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Abstract

Major Characteristics of 444 rangeland leasing arrangements used by South Dakota ranchers were examined. Econometric modeling results indicate lease rates per acre from 1986-1988 are explained by tract productivity (AUM's), tract size, regional location, selected leasing practices, and by type of lease (private, state, tribal trust, or federal).

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ECONOMIC ANALYSIS OF RANGELAND LEASING PRACTICES AND RATES

Rangeland is a major resource in the Great Plains and Western regions of the United States. In these regions, rangeland is owned by public agencies (Federal and state), tribal trusts, and private individuals, partnerships or corporations. A substantial proportion of private rangeland and most tribal trust and public agency rangeland is leased to ranchers (1). The impact of public land leasing on ranch values has been examined in several studies (4,8,12,14), but few studies have examined factors explaining variation in lease rates when alternative rangeland leases (private, Federal, state and tribal trust) are available.

The purposes of this study are to: (1) examine major characteristics of private, public and tribal trust rangeland leasing agreements, and (2) develop and estimate an economic model that explains variation in rangeland lease rates per acre.

Rangeland Leasing Study Location and Data Sources

The study location and major data sources are rangeland leases in central and western South Dakota. This location is one of the few regions in the 17 Western states where: (1) private ownership and leasing of rangeland is dominant, and (2) rangeland leasing or grazing permits from Federal agency, state agency and tribal trust lands are also prevalent.

A majority (53%) of South Dakota's agricultural land acreage is rangeland and permanent pasture (13,15). Approximately 78% of South Dakota rangeland acres are privately owned, 14% are Federal or state agency lands, and 8% of rangeland acres are in tribal trusts. However, more than 40% of leased rangeland acres are leases or grazing permits from public agencies or tribal trusts. Almost all public agency and tribal trust rangelands are located in

central and western regions of South Dakota, which also have 90% of the State's total rangeland acres operated by farmers and ranchers (13). In these regions, more than 80% of feed intake of beef cattle and sheep not in feedlots is supplied from livestock grazing (1).

The major source of data was from the 1988 South Dakota State University Pasture/Rangeland Leasing Survey which was sent to 1515 ranchers leasing rangeland in central and western regions of South Dakota. A total of 319 of 413 respondents provided detailed management information on their most important or most typical rangeland leasing arrangements. The data set includes 174 private cash leases and 270 leases or grazing permits from public agencies or tribal trusts.

RANGELAND LEASING ARRANGEMENTS

Most respondent ranchers leased several rangeland tracts and a majority leased tracts from both (1) private landlords, and from (2) public agencies or tribal trusts. On average, these respondents operated about 6000 acres of rangeland, which was almost equally divided between owned and leased rangeland.

Almost all private rangeland leases were cash leases and average (mean) size was 1491 acres per tract. The median length of time that private leases have been in effect is 5 years, with 76% of the leases in effect for less than 10 years. Approximately 58% of private leases were verbal, annual leases and 42% were written leases and most of these were multi-year leases. Water sources (wells, ponds, or streams) for livestock were available on 95% of privately leased tracts.

South Dakota School and Public Land leases (state agency leases) were cash leases on a per acre basis. The average tract size leased was 490 acres.

Water sources for livestock were available on 78% of these tracts. These leases are usually written for a 5 year period, with an option to lease for additional 5 year period. The median length of time that respondent ranchers had leased state tracts was 17 years.

State leases are subject to an open bidding process, but the bid must exceed an established minimum price. Lease payments are annual and paid in advance. Each tract has a designated stocking rate, stated in AUM's, which is set by the agency. When the stated AUM's are used up, the animals must be removed (11).

Federal grazing lands are leased through issuance of grazing permits by the Bureau of Land Management (BLM) or U.S. Forest Service (13). Grazing permits are different from other cash leases for rangeland because the permit holder only has permission for livestock grazing and cannot use the land for haying or timber cutting. There are no direct sales of Federal grazing permits.

To obtain a Federal grazing permit, an individual must own land or livestock to which a grazing permit is attached and have sufficient amount of land that qualifies as "base property". A rancher has this permit until sale of the land or livestock to which the grazing permit is attached. A person may also obtain grazing rights to Federal land by joining a grazing association. The grazing permits are still tied to land or livestock and the rancher must abide by the rules and regulations of the association. Decisions concerning the time in which livestock are placed and removed from the tract are determined by the Federal agency or grazing association, with the Federal agency maintaining final control (2).

The lease rate is an "administered" base rate per AUM and is adjusted by indices that measure changes in private lease rates, the price of beef cattle and the costs of livestock production (9). Payments are usually annual and made in advance.

