Public Land Policy and the Value of Grazing Permits

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This article provides an empirical test of the traditional theory of permit value and investigates the impact of recent changes in public land policies on the value of grazing permits. Results suggest that the cost advantage for grazing on public lands has been capitalized into substantial permit values, but other economic and hedonic factors influencing land prices also have contributed to the value of grazing permits. Public land grazing permits have fallen in value relative to deeded land as grazing fees have increased and as assurance has waned that public land policies will continue to be favorable to ranchers.

Key words: grazing permits, grazing fees, permit values, public land policy.

Western public land ranchers face increasing uncertainties about the use and tenure of public land grazing permits. The mandate for multiple-use management of public lands by the Federal Land Policy and Management Act (FLPMA) and a heightened interest in public land use by nonranchers have increased the controversy surrounding public land management. Environmental concerns have become important, and ranchers, especially public land ranchers, have come under repeated attacks for allegedly destroying rangelands by overgrazing.

Fees charged for grazing on public lands have generated a long-standing controversy. Seminal articles on the topic were published by Roberts and by Gardner (1962, 1963) in the early 1960s, and debate about public land grazing fees and imputed permit values has been lively ever since. The traditional economic logic developed to explain the existence of market values for public land grazing permits suggests the value arises from a capitalized cost advantage accruing to the ranchers holding the permits. The original grazing permits issued by state and federal land agencies were awarded to ranchers gratis, and grazing fees were set low to encourage use and private investment on these lands. As a result, the grazing permit reflected a capital gift to the original permittee, and the permits acquired a market value paid by subsequent purchasers (Gardner 1962, 1963; Hooper; Nielsen, Godfrey, and Obermiller; Workman; Torell, Ghosh, and Fowler). The permit value that accrued depended partly on the characteristics of local land markets, but the value of grazing permits contributed to ranch values and also to the debt obligations of the ranchers purchasing the permits. An estimated 85% to 90% of state and federal land lessees paid some amount for the public land leases they now hold (Nielsen and Workman; Torell, Ghosh, and Fowler).

Public land ranchers[1] contend the market value of grazing permits, as paid at the time of ranch purchase, is a legitimate cost of doing business on public rangelands and should be considered when setting grazing fee policy (Hage). The USFS, BLM, and various state land offices are not legally obligated to recognize permit values and do not do so.[2] Federal

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[1] In this report a public land ranch may include Bureau of Land Management (BLM), U.S. Forest Service (USFS), and/or New Mexico state trust lands (NMSLO). Technically, New Mexico state lands are not public lands; they are trust lands generating revenue for beneficiary institutions in New Mexico.

[2] The Internal Revenue Service does recognize the value of the grazing permit and taxes the value of the estate when leases transfer.

land agencies contend that recognition of permit values would allow the permittee to retain the capitalized value of a resource that belongs to the public [U.S. Department of Agriculture/U.S. Department of the Interior (USDA/USDI)]. A similar position has been taken by the NMSLO.

It is well established that public land grazing permits have value. Collins; Fowler and Gray; Martin and Jefferies; and Torell and Fowler (1986a, b) all have shown that public land AUMs[3] contribute to the market value of western ranches. Additionally, the 1986 USFS and BLM grazing fee review (USDA/USDI), while not recognizing permit value as a valid consideration in setting grazing fee policies, did recognize that permits have value and summarized those market values by state. Of the literature reviewed, only Winter and Whitaker could not verify permit values.

The objective of this study was to determine the impact of recent public land policies on the value of public land grazing permits. We provide statistical estimates of permit values in New Mexico and compare and contrast intertemporal differences in these values to the policies of the various state and federal land agencies. Although ranch appraisers and buyers often argue that grazing fees are inconsequential to the ranch purchase decision, we find that recent increases in grazing fees, especially on New Mexico State trust lands where fees have increased the most, have reduced the value of grazing permits relative to deeded land. Further, we believe the controversy and uncertainty surrounding the release of BLM Environmental Impact Statements (EISs) during the early 1980s and the present controversy arising from USFS planning documents (calling for decreased stocking rates on Forest Service lands) have reduced the market value of public land grazing permits.

Public Land Policy

The BLM has released more than a dozen EISs and planning documents in New Mexico since 1977. Similarly, the USFS recently released forest plans and EISs for New Mexico. The reports emphasize apparent resource conflicts with livestock grazing, especially on riparian areas, and propose major reductions in allowed grazing based on range surveys in each BLM and USFS resource management area. Most of these documents were released in the early 1980s and stimulated substantial controversy throughout the West.

