sales). The Dependent Ranches sector exported 83% of its output, while the Other Agriculture sector exported 78% of its output. With this estimate of the magnitude of new money brought into the local economy, it is of interest to see how much of it was spent in intermediate production as compared to the other large exporting sector, Lumber. The Dependent Ranches sector spent just less than half (\$0.48) of every dollar earned for the purchase of intermediate goods (for production purposes) from Grant County's businesses (sum of Rows 1-14, Table 6). The Other Agriculture sector, although accounting for only 22% of the total agricultural output of the county, spent almost half of every income dollar (\$0.49) in the acquisition of intermediate goods and services. Thus the two agricultural sectors taken together purchased \$0.48 worth of goods and services from Grant County businesses for every \$1.00 of output they sold. The total amount spent in the county by the two sectors was \$2,317,834. Of this amount, the Dependent Ranches sector spent \$1,792,539, or over 77%. The Other Agriculture sector spent \$525,295 for the remaining 23%.

The Lumber sector is the largest exporter, both in absolute quantity and in percent of its output (90%). At the same time, it spent much less in the local communities per dollar of output (\$0.24) than did either of the agricultural sectors. While its gross output was \$13,886,670, because of its low intermediate goods coefficient, it spent only \$3,304,324 on the acquisition of intermediate goods and services from the county's businesses.

The Dependent Ranches sector with a gross output of \$3,721,243 and the Lumber sector with a gross out-

Table 6. Trade Coefficients, Grant County, Oregon, 1964

SALES

PURCHASES							
	Dependent Ranches (1)	Other Agriculture (2)	Lumber (3)	Mining (4)	Lodging (5)	Cafes and Taverns (6)	Agricultural Services (7)
(1) Dependent Ranches .....	.011478	.071624	.003066	0	.001376	0	.004469
(2) Other Agriculture .....	.011160	.016204	.000124	0	0	0	0
(3) Lumber	0	0	.083157	0	0	0	0
(4) Mining	0	0	0	0	0	0	0
(5) Lodging .....	.000451	.001125	.000323	.000201	0	0	0
(6) Cafes and Taverns	0	0	0	0	0	0	0
(7) Agricultural Services .....	.053203	.035568	.003241	.083799	.036092	0	0
(8) Automotive .....	.266553	.188616	.078355	.028182	.205197	.029561	.022276
(9) Communication and Transportation .....	.000466	.000485	.003151	.001933	.009731	.004697	.008010
(10) Professional .....	.019703	.038679	.000840	0	.006424	.003104	0
(11) Financial .....	.030585	.028375	.005187	0	.003768	.002051	0
(12) Construction .....	.009091	.005476	.000248	.004804	0	.007544	0
(13) Products .....	.048793	.059951	.053956	.016413	.113874	.455594	.013807
(14) Services .....	.030219	.046532	.006303	0	.079439	.049438	.000297
Sum of 1-14 .....	.481702	.492635	.237941	.134332	.455901	.551989	.048859
(15) Households .....	.097761	.178796	.301076	.198064	.174927	.305384	.093750
(16) Payments to Government .....	.124592	.118368	.012053		.072815	.008752	.009375
(17) Imports .....	.102266	.033327	.417587		.028251	.114887	.824578
(18) Depreciation and Neg. Inven. Changes .....	.193679	.176874	.031333		.268106	.018988	.023438

SALES

PURCHASES							
	Automotive (8)	Communica- tion and Transporta- tion (9)	Professional (10)	Financial (11)	Construction (12)	Products (13)	Services (14)
(1) Dependent Ranches	0	0	0	.000620	.000917	.000981	.000570
(2) Other Agriculture	0	0	0	0	0	.000049	.005724
(3) Lumber	0	0	0	0	0	0	0
(4) Mining	0	0	0	0	0	0	0
(5) Lodging	0	.001102	0	0	.005576	0	0
(6) Cafes and Taverns	0	0	0	0	0	0	0
(7) Agricultural Services	0	0	0	0	0	0	0
(8) Automotive .....	.138763	.096005	0	.000085	.093308	.002786	.029247
(9) Communication and Transportation .....	.012395	.020079	.011183	.005118	.012312	.009222	.014823
(10) Professional .....	.000959	.002729	.000405	.000975	.003076	.002034	.008526
(11) Financial	0	.008632	0	0	.016059	.001307	.006246
(12) Construction	0	.000184	0	0	.011024	.000291	0
(13) Products .....	.008213	.045412	.015699	.004236	.107495	.053668	.042912
(14) Services .....	.002086	.000827	.003848	.000417	.001711	.003123	0
Sum of 1-14 .....	.162416	.174970	.031135	.011451	.251478	.073461	.108048
(15) Households .....	.099760	.420147	.490788	.145249	.166929	.092906	.402265
(16) Payments to Government .....	.004722	.093976	.007959	.030303	.004645	.031426	.036524
(17) Imports .....	.724972	.210474	.395016	.809486	.551029	.773588	.354061
(18) Depreciation and Neg. Inven. Changes .....	.008130	.100433	.075102	.003511	.025919	.028619	.099102

put of \$13,886,670 accounted for almost 40% of the total output of all the county's commercial and agricultural firms (\$45,339,429). Exports of these two sectors accounted for 75% of the basic income brought into Grant County in 1964 (\$16 million out of \$21 million). Of the total amount spent by all commercial and agricultural firms in the county for purchases of intermediate goods and services, the Dependent Ranches sector and the Lumber sector accounted for 57%. Total payments to Grant County households by commercial and agricultural businesses and government agencies in return for labor and management services in 1964 amounted to \$10,338,665. Of this amount, the Lumber sector accounted for 40%, or \$4,180,952. The Dependent Ranches sector contributed another 4% (\$363,792). Thus it is seen that these two activities, which are highly dependent upon the use of federal land, account for the majority of economic activity in Grant County.