The average size of Federal grazing tracts leased by respondent ranchers was 2650 acres and the median number of years the tract has been leased is 20 years. Almost all of the tracts had water sources for livestock available on the tract (3).

Tribal trust grazing permits are governed by provisions of the Wheeler-Howard Act of 1934 and are administered by the Bureau of Indian Affairs (BIA). Two types of grazing permits (allocated and competitive bid permits) are used. Competitive bid permits involve land in excess of allocated tribal land with lease rates and grazing rights determined by sealed bids. The sealed bid must be equal to or above an established minimum rate and is subject to the provision that a tribal member may equal the opened sealed bid and thus obtain the grazing permit (lease). The time length of the permit is set by the tribal council and is generally 5 years or longer (5).

The average size of BIA tracts leased by ranchers was 1850 acres and have been leased for a median length of 15 years. Nearly 94% of these tracts had water sources for livestock on the tract.

Respondent ranchers reported some differences between type of lease (private, public agency or tribal trust) in terms of specific management activities and responsibilities of the rancher-tenant and landlord (or administrative agency). Respondent rancher-tenants reported that they were primarily responsible for most tasks associated with leasing grazing land (Table 1). On privately leased tracts, more than 50% of respondents indicated

Table 1. Tenant and Landlord Management Responsibilities in Private, Public Agency and Tribal Trust Rangeland Leases, South Dakota, 1988.

Responsibility	Type of Lease[a]	Responsibility of Tenant	Landlord	Both	
		percent of leases where -----practice is done-----			
Checking Livestock	Private	87.2	4.8	7.9	*
	Public/Tribal	95.0	2.3	2.7	*
Salt and Mineral	Private	91.5	5.5	3.0	*
	Public/Tribal	96.9	2.3	0.8	*
Fencing Materials	Private	45.4	48.5	6.1	*
	Public/Tribal	90.4	6.5	3.1	*
Fencing Labor	Private	75.7	19.3	5.0	*
	Public/Tribal	95.8	3.8	0.4	*
Water Developments	Private	38.3	59.2	2.5	**
	Public/Tribal	86.1	8.0	5.9	**
Livestock Damage	Private	94.3	4.3	1.4	**
	Public/Tribal	97.1	2.9	---	**
Liability Insurance	Private	83.3	13.7	3.0	**
	Public/Tribal	96.5	3.1	0.4	**
Fertilizer Expense	Private	85.1	12.8	2.1	***
	Public/Tribal	98.3	1.7	---	***
Spray & Herbicide	Private	81.4	15.3	3.3	***
	Public/Tribal	93.0	3.9	3.1	***

Source: The 1988 SDSU Pasture/Rangeland Leasing Survey

[a] 174 respondents reported having private leases, 270 reported leasing rangeland from Federal agencies, state agencies or tribal trusts.

* These practices were done in almost all of the leases reported.

** These practices were done in at least 80% of the private and public leases reported.

that the cost of fencing materials and water development was the landlord's responsibility or was a shared expense. Ranchers leasing public agency or tribal trust tracts reported all improvements were usually the tenant's responsibility.

Some tasks and responsibilities (liability insurance, fertilizer expense, spraying and herbicides) were not always performed. If these tasks were performed, they were usually reported to be the tenant's responsibility (3).

Rangeland leasing rates per acre should reflect the productivity of the leased tract and the desirability of other attributes of a specific lease. The highest private lease rates for 1988 were reported in the North Central, East Central and South Central regions. The lowest private lease rates (per acre average of $3.12 to $3.92) were reported in the four regions of western South Dakota, where lower fertility and lower annual precipitation are more prevalent. Lease rates per acre for public and tribal trust in rangeland follows a regional pattern similar to that of private rangeland. In each region, average lease rates per acre are higher for private rangeland (Figure 1).