Over the same period, starting in the early 1980s, 944,000 acres of BLM land in New Mexico were studied for possible designation as wilderness areas, and 560,000 acres of BLM land eventually were recommended for conversion to wilderness areas (New Mexico Congressional Delegation Office). Grazing would not be prohibited on these lands, but management problems would be created by increased difficulty of access and restrictions on vehicular travel.

Although some land agency reports supported an increase in grazing over the long term, most called for short-term decreases. Obviously, a major controversy resulted from proposed reductions in grazing use. After the initial publicity surrounding the BLM's recommended cuts in allowed grazing, the controversy subsided when BLM did not initiate the reductions but moved instead to a five-year rangeland monitoring program. This monitoring period is now over, and BLM is again evaluating potential adjustments to allowable use rates for New Mexico ranchers.

Public land grazing fees also have been a focal point of a major historical debate centered on the appropriate charge rate. The last federal grazing fee study was published in 1986 (USDA/USDI) and found that fees set under the current Public Rangelands Improvement Act (PRIA) fee formula were substantially less than private land lease rates negotiated in the competitive market. A 1986 Executive Order mandated that federal land grazing fees continue to be set using the PRIA fee formula, but proposals for increased grazing fees on federal lands continue to be heard.

Policies of the NMSLO have been as controversial as federal land policies in recent years. This was not always the case, however, as demonstrated by the popular saying, "State land management is no management," long used by ranchers to describe management of New Mexico state trust lands. With nearly 9 million acres to manage and a minimal field staff, state land management was largely left

[3] An Animal Unit (AU) is considered to be one mature cow with calf or the equivalent. An AUM (Animal Unit Month) is the amount of forage required by an AU for one month, and an AUY (Animal Unit Yearlong) is the forage required by an AU for the year. Because year-long grazing is common in the Southwest, we compute values on a dollar per AUY basis. This value can be converted to $/AUM by dividing by 12.

to the lessee. Ranchers generally favored holding a state lease because this tacit shift in management responsibility meant minimal interference by NMSLO. A substantial advantage accrued to state land ranchers because of relatively low fees and indications that favorable policies toward the livestock industry would continue.

NMSLO's laissez-faire attitude changed somewhat with the 1982 elections. The newly elected administration made it clear that the state planned to take a more active role in administering trust lands and to fulfill fiduciary responsibilities to maximize state land revenues. The administration proposed to increase state trust beneficiary income through higher user fees, to consolidate small scattered state land parcels, to implement trespass laws on state lands similar to those on federal lands, and to inventory range improvements on state lands.

The 1982–86 NMSLO administration proposed an increase in grazing fees to $2.67/AUM. This proposal was challenged in court and not implemented (*Victor Perez, Jr. et al. vs. Jim Baca, Commissioner of Public Lands,* SF 85-1000). Grazing fees remained at $1.60/AUM for the remainder of the administrative term.

Under a new administration elected in 1986, grazing fees increased to $1.87/AUM in 1987. NMSLO then funded studies to investigate the feasibility of adding an annual adjustment factor to the fee calculation, similar to that used in the federal PRIA fee formula. A new fee formula including these adjustments was implemented with the 1988 fee year (Torell, Ghosh, and Fowler). The base charge rate also was substantially increased. As a result, NMSLO grazing fees increased to $2.35/AUM in 1988, $3.13/AUM in 1989, and $3.16/AUM in 1990.

Other public land issues have made headlines in recent years. Some of the more notable include protection of endangered species, off-road vehicle use on public lands, riparian area management, wildlife habitat, and competition between livestock and wildlife. More radical proposals include complete elimination of grazing on public lands (Godfrey and Pope; Quigley and Bartlett).

The effect of all these proposed, and sometimes implemented, public land policies has been to increase the uncertainty and therefore risk surrounding the tenure of public land grazing leases. Although the decline in New Mexico ranch values has followed the national trend and is related in part to AUY earnings, the controversy and uncertainty about future public land policies would be expected to reduce the value of ranches that depend on public lands for forage.