A sector which is outside the processing portion of this model, but one that deserves some discussion, is the Household sector. Again, the coefficients in this row (Table 6) reflect the purchase of labor and entrepreneurial inputs per dollar of gross income received by the respective sectors across the top of the table. For the most part, these coefficients indicate the degree of labor intensity of the various sectors.

Several interesting aspects of these coefficients should be noted. First, there is a considerable difference in wage and salary payments between the two agricultural sectors. The Dependent Ranches sector pays a labor bill of less than \$0.10 per dollar of gross sales, as compared to almost \$0.18 per dollar for the Other Agriculture sector. In view of the extensive nature of the former sector, this difference might be expected.

The Lumber sector paid a little over \$0.30 of every dollar of gross income to Grant County residents for labor and management services. The Mining sector paid \$0.20 of every dollar; the Communications and Transportation sector and the Professional Services sector paid \$0.42 and \$0.49, respectively, per dollar of gross income. The other large coefficient belongs to the Services sector which paid \$0.40 for labor per dollar of sales. The significance of these particular coefficients is manifest when it is realized that for every dollar change in gross income of one of the sectors, household incomes in that sector change by at least the amount of the coefficient for that sector.

Because the headquarters of the mining firms operating in Grant County are not located within the county, and because of the remote location of the mining activity, this sector has a low intermediate goods coefficient of .134332. Most of the mining operations depend on sources outside of Grant County for a large share of their supplies, and thus their expenditures within the county are relatively small.

The Lodging sector is a large "exporter," in that the main part of its business (74%) comes from non-residents of Grant County. This basic income is then

utilized to purchase intermediate goods from local businesses at the rate of \$0.46 per dollar of income by the Lodging sector. The Cafes and Taverns sector is also an exporter of goods and services in a manner similar to the Lodging sector. Forty percent of the income of the Cafes and Taverns sector came from outside Grant County. For every dollar of income received by this sector, \$0.55 was spent within the county for purchases of intermediate goods and services. While no attempt was made to specify the importance of the recreation "industry" to the county, the Lodging and Cafes and Taverns sectors account for much of the business which comes from tourists, hunters, and other noncounty residents.

The Agricultural Services sector is, as would be expected, a large importer of goods that are in turn resold to the agricultural sectors. The purchases of this sector from others within the county and the distribution of its sales to them are minimal, since it deals in unique merchandise which cannot be acquired within the county and for which the demand is concentrated in the agricultural sectors.

The remaining seven sectors all participate in inter-sector trade to a greater degree than do the first seven. None is a particularly large exporter; the Communications and Transportation sector is the only one that receives anywhere near one half of its income from outside the county. Both the Automotive and the Products sectors are large importers, as might be expected.

The foregoing represents a quantitative description of the economy of Grant County. It can be seen from the transactions table that the county's economic role is largely that of an exporter of raw materials. There is a conspicuous lack of any value-adding activity (manufacturing) in the county. The two largest industries—livestock and lumber—export 83% and 90%, respectively, of their gross output; they are also the two activities most dependent upon public lands. However, an economy must not only have industries which export, it must also have extensive trade between these industries and other firms in the economy in order to reap the full benefit of the exporting activities.

Before proceeding to investigate the impact of changes in federal land use, brief mention will be made of the possibilities for guidance in general regional development which are available from input-output models.

The first step is the derivation of a table of direct and indirect requirements per dollar change in the output of any given sector. The indirect effect is the result of the interdependence of the economy's businesses, going beyond the interdependencies portrayed so far. When the output (gross sales) of any sector is reduced (or increased), it in turn buys fewer (more) inputs from its suppliers. When the output of these suppliers is reduced (increased), they in turn buy fewer (more) inputs from their respective suppliers. This process repeats itself through as many rounds as required to reach

Table 7. Direct and Indirect Trade Coefficients, Grant County, Oregon, 1964

SALES	PURCHASES						
	Dependent Ranches (1)	Other Agriculture (2)	Lumber (3)	Mining (4)	Lodging (5)	Cafes and Taverns (6)	Agricultural Services (7)
(1) Dependent Ranches	1.012810	.074045	.003488	.000404	.001768	.000545	.004542
(2) Other Agriculture .....	.011679	1.017609	.000224	.000007	.000495	.000328	.000056
(3) Lumber	0	0	1.090699	0	0	0	0
(4) Mining	0	0	0	1.000000	0	0	0
(5) Lodging .....	.000530	.001220	.000362	.000232	1.000019	.000056	.000012
(6) Cafes and Taverns	0	0	0	0	0	1.000000	0
(7) Agricultural Services .....	.054319	.040178	.003742	.083829	.036204	.000043	1.000244
(8) Automotive .....	.320594	.250459	.101663	.036046	.244775	.039934	.028336
(9) Communication and Transportation .....	.006569	.006244	.005595	.003368	.015856	.010811	.008695
(10) Professional .....	.021201	.041736	.001310	.000110	.007710	.004648	.000179
(11) Financial .....	.031797	.031714	.005956	.000148	.004644	.003249	.000240
(12) Construction .....	.009394	.006339	.000327	.004868	.000060	.007780	.000048
(13) Products .....	.059935	.075341	.064053	.019655	.127675	.485646	.015530
(14) Services .....	.032180	.050645	.007445	.000204	.080482	.051116	.000554
TOTALS	1.561008	1.595530	1.284864	1.148871	1.519688	1.604156	1.058436