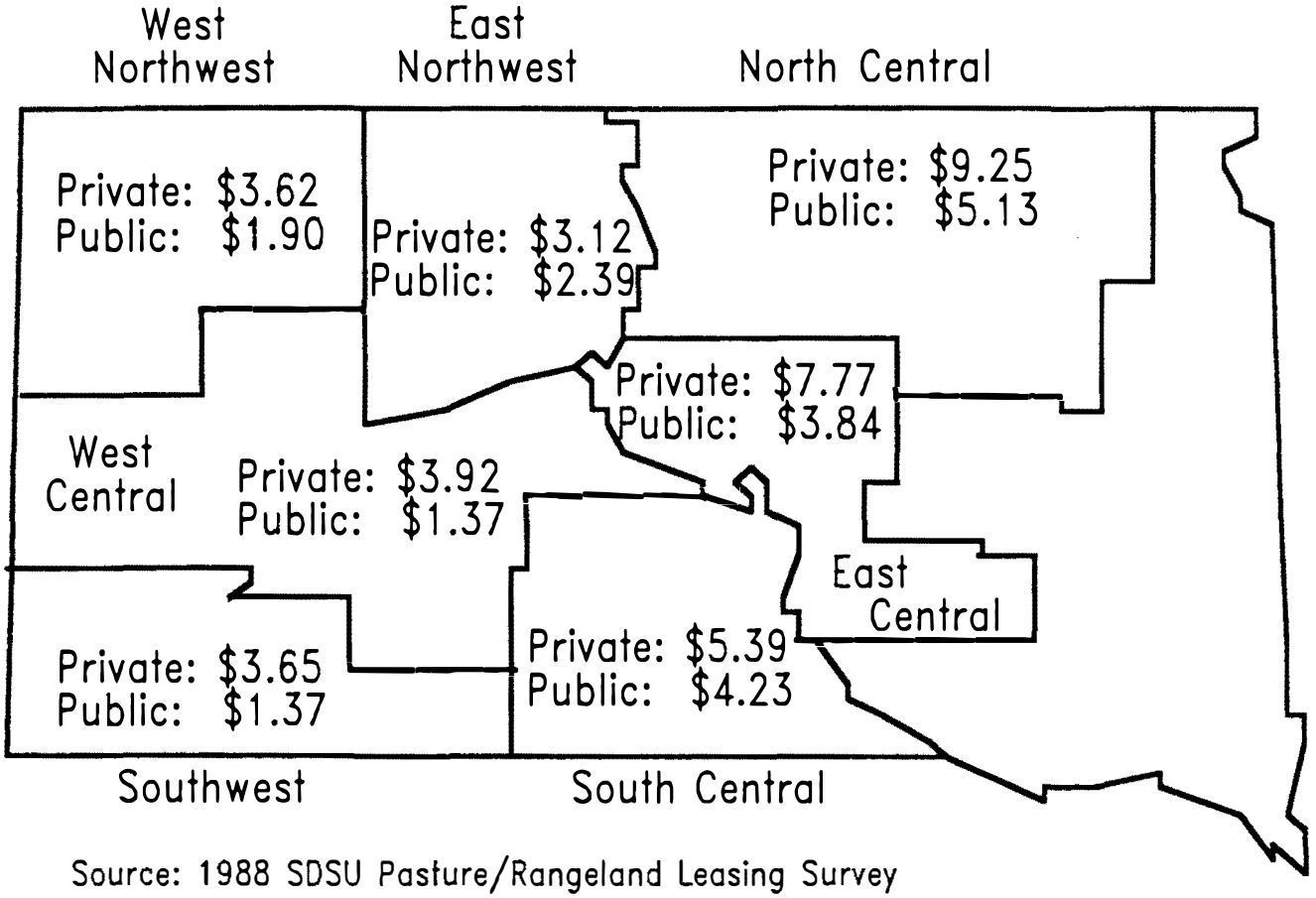
RANGELAND LEASING RATE DETERMINATION

Model Specification

A single equation econometric model was developed to examine the relationship between per acre lease rates and selected explanatory variables. The general form of the model was $Y=f(X_{1i}, X_{2i}, X_{3i}, X_{4i})$ where: Y = lease rate per acre, X_{1i} = productivity and location variables, X_{2i} = tract size variables, X_{3i} = selected lease agreement characteristic variables, and X_{4i} = type of lease variable. An ordinary least squares (OLS) multiple regression procedure (PROC GLM in the Statistical Analysis System was used to estimate

Figure 1

Private and Public Lease Rates in Dollars per Acre by Region, 1988[a]



Source: 1988 SDSU Pasture/Rangeland Leasing Survey

[a]Public lease rates in this map include average lease rates per acre for rangeland leased from state, federal and tribal trust (BIA) agencies.

the coefficients and to obtain the type III partial sums of squares and resultant F-test which allows for testing the significance of adding subsets of categorical (dummy) variables in a model (10).

Productivity and Location Variables

Productivity and location variables are AUMPERAC and REGION. AUMPERAC is an estimate of the productivity of the rangeland tract in Animal Unit Months (AUM's) and is derived from long term stocking rate information supplied by the rancher. The AUMPERAC coefficient is expected to be positive (7).

REGION is a set of category (dummy) variables for regional location of the tract. REGION was included as a proxy variable to capture differences between regions such as precipitation, soil fertility, local supply and demand conditions for leased rangeland, property taxes on rangeland, and other regional-specific factors. The coefficients for the regions in central South Dakota were expected to be positive relative to the base region - West Northwest South Dakota (Figure 1).