The Regression Model

Other things being equal, the price paid for an AUY of grazing capacity should be determined by the value the ranch market imputes to grazing capacity from public and private land sources. The regression model presented below estimates the contributory value of each public land lease type, as well as the deeded land. The first step was to estimate an equation that would predict the value of New Mexico ranches on a dollar per AUY (*$AUY*) basis, given the characteristics and land ownership pattern of the ranch. This definition of the dependent variable was used because western livestock ranches heavily dependent on public lands typically are valued on an AUY or cow-unit basis.[4]

The total sale price of a ranch (*$TOTAL*) can be found by multiplying *$AUY* times the total carrying capacity rating of the ranch, including both deeded and leased forage sources. The marginal value of a deeded or leased AUY can then be determined by evaluating the derivatives of total ranch sale price with respect to AUYs obtained from various sources. The crucial analytical link is the estimate of ranch sale price per AUY.

Widely divergent methodologies have been used to model land values. These range from variations on the traditional capitalization formula (Burt), adaptations of simultaneous equation models (Heady and Tweeten; Reynolds and Timmons), some rather eclectic formulations (Castle and Hoch; Alston), and VAR estimations requiring no formal model (Featherstone and Baker). The models vary depending on the research objectives and the type and completeness of the data available for empirical application.

[4] Public lands are not purchased outright. Instead, the deeded land associated with the ranch is sold at an increased price and the grazing permits historically associated with the deeded land are transferred by public land agencies at little or no cost. As a result, price per acre is not a satisfactory measure of value. Further, rangeland carrying capacity is so variable between western ranches that even private land ranches are typically sold on an AUY, AUM, or per-cow basis.

The objectives of this study, as well as the data available, are best suited to a hedonic specification adapted from the model formulated by Rosen and applied to land value estimation by Palmquist; Chicoine; and Dunford, Marti, and Mittelhammer. With this model specification, the market value of a ranch is determined by its local physical characteristics and other factors affecting earning potential. Land is not treated as a homogeneous factor of production but rather possesses unique characteristics. Ranches are, therefore, valued differently in the marketplace because of the differentiated factors of production associated with them.

The general form of the equation used to predict the AUY sale price of ranches was

$$\$AUY = f(PERBLM, PERFS, PERSTAT, PROD, HBVALAUY, ACCULAUY, SIZE, COSTAUY, TIME).$$

The variable definitions are given in table 1. The first seven variables on the right-hand side are hedonic in nature; that is, they relate the value of the ranch to local and specific ranch characteristics. The last two variables, which were entered in various forms in the final model, capture the effects of important economic variables as they changed or were anticipated to change through time. A more complete modeling of changing expectations about earning potential, public land policies, and land appreciation/depreciation rates could not be made because of data limitations.

The *COSTAUY* variable needs additional explanation. This variable tests the validity of the traditional theory of permit value by evaluating the impact of recent increases in grazing fees on ranch sale prices. If the theory of permit value is correct, the value of western ranches should decrease (increase) as the difference between public land grazing fees and forage value decreases (increases). To test the traditional theory of permit value, we assumed the value of public land leases would be based on the AUY cost advantage computed for the year prior to the ranch sale.

The steps in estimating the cost advantage of New Mexico public land ranches were as follows. First, the dollar per AUY value of public land forage that would be obtained in a competitive market was estimated by multiplying the annual lease rate for grazing on nonirrigated private rangeland by 70%. Torell, Ghosh, and Fowler estimated an average 30% of observed private land lease payments goes to pay for services provided with private leases that are not provided by public land agencies. The 30% allowance in setting forage value reflects a premium willingly paid for private leases because of cost savings (lower nonfee costs) on private lands, including less lost stock, no association fees, and less travel to and from allotments. The grazing fee for each public lease type on the ranch was subtracted from the estimated forage value to give the apparent cost advantage per AUY on the ranch. The total cost advantage for the ranch was then determined by multiplying the differential for each lease type by the number of AUY from that source and summing across all public leased AUY, i.e.,

$$COSTADV_{t-1} = [(FV_{t-1} - FEEFED_{t-1}) \cdot (BLMAUY + FSAUY) + (FV_{t-1} - FEESTAT_{t-1}) \cdot STATAUY].$$

The cost advantage was expressed as an average amount per AUY of ranch carrying capacity by defining

$$COSTAUY_{t-1} = COSTADV_{t-1}/TOTAUY.$$

The estimated average annual cost advantage per AUY for both federal and New Mexico state trust lands is shown in table 2.