SALES	PURCHASES						
	Automotive (8)	Communication and Transportation (9)	Professional (10)	Financial (11)	Construction (12)	Products (13)	Services (14)
(1) Dependent Ranches .....	.000014	.000059	.000021	.000633	.001078	.001059	.001052
(2) Other Agriculture .....	.000015	.000011	.000024	.000010	.000035	.000084	.005836
(3) Lumber	0	0	0	0	0	0	0
(4) Mining	0	0	0	0	0	0	0
(5) Lodging .....	.000016	.001128	.000013	.000006	.005656	.000014	.000025
(6) Cafes and Taverns	0	0	0	0	0	0	0
(7) Agricultural Services .....	.000002	.000044	.000002	.000034	.000263	.000060	.000264
(8) Automotive	1.162909	.114507	.001505	.000922	.113454	.005048	.037560
(9) Communication and Transportation .....	.014865	1.022529	.011661	.005300	.015476	.010106	.016197
(10) Professional .....	.001201	.003034	1.000509	.001017	.003602	.002240	.008964
(11) Financial .....	.000159	.008910	.000149	1.000075	.016599	.001530	.006650
(12) Construction .....	.000006	.000206	.000008	.000008	1.011194	.000323	.000059
(13) Products .....	.010943	.050377	.017354	.004812	.117596	1.057536	.047091
(14) Services .....	.002479	.001349	.003920	.000462	.002851	.003368	1.000582
TOTALS	1.192609	1.202154	1.035166	1.013279	1.287804	1.081368	1.124280

a new equilibrium position. The results of these interactions are incorporated in a new table of coefficients to show the direct effects of a change in output plus additional indirect effects.⁹ These coefficients are presented in Table 7.¹⁰

Table 7 is read in the same manner as the previous table of coefficients (Table 6). For a \$1.00 change in final demand of a sector listed across the top, the sectors listed along the left side of the table will have their output changed by the amount of the coefficient. In other words, a \$1.00 change in the output of the Dependent Ranches sector will cause a \$0.01 change in both of the agricultural sectors, no change in either the Lumber or Mining sector, a very small change in the Lodging sector, no change in the Cafes and Taverns sector, a \$0.05 change in the Agricultural Services sector, and so on down Column 1. The sum of each column shows the total change in business output in the county for a \$1.00 change in the output of the respective sector. This latter coefficient is herein referred to as the "business income multiplier."

The change in gross sales of the various sectors is not the only impact to consider. When the output of a sector declines (or increases), there will be a reduction (increase) in the quantity of labor and management services demanded by that sector. The magnitude of this impact is depicted by the household income multipliers presented in Table 8.¹¹

Table 8. Household Income Multipliers for the Fourteen Sectors of the Grant County Model, 1964

Household income multiplier	Household income multiplier
Dependent Ranches .. 1.801680	Communication and
Other Agriculture .. 1.534112	Transportation 1.069352
Lumber 1.169734	Professional 1.017360
Mining 1.079510	Financial 1.024310
Lodging 1.477028	Construction 1.222046
Cafes and Taverns .. 1.256677	Products 1.139410
Agricultural Services 1.093387	Services 1.053974
Automotive 1.251925	

The household income multiplier shows how much the total household incomes in Grant County would change for a \$1.00 change in household income of any one of the 14 sectors. For example, a \$1.00 change in household incomes of the Dependent Ranches sector would cause a change in total county household income of \$1.80 (an additional \$0.80 in the other 13 sectors).

⁹ The actual changes occur in final demand but, for convenience, are treated here as changes in output.

¹⁰ The equations used in compiling Table 7 are presented in the Appendix.

¹¹ See the Appendix for details of their derivation.

By utilizing the information contained in Tables 7 and 8, it is possible to select those sectors which, if their output were increased, would have the greatest effect upon the general health of the local economy. Referring to Table 7, the row of business income multipliers will be discussed first. Reading across the bottom row of Table 7 indicates that for a \$1.00 change in the output of the Dependent Ranches sector, an additional \$0.56 worth of business income would be generated in the county. For Other Agriculture, the generated business would be \$0.60 for a \$1.00 increase in its output; for Lumber, \$0.28; for Mining, \$0.15; and so on across the row.

Two sectors which cater to outside visitors (for example, tourists) are the Lodging, and the Cafes and Taverns sectors. The coefficients for these two sectors are \$1.52 and \$1.60, respectively. The two rank in the top four (along with the two agricultural sectors) of the 14 sectors. An increase in tourists in Grant County would have a fairly significant impact upon business income.

When the information from Table 7 is coupled with that in Table 8, a more complete picture of the sensitive sectors is revealed. The latter table shows the household income multipliers and indicates the extent to which total county household income would be increased for a \$1.00 increase (or decrease) in the household incomes of any of the 14 sectors. Again, the same four sectors come out on top. Dependent Ranches is first with \$1.80, followed by Other Agriculture with a multiplier of \$1.53. The Lodging sector is third at \$1.48, with the Cafes and Taverns sector fourth at \$1.26.