Size of Tract Variables

Lease rates were expected to be negatively related to the size of the leased tract, measured in hundreds of acres (ACRE), because of greater difficulty in making larger lease payments and managing larger tracts. Since lease rates per acre may have a non-linear relationship to size of tract, a second variable ($ACRE^2$) was used to examine this possibility.

Lease Agreement Characteristics

Lease rates may be affected by management practices and amenities which may be incorporated into a lease agreement. Lease agreement characteristic variables included in the model are: PAYMENT, WATER, FENCE, and HERBFERT (7).

PAYMENT was included in the model to reflect how often lease payments were made. Annual lease payments may be difficult for some ranchers to cash flow, placing downward pressure on lease rates.

The availability of water sources (WATER) on the leased tract is a very important management consideration. The expected coefficient sign for the absence of water source(s) is negative.

Fencing repair and maintenance is frequently a negotiating point in a rangeland lease. The variable FENCE is included to reflect which party is responsible for fencing materials and labor. If the landlord assumes some of the responsibility of fence maintenance and improvements, the expected sign of the FENCE coefficient is positive. A negative sign is expected if no fencing maintenance is reported.

The use of herbicides or fertilizers to improve range condition is reflected in the HERBFERT variable. If these practices are the landlord's responsibility, the expected coefficient sign is positive. If no fertilizer or herbicide is used, the expected coefficient sign is negative.

Type of Lease Variables

The category variable LEASE indicates the type of landlord and lease (private, state, Federal, or tribal trust (BIA)) involved in the leasing agreement. In private leasing markets, leasing rate differentials are expected to reflect tract productivity and location, tract size, and selected amenities of specific leases. These same factors are also expected to have considerable influence on competitive bid state leases and BIA leases. These factors may have less influence on Federal grazing permit rates which are calculated by formula and are not subject to a bidding process (12).

Private lease rates were expected to exceed BIA and state land lease rates per acre, after accounting for other explanatory variables. A negative coefficient is expected for Federal grazing permits.

Model Results

Four regression equations were initially developed to explain variation in per acre lease rates. Separate equations were developed for each year (1986, 1987, and 1988) of leasing data obtained from the survey. The fourth equation is a pooled data set of leases from 1986 - 1988.

The coefficients for each equation were examined and it was hypothesized that no structural changes had occurred in the rangeland leasing model coefficients over the 1986 - 1988 period. This hypothesis was confirmed by an F-test comparing restricted and unrestricted models (6). The calculated F-value was 0.0256 and the critical F-value (α=.05, 19, 893) was 1.88. Based on this result, further discussion of lease rates are limited to the pooled data set (1986 - 1988).

The coefficients of the model are expressed in cents per acre and the R^2 is 0.656, indicating 65.6% of the variation in per acre lease rates is explained by the coefficients in the model (Table 2). The mean lease rate is about $4.30 per acre, the root mean square error (RMSE) is about $1.71, and the overall F-value is significant at the 0.01 probability level. Additional findings are discussed by groups of variables.

Productivity, Location and Tract Size Variables

Coefficients for productivity, regional location and tract size were significant at the 0.05 or 0.01 probability level. AUMPERAC is a proxy for tract productivity and its mean value is 0.62 AUM's per acre. The coefficient is positive and has a value of $0.55 per acre.

Table 2. Results of the Lease Rate per Acre Model for South Dakota, Pooled Data 1986-88.

Variable	Beta	Standard Error
Intercept	282.26	27.14[c]
Productivity Variables		
REGION		
East Central	231.39	24.09[c]
East Northwest	-38.79	25.98
North Central	337.40	21.97[c]
South Central	160.78	25.12[c]
Southwest	-59.08	27.73[d]
West Central	-51.84	21.25[d]
West Northwest	0.00	---
AUMPERAC	54.74	13.38[c]
Size of Tract Variables		
ACRE (hundreds of acres)	-1.57	0.47[c]
$ACRE^2$	3.57E-05	1.51E-05[d]
Lease Agreement Characteristics		
PAYMENT		
Annual	-72.90	15.55[c]
Not Annual	0.00	---
FENCE		
Landlord	73.41	15.46[c]
Not Done	-15.67	39.81
Tenant	0.00	---
HERBFERT		
Landlord	9.44	26.28
Not Done	-37.41	12.95[c]
Tenant	0.00	---
WATER		
None	-52.21	17.86[c]
Present	0.00	---
TYPE OF LEASE		
Tribal trust (BIA)	74.03	27.40[c]
Federal	-107.70	25.19[c]
Private	194.77	16.07[c]
State	0.00	---

Summary Statistics

R^2	= 0.656
F-value	= 98.76[c]
RMSE	= 170.97
Dep. Mean	= 429.64
N	= 949

	DF	Type III Sum of Squares	F-value
Region	6	1778.6[b]	101.41[c]
Lease	3	809.2	92.27[c]
Fence	2	67.2	11.49[c]
Herbfert	2	30.2	5.17[c]

[a]Beta coefficients are in cents per acre.