Data Sources

Ranch sales data are from sales information collected by ranch appraisers and lending institutions, including as a major data source the Farm Credit Services. Data cover the period from January 1979 through December 1988 and include data for 452 bona fide ranch sales. Appraisers estimated the possible presence of nonagricultural price influences, and all sales judged to be substantially influenced by nonagricultural factors were deleted. To further ensure the absence of urban influences, sales with capacities below 25 AUY were deleted. The value of livestock and machinery was not included in the sale price.[5]

[5] If livestock, machinery, and equipment were sold with the ranch, this value was defined and subtracted from the ranch sale price by the appraiser recording the ranch sale. Thus, the ranch sale price, as defined, is for land and improvements only.

Table 1. Definition of Variables in the Analysis

Variable	Definition
ACCUL	Total acres of cultivated land included with the ranch sale
ACCULAUY	Acres of cultivated land per AUY included with the ranch sale (i.e., *ACCUL/TOTAUY*)
BLMAUY	AUY carrying capacity from BLM land
$COSTADV_{t-1}$	The estimated total cost advantage the ranch has for public land grazing leases at time $t-1$ (one year before the ranch sale)
COSTAUY	Cost advantage per AUY of carrying capacity on the ranch
DEEDAUY	AUY carrying capacity from deeded land
$TOTAL	Total ranch sale price in dollars, excluding the value of cattle and machinery
$AUY	Ranch sale price on a $/AUY basis.
$FEEFED_{t-1}$	Federal land grazing fee ($/AUY) at time $t-1$
$FEESTAT_{t-1}$	State land grazing fee ($/AUY) at time $t-1$
FSAUY	AUY carrying capacity from USFS land
FV_{t-1}	Forage value ($/AUY) at time $t-1$
HBVAL	Total appraised value of houses and buildings included with the ranch sale
HBVALAUY	Appraised value of houses and buildings included with the ranch sale on a $/AUY basis (i.e., *HBVAL/TOTAUY*)
PERBLM	Percent of total ranch carrying capacity from BLM land [i.e., (*BLMAUY/TOTAUY*)·100]
PERFS	Percent of total ranch carrying capacity on leased USFS land [i.e., (*FSAUY/TOTAUY*)·100]
PERSTAT	Percent of total ranch carrying capacity on leased state trust land [i.e., (*STATAUY/TOTAUY*)·100]
PROD	Average rangeland productivity, computed as the total number of AUY included in the sale, divided by the total number of sections sold (i.e., *TOTAUY/SIZE*)
SIZE	Size of the ranch purchased in sections (including both deeded and leased lands)
STATAUY	AUY carrying capacity from state trust land
TIME	Time trend variable defined as the number of years following January 1979 that the ranch sold (i.e., January 1982 = 3, July 1988 = 9.5)
TIME·PERBLM	Slope shifter for *PERBLM*, computed by multiplying *PERBLM* by *TIME*
TIME·PERFS	Slope shifter for *PERFS*, computed by multiplying *PERFS* by *TIME*
TIME·PERSTAT	Slope shifter for *PERSTAT*, computed by multiplying *PERSTAT* by *TIME*
TOTAUY	Total AUY carrying capacity rating for the ranch (from deeded and public leased forage sources), *TOTAUY = DEEDAUY + BLMAUY + FSAUY + STATAUY*

Note: AUY (Animal Unit Yearlong) is the forage required by one mature cow with calf or the equivalent for a year; BLM is Bureau of Land Management; USFS is U.S. Forest Service.

Empirical Results

The Regression Model

Using ordinary least squares regression, the ranch price model was estimated as

$$(1)\quad \$AUY = \beta_0 + \beta_1 PERBLM + \beta_2 PERFS + \beta_3 PERSTAT + \beta_4 SIZE + \beta_5 SIZE^2 + \beta_6 ACCULAUY + \beta_7 HBVALAUY + \beta_8 PROD + \beta_9 TIME + \beta_{10} TIME^2 + \beta_{11} TIME^3 + \beta_{12} COSTAUY + \beta_{13} TIME \cdot PERBLM.$$

The functional form of the model was based on goodness of fit and a cubic time trend that best captured changes in New Mexico ranch values over the study period. Estimation of the model on a dollar-per-AUY basis standardized the parameter estimates so that a valid interpretation across all sizes of ranches could be made.