Increases or decreases in the output of any, or all four, of these sectors would have a greater impact on business income, as well as household income, than would similar changes in any of the other sectors in the county.

It should be pointed out that the household income multiplier, as computed here, is a low estimate of the changes in household incomes; because the model utilized contained households as exogenous (outside the processing portion of the matrix), the magnitude of the multiplier is less than it would be if households were endogenous to the model. By "closing" the model with respect to households, we permit business-induced changes in household expenditures to enter into the interdependence between the sectors. This is the more realistic (and empirically difficult) way to handle the household sector; it permits the "consumption function" phenomenon to be operative. Increased business income in one or more sectors means more business for all other county firms. When this happens, increased wage payments result in higher incomes to employees, which further increase the volume of sales among county businesses. If the more realistic model had been employed in Grant County, the household income multipliers would be larger than those obtained with this model.

Impact Upon the Local Economy From Changes in Federal Land Use

The two primary commercial uses of federal land—livestock grazing and timber production—are susceptible to policy changes which could influence considerably their gross output. To explore the effects of such changes on business and household incomes in Grant County, two hypothetical changes in federal land use will be outlined.

A reduction, rather than an increase, in the quantity of federal grazing was utilized because information was available on the probable impact on gross ranch income from a 20% reduction. An increase in timber harvest was used because it was felt that an increase in federal allowable cut in the county was more likely than a reduction. In actuality, the two contingencies are not independent of each other. Recent research at Oregon State University indicates that improved timber management practices in northeastern Oregon, such as thinning as well as logging practices in general, reduce competition and enhance the growth of understory vegetation. Therefore, an increase in timber harvest might also make it possible to increase the amount of grazing in the county (7).

Reduction in Federal Grazing

A reduction in grazing would not necessarily have the same effect on all of the dependent ranches in Grant County; some would continue their operation unchanged, while others might be required to change considerably. Any discussion concerning these impacts upon ranch operation must necessarily proceed with many assumptions about current ranching operations and the strategies which would be followed by ranchers in the face of a lesser quantity of available federal grazing.

Since the concern here is with the aggregate effects, the emphasis of the impact on individual ranch firms is

minimized. A recent study sponsored by the Forest Service and the Bureau of Land Management is utilized to arrive at gross ranch income changes from a 20% reduction in the quantity of permitted federal grazing (2, 15). The 20% reduction is an arbitrary figure which was used in the Caton study and will be utilized here to illustrate the technique of projecting with input-output models as well as to give an indication of the impact upon the local economy from such a reduction.

There are four types of possible reductions: 1) a reduction in permitted numbers; 2) a reduction in length of grazing season; 3) a reduction in both; or 4) complete elimination of federal grazing in an area. Each of these different types of reductions would produce quite dissimilar effects on an individual ranch operation. Although every ranch would not be reduced by 20% of its federal AUM's, the overall effect would amount to this figure; some ranches would be reduced more than this, some less, and some not at all.

REDUCTION IN GROSS RANCH INCOME

The work by Caton provides the information from which the prediction of economic impact is computed. Caton found the percentage reduction in gross ranch income resulting from a 20% reduction in AUM's of federal grazing for each of five ranch-size categories. Table 9 illustrates how the reduction in gross ranch income of the Dependent Ranches sector was computed. Total ranch sales (gross income) for the Dependent Ranches sector in 1964 was \$3,721,243. Projected gross sales of the sector are \$3,321,665 for a direct reduction of \$399,578, or 11%.

BUSINESS INCOME EFFECT

With the information contained in Tables 7 and 9, it is possible to simulate possible effects from a change in the output of any, or all, of the 14 sectors.

Table 9. Calculation of Reduction in Gross Ranch Income of the Dependent Ranches Sector Resulting from a 20% Reduction in Allowable Federal Range Use

Size in no. of cows owned (1)	Previous gross income (average) (2)	Percent reduction in gross income ¹ (3)	Projected gross income (average) (4)	No. of ranches each size (5)	Total income of each size group (4 × 5) (6)
<150	\$ 8,777	9	\$ 7,987	53	\$ 423,311
150-250	17,074	10	15,367	34	522,478
251-400	27,984	11	24,906	24	622,650
401-650	39,900	10	35,910	18	646,380
>650	96,752	12	85,142	13	1,106,846
TOTALS				143	\$3,321,665

¹From Caton: Percent gross income reduction figures are for each of the five size categories as a result of a 20% reduction in federal grazing use.

As shown previously, the total output of the Dependent Ranches sector would decrease by \$399,578 if a 20% reduction in federal grazing were imposed. With this lower output, the model was rerun and the indicated reductions in sector output are detailed in Table 10. The first two columns of Table 10 are taken from Table 5, and they represent the final demand columns (15-18) and the total output column, respectively. The third column in Table 10 is the projected level of final demand for the 14 sectors. It will be noticed that only one entry in Column 3 differs from Column 1, that of the Dependent Ranches sector. The projected final demand is \$399,578 less than the original final demand, the precise amount of the projected decrease in output of that sector.

When the new system is solved, as illustrated in the Appendix, a new column of sector outputs is derived. This is the fourth column in Table 10. Column 5 presents the reduction for each of the 14 sectors and the total projected reduction in output.