[b]Type III sum of squares are in ten thousands.

Probability Level of Significance: c = .01; d = .05

REGION is a categorical variable with seven parameters representing the regions of South Dakota included in the model. Based on Type III partial sums of squares (SSE) the regional coefficients were collectively significant (p=0.01). Parameter signs and values indicate that lease rate patterns followed soil productivity and precipitation patterns with the highest positive coefficients in the North Central, East Central and South Central regions.

Tract size (ACRE) coefficient was negative and significant (p=0.01) indicating that as tract size increases, the lease rate per acre decreases. This expected phenomena continues until tract size reaches 22,000 acres. The average tract size is 1490 acres and few tracts exceeded 22,000 acres. The coefficient for $ACRE^2$ was positive and significant (p=0.05).

Lease Agreement Characteristics Variables

Each of the category variables reflecting lease characteristics (PAYMENT, FENCE, HERBFERT, and WATER) were individually or collectively significant (p=0.01).

The coefficient for PAYMENT was negative and significant, indicating that lease rates involving annual payments are expected to be lower than lease rates where payments are more frequent. Annual payments were used in 73% of the leases.

The lease characteristic variable FENCE was significant (p=0.01) and positive for the landlord parameter. This likely reflects efforts by landlords to recover some of their added expenses and increased desirability by tenants for tracts where fencing maintenance is partly the landlord's responsibility. Landlords assumed or shared fencing maintenance expenses in 30% of the leases.

The absence of fertilizer and herbicide application was negatively related to lease rates. The application of fertilizer or herbicides would be expected to increase or maintain the carrying capacity of the tract and thus command a higher lease rate. Fertilizer and/or herbicides were applied on 45% of the leased tracts. The lease rate is slightly higher if the landlord provides or shares these expenses.

The absence of water sources for livestock on the tract has a negative and significant impact on lease rates. The coefficient for lack of WATER was -$0.52 per acre. A water source for livestock was not available on 14% of the tracts.

Type of Lease

The coefficients for the LEASE category variable were collectively significant (p=0.01), indicating that lease payments per acre substantially vary by type of cash lease or grazing permit (private, Federal, state, or BIA) after accounting for other possible factors (productivity, location, tract size and selected amenities).

Private leases had the largest positive coefficient (+$1.95 per acre) relative to state agency leases. Leases rates for competitively bid tribal trust (BIA) tracts were also higher per acre than state lease rates. The coefficient for Federal grazing permits (-$1.08) is lower than coefficients for other lease types in South Dakota. Compared to private leases, Federal grazing permits are about $3.02 lower per acre after accounting for other explanatory variables in the model.

SUMMARY AND IMPLICATIONS

Major characteristics of different types of rangeland cash lease agreements (private, state, Federal and BIA leases) used by ranchers in

central and western South Dakota were examined. A majority of private leases were annually renewable, verbal agreements while public agency and tribal trust leases were written, multi-year agreements. The median length of time that ranchers have leased rangeland from a specific private landlord is 5 years, compared to 15 - 20 years of leasing from BIA, Federal, or state agencies. Ranchers reported greater landlord participation in making rangeland and fencing improvements in private leases.

An econometric model was developed to explain variation in lease rates per acre during the 1986 - 1988 period. Four major types of variables were included in the model: (1) productivity and location, (2) size of tract (3) lease agreement characteristics, and (4) type of lease (private, state, Federal and BIA). Coefficients for each type of variable were significant at the 0.01 or 0.05 probability level and the overall R^2 was 0.656. Higher lease rates were associated with: (1) increases in AUM's per acre, (2) regional location in central South Dakota, (3) smaller tract size, (4) more frequent lease payments, (5) presence of water sources, (6) greater attention to fencing maintenance and use of fertilizers/herbicides, and (7) private leases.

Significant differences in lease rates per acre by type of lease remain, after accounting for differences in tract size, productivity, location and lease amenities. Private leases have the highest rates followed by BIA, state and Federal leases. The remaining differences in lease rates reflect: (1) differences in value of use rights and administrative difficulties between types of leases, and (2) net subsidy of below cost leasing of public lands.

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