In addition to the variables shown in equation (1), an additional model considered several other variables to determine whether the price discount (relative to deeded land) for each type of public land lease was stable through time. It might be expected that as public land policy changed for a particular land agency, the price discount for that type of leased land would change as well. Model I considered the variables *TIME·PERBLM*, *TIME·PERFS*, and *TIME·PERSTAT*. These variables are slope shifters for *PERBLM*, *PERFS*, and *PERSTAT* (table 1). Only the *TIME·PERBLM* variable was found to be statistically significant, implying the price discount for BLM land has changed through time. Because other slope shifters were not significant, Model II, as given by equation (1), excludes *TIME·PERFS* and *TIME·PERSTAT*. Only Model II will be discussed in detail.

After canceling and collecting terms, the

Table 2. Calculation of the Cost Advantage for Grazing on New Mexico Public Lands, $/AUY

Year	Private Lease Rate[a]	Forage Value[b]	State Trust Land		Federal Land	
			Grazing Fee	Cost Advantage	Grazing Fee	Cost Advantage
1978	71.28	49.92	12.72	37.20	18.60	31.32
1979	81.96	57.36	13.92	43.44	23.28	34.08
1980	82.20	57.54	15.12	42.42	29.04	28.50
1981	83.76	58.63	15.72	42.91	27.72	30.91
1982	75.12	52.58	16.92	35.66	22.32	30.26
1983	79.56	55.69	17.88	37.81	16.68	39.01
1984	81.60	57.12	19.20	37.92	16.44	40.68
1985	69.24	48.47	19.20	29.27	16.20	32.27
1986	71.76	50.23	19.20	31.03	16.20	34.03
1987	69.84	48.89	22.44	26.45	16.20	32.69
1988	65.52	45.86	28.20	17.66	18.48	27.38
1989	75.12[c]	52.58	37.56	15.02	22.32	30.26

Note: Except in the Southwest, it is most common to tabulate lease rates on a $/AUM basis instead of the $/AUY basis used here. Divide each number by 12 to convert to $/AUM.
[a] Source: USDA, National Agricultural Statistics Service, various issues.
[b] The net value of forage during 1986 was estimated to average 70% of the private lease rate by Torell, Ghosh, and Fowler, and this percentage allocation was assumed here.
[c] Source: Torell and Bledsoe.

equation for predicting total ranch value (Model II) is given by

$$\$TOTAL = \$AUY \cdot TOTAUY \tag{2a}$$

or

$$\begin{aligned}\$TOTAL = {} & \beta_0 TOTAUY + (\beta_1 \cdot 100) BLMAUY \\ & + (\beta_2 \cdot 100) FSAUY \\ & + (\beta_3 \cdot 100) STATAUY \\ & + \beta_4 SIZE \cdot TOTAUY \\ & + \beta_5 SIZE^2 \cdot TOTAUY + \beta_6 ACCUL \\ & + \beta_7 HBVAL + \beta_8 PROD \cdot TOTAUY \\ & + \beta_9 TIME \cdot TOTAUY \\ & + \beta_{10} TIME^2 \cdot TOTAUY \\ & + \beta_{11} TIME^3 \cdot TOTAUY \\ & + \beta_{12} COSTADV \\ & + (\beta_{13} \cdot 100) TIME \cdot BLMAUY.\end{aligned} \tag{2b}$$

Ranch Prices and Ranch Characteristics

Table 3 gives the parameter estimates for the two models. The SAS software package diagnostics suggested no problems with multicollinearity in either of the model formulations. All parameters were significant at the $\alpha = .03$ level or higher in Model II. Plots of the residuals indicated the models predicted equally well for different size ranches, for different leased land percentages, and for all years of the analysis. All estimated parameters were of the expected sign and were reasonably stable across both model specifications.

It would be expected that as the number of AUY that could be carried on a ranch increased, through either added acreage or improved rangeland productivity, the total value of the ranch would increase. Our results show that this is the case. The −11.37 parameter estimated for rangeland productivity (*PROD*) indicates that the ranch sale price per AUY decreases as the carrying capacity of the ranch increases but because more AUY are added, the total value of the ranch increases, i.e., more AUY on the ranch are valued at slightly less per AUY.

The estimated coefficients for *SIZE*, entered as a quadratic variable, indicate that as the total acreage of a ranch increases, the price per AUY falls, but at a decreasing rate. The magnitude of the adjustment is small; for a 20-section ranch, the downward adjustment is −$71.40/AUY. Similar to increased rangeland productivity, a diminished sale price per AUY with increased ranch size does not mean the total value of the ranch will be less. Additional carrying capacity on the added acreage will increase the total sale price of the ranch.