It will be noticed that the Dependent Ranches sector has had its output reduced by \$404,691. This is \$5,113 greater than the initial reduction of \$399,578 and represents the indirect effects previously mentioned.

The reduction in federal grazing had different secondary effects upon the various sectors of the economy. Although the Automotive sector suffered the largest absolute loss, the Agricultural Services sector was reduced over 5.5%. The Automotive sector was the second most affected industry with a loss of 1.6%.

HOUSEHOLD INCOME EFFECT

To project the impact on household income from a 20% reduction in federal grazing, several steps are required.

First, the decline in household income of the Dependent Ranches sector must be computed. This is done by multiplying the household coefficient (Table 6, Row 15) of the Dependent Ranches sector times the change in output of that sector. Thus,

$$(\$0.097761) \times (\$404,691) = \$39,563$$

is the amount that household income in the Dependent Ranches sector would fall as a result of the reduction.

Then to project the impact on total county household income from this change in the Dependent Ranches income, the household income multiplier (Table 8) for the sector is multiplied by this change. This gives:

$$(\$39,563) \times (1.801680), \text{ which yields } \$71,280.$$

Thus the loss to total county household income from a 20% reduction in federal grazing would be \$71,280. More than half of this loss (\$39,563 plus) would occur in the Dependent Ranches sector, while the remainder would come from the other 13 sectors. The reason the household income loss in the Dependent Ranches sector would be greater than the \$39,563 is the same as before; this amount represents the direct loss only. With households having a lower income, aggregate demand in the county would decline. When this happens, gross sales of the business firms are decreased. They, in turn, buy fewer labor services from households. The gross sales of the Dependent Ranches sector declines along with the other sectors, and its households receive less income.

In addition to the loss of retail trade and household income, there are other changes which might occur. With lower household incomes, it is possible that some of the reduction might be reflected in unemployment increases in several of the sectors most adversely affected. Investment expenditures might be curtailed,

Table 10. Results of a 20% Reduction in Federal Grazing, Grant County, Oregon

	Final demand (1964) \$ Y _i (1)	Total output (1964) \$ X _i (2)	Projected final demand \$ Y _i (3)	Projected total output \$ X _i (4)	Reduction in total output \$ (5)	Percent reduction ¹ (6)
Dependent Ranches	3,543,857	3,721,243	3,144,279	3,316,552	404,691	10.88
Other Agriculture	999,455	1,066,298	999,455	1,061,631	4,667	0.44
Lumber	12,731,894	13,886,670	12,731,894	13,886,670	—	0
Mining	358,000	358,000	358,000	358,000	—	0
Lodging	402,610	415,600	402,610	415,388	212	0.05
Cafes and Taverns	763,500	763,500	763,500	763,500	—	0
Agricultural Services	58,092	384,000	58,092	362,295	21,705	5.65
Automotive	4,266,168	8,027,277	4,266,168	7,899,175	128,102	1.60
Communication and Transportation	759,162	1,088,453	759,162	1,085,828	2,625	0.24
Professional	931,848	1,110,118	931,848	1,101,647	8,471	0.76
Financial	659,964	922,831	659,964	910,126	12,705	1.38
Construction	717,307	780,135	717,307	776,381	3,754	0.48
Products	9,513,829	11,812,485	9,513,829	11,788,536	23,949	0.20
Services	621,827	1,002,819	621,827	989,961	12,858	1.28
TOTALS		45,339,429		44,715,690	623,739	1.37

¹ Each figure is the percent change for that respective sector. The sum of this column is meaningless unless weighted. The percentage change in total business is found by $623,739/45,339,429 \times 100 = 1.37\%$.

which could further decrease future output of some of the sectors. The present decline in county population might possibly be accentuated if there were fewer jobs available. On the other hand, if recreation became an important county "product," the enumerated losses could possibly be compensated for. Other sectors would experience an increase in output (probably the Lodging, Cafes and Taverns, and Automotive sectors). Although somewhat rearranged, net changes in employment, investment, retail sales, and household incomes could be zero. It was not the intent to investigate which use of public lands would maximize these particular items, but to demonstrate the effects of changing one of the present uses.

In addition to the above-mentioned changes, a reduction in the quantity of federal grazing could influence the trade relationships of several sectors, particularly the two agricultural ones. It is possible that trade between the two agricultural sectors might increase if the Dependent Ranches sector were denied access to the federal range. This would manifest itself in an increased quantity of hay sold to the Dependent Ranches sector by the Other Agriculture sector or in an increased quantity of pasture and rangeland which was owned by the Other Agriculture sector being rented or leased to Dependent Ranches. This would require excess capacity in the Other Agriculture sector or a bidding away of resources by the Dependent Ranches. If some of the ranches affected by a reduction solved part of the problem by purchasing more hay (an expensive long-run solution) from outside the county, this would increase the proportion of their gross receipts which left the county (leakage) and would show up as increased imports. If this importation of hay were carried out by the Agricultural Services sector, two of the coefficients in Table 6 would change: the proportion of gross sales spent on imports by the Agricultural Services sector would increase, and the proportion of gross receipts of the Dependent Ranches sector which was spent in the Agriculture Services sector would increase. There probably are other changes which might occur, but further speculation is unnecessary. Much more research and thought is necessary to correctly predict coefficient changes.

Increase in Timber Harvest

In view of the fact that 75% of the logs harvested in Grant County in 1964 were from federal land, the lumber industry in the county is highly sensitive to policy concerning allowable cut from national forests. A change in policy could have a significant effect on the economy.

Several factors could enter into a change in the allowable cut from federal land. Changing markets have created a demand for various species which were heretofore uneconomical to harvest. Also, timber stand improvement projects in recent years have increased the



Lumber production is an important economic activity in Grant County. Most of the logs come from national forest land. (Courtesy U.S. Forest Service.)

quantity of marketable logs on many forests. As a result, it appears that if a change in allowable cut were enacted, it would be a slight increase.

INCREASE IN GROSS OUTPUT OF THE LUMBER SECTOR

The Lumber sector consists of three subsectors: the mills, the loggers who harvest the timber, and the trucking firms which haul both logs and processed lumber. There were six commercial lumber mills in Grant County in 1964 and each processed logs harvested within the county. The processed lumber was then hauled out of the county to either Burns, Baker, Pendleton, or Prineville. The total output (gross receipts) of the mill subsector was the value of processed lumber shipped by these six mills. Added to this are other miscellaneous mill receipts.

The logging and hauling subsectors are the other portion of the Lumber sector, and their gross output is represented by the total value of their services for 1964.

To investigate the possible impact from an increase in the allowable cut of federally owned timber, a hypothesized increase in the output of the Lumber sector was traced through the model. An increase of 10% in the sector's output would be \$1,388,667, which would bring the gross output of the Lumber sector to \$15,275,337.

BUSINESS INCOME EFFECT

The analysis here will parallel that of the preceding section where the impact from a reduction in grazing was investigated. Table 11 presents the results from the 10% increase in output of the Lumber sector. Columns 1 and 2 are taken from Table 5 and represent the final demand in 1964 and the total output in 1964, respectively, for the 14 sectors. To simulate the increase, the final demand of the Lumber sector is increased by the amount of the direct effect upon the sector, or \$1,388,667. This brings the projected final demand of the sector to \$14,120,561 (\$12,731,894 plus \$1,388,667). Notice that the projected final demands of the other 13 sectors are unchanged. The model is then solved to derive new total projected outputs for all 14 sectors. These are shown in Column 4 of Table 11. Column 5 of the same table shows the increase in sector output which would be expected to result from an increase in the output of the Lumber sector. It is observed that the increase in the output of the Lumber sector is greater than the original \$1,388,667 by \$125,945. This again is a manifestation of the economic interdependence within the economy.

The greatest increase is in the Automotive sector which would experience an almost 2% increase in output, or \$141,176. The second most significant increase (percentage) is in the Agricultural Services sector, a 1.35% change. The absolute change of this sector is overshadowed by several others, but its relative increase is greater.

HOUSEHOLD INCOME EFFECT

As in the case of a reduction in federal grazing, the impact of an increase in timber harvest upon Grant County household incomes is presented. The income multiplier for each of the 14 sectors was previously computed (Table 8).

To project the impact upon all household incomes in Grant County, the impact upon households in the Lumber sector must first be computed. This is accomplished by multiplying the household coefficient (Table 6, Row 15) of the Lumber sector times the total change in that sector. Thus,

$$(\$301076) \times (\$1,514,612) = \$456,013$$

is the amount that household incomes in the Lumber sector would increase from the 10% increase in output. To estimate the ultimate impact upon total county household income, this figure is multiplied by the household income multiplier of the Lumber sector:

$$(\$456,013) \times (1.169734) = \$533,414.$$

The total increase to Grant County household incomes would therefore be \$533,414; \$456,013 of this would be in the Lumber sector, with the remaining \$77,401 coming as increased incomes to the households of the other 13 sectors.

Just as in the case of a change in the quantity of federal grazing, there are other changes which might take place. The increased household incomes could reflect more earnings by presently employed workers as well as more jobs. Investment could be stimulated, and this might further increase gross receipts and household incomes.

Table 11. Results of a 10% Increase in Gross Sales (Output) of the Lumber Sector, Grant County, Oregon

	Final demand (1964) \$ Y_i (1)	Total output (1964) \$ X_i (2)	Projected final demand \$ Y_i (3)	Projected total output \$ X_i (4)	Increase in output \$ (5)	Percent increase ¹ (6)
Dependent Ranches	3,543,857	3,721,243	3,543,857	3,726,087	4,844	0.13
Other Agriculture	999,455	1,066,298	999,455	1,066,609	311	0.03
Lumber	12,731,894	13,886,670	14,120,561	15,401,282	1,514,612	10.91
Mining	358,000	358,000	358,000	358,000	—	0
Lodging	402,610	415,600	402,610	416,103	503	0.12
Cafes and Taverns	763,500	763,500	763,500	763,500	—	0
Agricultural Services	58,092	384,000	58,092	389,196	5,196	1.35
Automotive	4,266,168	8,027,277	4,266,168	8,168,453	141,176	1.76
Communication and Trans- portation	759,162	1,088,453	759,162	1,096,223	7,770	0.72
Professional	931,848	1,110,118	931,848	1,111,937	1,819	0.16
Financial	659,964	922,831	659,964	931,102	8,271	0.90
Construction	717,307	780,135	717,307	780,589	454	0.06
Products	9,513,829	11,812,485	9,513,829	11,901,433	88,948	0.75
Services	621,827	1,002,819	621,827	1,013,158	10,339	1.03
TOTALS		45,339,429		47,123,672	1,784,243	3.94

¹ Each figure is the percent change for that respective sector. The sum of this column is meaningless unless weighted. The percentage change in total county business is found by $1,784,243/45,339,429 \times 100 = 3.94$.