The estimated coefficient for house and building values was $1.18, suggesting that each dollar of appraised value for houses and buildings adds $1.18/AUY to the value of the ranch.

Table 3. Regression Estimates for Alternative Ranch Price Models

Variable	Model Parameter	Model I		Model II	
		Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
Intercept	β_0	3,333.49*	107.74	3,348.54*	104.35
PERBLM	β_1	−36.82*	5.47	−38.85*	4.71
PERFS	β_2	−28.60*	5.62	−30.64*	4.78
PERSTAT	β_3	−26.28*	7.50	−30.30*	5.13
SIZE	β_4	−3.72*	1.00	−3.67*	.99
$SIZE^2$	β_5	.005*	.002	.005*	.002
ACCULAUY	β_6	85.12*	28.08	85.71*	28.03
HBVALAUY	β_7	1.18*	.13	1.18*	.13
PROD	β_8	−11.43*	1.47	−11.37*	1.47
TIME	β_9	739.66*	81.54	738.31*	81.19
$TIME^2$	β_{10}	−166.61*	19.69	−167.99*	19.60
$TIME^3$	β_{11}	9.09*	1.33	9.23*	1.32
COSTAUY	β_{12}	23.11***	16.60	29.81**	14.00
TIME·PERBLM	β_{13}	.96*	.275	.93*	.27
TIME·PERFS	β_{14}	.26	.489	—	
TIME·PERSTAT	β_{15}	−.33	.467	—	
Adjusted R^2		.788		.789	
F		112.78*		130.43*	
Number of Sales		452		452	
Dependent Mean		2,636		2,636	
Root MSE		530		529	

Note: Single asterisk indicates significance at $\alpha = .01$ level or higher; double asterisk indicates significance between $\alpha = .03$ and $\alpha = .01$; triple asterisk indicates significance between $\alpha = .20$ and $\alpha = .03$. For definitions of variables, see table 1.

This implies a dollar invested in buildings adds more than a dollar to the property's value at the time of sale. A possible explanation is that the *HBVALAUY* variable may be capturing the value of other range improvements, assuming ranches with higher quality and quantity of houses and buildings also have more range improvements and other developments. Further, the estimated coefficient may suggest that the appraisers and lenders who provided data for this study tended to estimate building values conservatively for lending purposes.

The time trend of New Mexico ranch values closely followed the trend estimated by the cubic specification of time variables. Time-series estimates of net returns for New Mexico ranches followed a similar trend (Torell and Doll), but in the absence of a precise measure of expected future ranch earnings, the trend variables best captured time differences in ranch values.

Grazing Fees and Permit Value

The coefficients for *PERBLM, PERFS,* and *PERSTAT* were estimated to be −$38.85, −$30.64 and −$30.30, respectively (Model II, table 3). These are estimates of the amounts by which the price of an average AUY is discounted (relative to deeded land) as the proportion of leased land from each public land source increases by 1%. It would be expected that the price discount would be different for each type of lease and changing through time, depending on policies and fees of each land agency.

In 1979 when the *TIME* variable was set to zero, the discount for a BLM grazing permit was significantly larger (more negative) than the discount for permits from the other two land agencies. From this point, the magnitude of the BLM permit discount diminished. The estimated *TIME·PERBLM* coefficient ($\hat{\beta}_{13}$) was statistically significant and equal to .93. Thus, the total BLM discount was −$38.85 + $0.93*TIME*. This means that by January 1988 (*TIME* = 9) the price discount for BLM was −$30.48, suggesting that the difference in the discount for AUYs leased from the three public land sources disappeared by the late 1980s.

Relatively low public land grazing fees have created a cost advantage that has been capitalized into permit values. The parameter estimate for *COSTAUY* (29.81) was statistically significant at the $\alpha = .03$ level, indicating that a $1 increase in the cost advantage of public