Scope of the Findings

While the stated relationships and interactions hold for Grant County, their applicability to other areas of eastern Oregon, and indeed the West, greatly influence their significance. It is reasonable to assume that production of livestock or harvested timber is basically the same between and among somewhat similar regions. That is to say, beef production or the harvesting of timber in Grant County requires approximately the same quantity of the various inputs *per dollar of output* as do the same activities in other reasonably similar areas. Ranchers with federal grazing in Harney, Baker, Crook, or Lake counties can be expected to buy approximately the same *proportion* of inputs from the Agricultural Services sector, the Automotive sector, the Communications and Transportation sector, the Professional Services sector, the Financial sector, and so forth as do ranchers with federal grazing in Grant County. The same would hold for similar regions in other western states.

What will change, of course, is the relative importance of federal lands to beef and lumber production and the relative importance of these two activities in the total economic milieu of a county.

Concerning federal range use, if the area in question were the 19-county area of eastern Oregon, and if federal range beef production were of similar relative importance in this larger area as in Grant County, then ranchers with federal grazing could be expected to spend at least as much per dollar of output as they do in Grant County. The reason they would spend as much, and probably more, is that this larger area would be more self-sufficient than Grant County. There would be less need to import from outside of the system.

The relative importance of public lands to beef production is not the same in all counties of eastern Oregon

as revealed in Table 3. Harney, Grant, and Lake counties are all very similar in relevant aspects, and thus it appears that agricultural activity in the three counties is equally dependent upon federal lands.

Agricultural production in the counties of Baker, Wallowa, Deschutes, Crook, Wheeler, Malheur, Klamath, and Union is less dependent upon federal lands than in the first three counties enumerated. However, these counties have sizeable tracts of federal range, and the production of beef cattle in relation to the total agriculture is fairly similar. Although ranchers with federal grazing would spend approximately the same amount per dollar of output in these counties as would ranchers in Harney, Grant, and Lake counties, the relative importance of federal range operations is not as great. Although the absolute amount might be more than in Grant County, the relative significance to the total economic output would be somewhat less.

The remaining eight counties are Umatilla, Jefferson, Morrow, Wasco, Gilliam, Jackson, Sherman, and Hood River. Other agricultural activities in these counties overshadow the importance of range-beef production to the extent that one is much less confident in applying the findings of this study to them.

The lumber industry in eastern Oregon was not studied in the same detail as the range-livestock industry and, therefore, to generalize for eastern Oregon would be highly speculative. Of the 19 counties in eastern Oregon, 9 obtained more than 60% of their total log production (1964) from Forest Service lands. However, more information is needed on the lumber industry to accurately predict how closely the results for Grant County would apply for the rest of eastern Oregon.

Literature Cited

1. American Forest Products Industries, Inc. Government land acquisition: a summary of land acquisition by federal, state and local governments up to 1964. Oregon edition. Washington, D.C., 1965, 31 pp.
2. Caton, Douglas D. Western livestock ranching and federal rangeland (an interagency study). Washington, D.C., U.S. Department of Agriculture, Economic Research Service and U.S. Department of the Interior, n.d., 339 pp. (Processed)
3. Chenery, Hollis B., and Paul G. Clark. *Interindustry Economics*. New York: John Wiley, 1959, 345 pp.
4. Dwyer, P. S. *Linear Computations*. New York: John Wiley, 1951, 344 pp.
5. Evans, W. D. "Input-output computations." In: *Structural Interdependence of the Economy*. Proceedings of an international conference on input-output analysis, Varrena, June 27-July 10, 1954, Tibor Barna, ed. New York: John Wiley, (1956), pp. 53-102.
6. Gedney, Donald R. Toward complete use of eastern Oregon's forest resources. Washington, D.C., U.S. Department of Agriculture Forest Service, Pacific Northwest Forest and Range Experiment Station. Resource Bulletin PNW-3, May 1963, 71 pp.
7. Hedrick, D. W., J. A. Young, J. A. B. McArthur, and R. F. Keniston. *Effects of Forest and Grazing Practices on the Mixed Coniferous Forests of Northeastern Oregon*. (Oregon Agricultural Experiment Station Technical Bulletin 103, 1968.)

8. Lofting, E. M., and P. H. McGahey. Economic evaluation of water. Part 3. An interindustry analysis of the California water economy. Berkeley, 1963, 83 pp. (Processed) (University of California, Berkeley. Water Resources Center, Contribution No. 67.)
9. Miernyk, William H. *The Elements of Input-Output Analysis*. New York: Random House, 1965. 156 pp.
10. Miernyk, William H. A primer of input-output economics. Boston, 1957, 33 pp. (Northeastern University, Bureau of Business and Economic Research, Business and Economic Education Series No. 2.)
11. Moore, Frederick T., and James W. Petersen. "Regional analysis: an interindustry model of Utah." *The Review of Economics and Statistics*, 37:368-383, 1955.
12. Oregon. Oregon economic statistics, 1966. Eugene: University of Oregon, Bureau of Business and Economic Research, 1966, 76 pp.
13. Oregon. Secretary of State. *Oregon 1965-1966 Blue Book*. Salem, 1965, 304 pp.
14. Oregon State University, Cooperative Extension Service. Value of sales by counties, December 8, 1965.
15. U.S. Department of Agriculture, Economic Research Service. Effects of changes in grazing fees and permitted use of public rangelands on incomes of western livestock ranches. Washington, D.C., 1965, 33 pp. (Economic Research Service Publication No. 248.)
16. U.S. Department of Commerce, Bureau of the Census. U.S. Census of population—1960 (Oregon). Washington, D.C., 1961, 168 pp.
17. U.S. Department of the Interior, Bureau of Land Management. An evaluation of adjustments in grazing use as they occur in the management of the federal range by the Bureau of Land Management. Washington, D.C., 1962, 100 pp.
18. U.S. Department of the Interior, Bureau of Land Management. Public land statistics, 1964. Washington, D. C., 1965, 203 pp.

Appendix

The Input-Output Model as a Predictive Device

The technique of predicting with input-output models can best be illustrated in equation form. Equation (1) presents the input-output system with its only variable, namely output, being dependent upon two parameters; final demand and the input-output coefficients. Equations (1) through (6) trace the solution of the model and the derivation of the inverse matrix.¹² The inverse matrix, or matrix of direct and indirect coefficients, shows the total change in required purchases of one sector from all other sectors, for a \$1.00 change in final demand of that one sector.

The input-output system can be expressed as:

$$X_i = \sum_{j=1}^n a_{ij} X_j + Y_i \quad i = 1, 2, \dots, m \quad (1)$$

where X_i represents total output of the i th sector,

$\sum_{j=1}^n a_{ij} X_j$ represents total demand in the i th sector as

¹² For a more exhaustive treatment of input-output solutions, see: Dwyer (4), Cheney and Clark (3), and Evans (5).

depicted by the processing portion, and Y_i represents final demand in the i th sector. Rewriting equation (1) in matrix form yields

$$X = AX + Y \quad (2)$$

or

$$X - AX = Y \quad (3)$$

where

X represents a column vector of outputs for the economy (m elements),

A represents the $m \cdot n$ matrix of trade coefficients (a_{ij} 's), and

Y represents the column vector of final demand (m elements).

With I representing an identity matrix¹³, X can be multiplied times I , leaving it unchanged; that is ($IX = X$).

¹³ An identity matrix is one in which all elements are zero except those in the principal diagonal, i.e., starting in the upper left-hand corner and proceeding diagonally to the lower right-hand corner. The elements in the principal diagonal are ones.

Thus, equation (3) can be rewritten as

$$IX - AX = [I - A]X = Y \quad (4)$$

Solving for X in equation (4) yields

$$X = [I - A]^{-1} Y \quad (5)$$

This provides a solution for the system. The inverse of $[I - A]$ can be used for estimating new levels of output; for predicted levels of final demand (\hat{Y}), equation (6) yields the projected levels of total output (\hat{X}),

$$\hat{X} = [I - A]^{-1} [\hat{Y}] \quad (6)$$

THE HOUSEHOLD INCOME MULTIPLIER

The household income multiplier depicts the total change in county household income from a \$1.00 change in the output of any of the sectors in the economy. The multiplier is computed using Table 7 and the a_{15j} elements (household row, Columns 1-14) of Table 5 (trade coefficients matrix).¹⁴ M_k , which is the household income multiplier of the k th sector, is found by:

$$M_k = \sum_{i=j=1}^{14} \frac{a_{15j} r_{ik}}{a_{15k}} \quad (7)$$

where

a_{15j} represents the value of purchased labor services from the household sector by the j th sector per dollar of gross output in the j th sector, and

r_{ik} represents the elements of $[I - A]^{-1}$; the numerical values are found in Table 7.

SECTORS OF THE GRANT COUNTY MODEL

The following table lists the 14 sectors as defined in the Grant County model and the types of businesses found in each.

¹⁴ For a more thorough discussion of the income and employment multipliers see Lofting and McGauhey (7), and Moore and Petersen (10).

Appendix Table 1. Sectors and Subsectors of Grant County Businesses, 1964

Sector	Subsector
Dependent Ranches	Cattle ranches with Forest Service or Bureau of Land Management grazing privileges
Other Agriculture	All other farms and ranches
Lumber	Lumber mills, logging, and lumber trucking
Mining	
Lodging	Hotels, motels, trailer parks, apartments, and resorts
Cafes and Taverns	
Agricultural Services	Feed, seed, and farm machinery
Automotive Sales and Services	Gas and oil distributors, service stations, auto repairs, auto sales, tires, auto supplies, and machine shops
Communications and Transportation	Radio stations, newspapers, trucking, Western Union, T.V. cable, busses, railroads, telephones, and aircraft
Professional Services	Physicians and dentists, attorneys, optometrists, accounts, hospital services, and veterinarians
Financial	Banks and loan agencies
Construction	Lumber (retail), contractors, and hardware
Product oriented (wholesale and retail)	Groceries, furniture, department and variety, florists, jewelers, electricity and gas, clothing and shoes, appliances, drug stores, machinery dealers, office supplies, and all other (dairy, photo, Sears, Montgomery Ward, liquor store, saw shop, etc.)
Service oriented (wholesale and retail)	Barber and beauty shop, insurance and real estate, laundry and cleaning, nonprofit organizations (churches, Elks Club, etc.), entertainment (movies, golf, bowling), saddle-maker, garbage disposal, other repairs (gunsmith, etc.), undertaking, and all other (credit bureau, Chamber of Commerce)
Households	All private individuals