Table 4. Marginal Permit Values through Time, Relative to Deeded Land, $/AUY

Sale Year (July)	Deeded Land ($/AUY)	Deeded Land Time Index	BLM Permit ($/AUY)	BLM Permit Time Index	BLM Permit Ratio to Deeded (%)	USFS Permit ($/AUY)	USFS Permit Time Index	USFS Permit Ratio to Deeded (%)	State Land Permit ($/AUY)	State Land Permit Time Index	State Land Permit Ratio to Deeded (%)
1980	3,677	96	947	79	25.76	1,629	96	44.32	1,942	93	52.82
1981	3,856	100	1,052	88	27.29	1,642	97	42.58	2,091	100	54.22
1982	3,838	100	1,199	100	31.24	1,696	100	44.18	2,087	100	54.38
1983	3,677	96	1,112	93	30.24	1,516	89	41.22	1,711	82	46.52
1984	3,430	89	1,218	102	35.51	1,529	90	44.58	1,527	73	44.52
1985	3,152	82	1,082	90	34.34	1,301	77	41.27	1,252	60	39.73
1986	2,898	76	670	56	23.14	796	47	27.47	740	35	25.55
1987	2,724	71	642	54	23.56	675	40	24.76	619	30	22.72
1988	2,685	70	656	55	24.42	596	35	22.18	443	21	16.51
1989	2,837	74	742	62	26.17	590	35	20.78	334	16	11.76

land grazing results in a $29.81 increase in the value of the ranch. This conversion implies a capitalization rate of 3.35%, an estimate that is consistent with the traditional economic theory of permit value (Workman; Gardner 1962).

Capitalization of the cost advantage for public land grazing does not completely explain the recent downward trend in permit values on New Mexico ranches. This can be seen by considering the marginal value of each lease type. These equations are estimated by differentiating equation (2b) with respect to AUYs from each land type:

$$(3)\quad \partial \$TOTAL/\partial DEEDAUY = \beta_0 + \beta_4 SIZE + \beta_5 SIZE^2 + 2\cdot\beta_8 PROD + \beta_9 TIME + \beta_{10} TIME^2 + \beta_{11} TIME^3,$$

$$(4)\quad \partial \$TOTAL/\partial BLMAUY = \beta_0 + \beta_1\cdot 100 + \beta_4 SIZE + \beta_5 SIZE^2 + 2\cdot\beta_8 PROD + (\beta_{13}\cdot 100 + \beta_9) TIME + \beta_{10} TIME^2 + \beta_{11} TIME^3 + \beta_{12}(FV_{t-1} - FEEFED_{t-1}),$$

$$(5)\quad \partial \$TOTAL/\partial FSAUY = \beta_0 + \beta_2\cdot 100 + \beta_4 SIZE + \beta_5 SIZE^2 + 2\cdot\beta_8 PROD + \beta_9 TIME + \beta_{10} TIME^2 + \beta_{11} TIME^3 + \beta_{12}(FV_{t-1} - FEEFED_{t-1}),$$

and

$$(6)\quad \partial \$TOTAL/\partial STATAUY = \beta_0 + \beta_3\cdot 100 + \beta_4 SIZE + \beta_5 SIZE^2 + 2\cdot\beta_8 PROD + \beta_9 TIME + \beta_{10} TIME^2 + \beta_{11} TIME^3 + \beta_{12}(FV_{t-1} - FEESTAT_{t-1}).$$

As shown, marginal permit values depend on the cost advantage on public lands but also on ranch size, productivity, and unspecified factors captured in the trend variables of the model.

The average-size ranch in the data set had 19.3 sections of total land area (deeded and public) and carried 309 AUY, for an average productivity rating of 16 AUY/section. The average house and building value was $72.72/AUY. Considering this average ranch, table 4 shows the marginal value of an additional AUY of carrying capacity coming from each land type. The table also gives a time index for the relative value of the marginal AUY when compared to its 1982 peak value. The ratio of permit value to deeded land value also is computed. Marginal permit values are graphed in figure 1, along with earlier estimates of federal permit values in New Mexico published by Fowler and Gray.

The marginal value of public land AUYs followed the same general trend as the value of AUYs from deeded land sources. In the early 1980s when deeded land ranches were selling for relatively high amounts, public land grazing permits contributed more to the value of the ranch than the capitalized cost advantage of public land forage would justify. More recently, public lands contribute less to value than the simple capitalization formula would estimate. Consider as an example the value estimates for New Mexico state trust land. The apparent cost advantage on New Mexico state trust land during 1980 was $42.42/AUY ($3.54/AUM) (table 2). Multiplying this amount by $\hat{\beta}_{12}$ = $29.81 gives an estimated 1981 capitalized permit value (the *COSTADV* variable is lagged one year) of $1,265/AUY ($105.42/AUM). By comparison, the marginal permit value estimated using equation (6) is $2,091/AUY ($174.25/AUM). This difference in value has reversed in recent years. The cap-

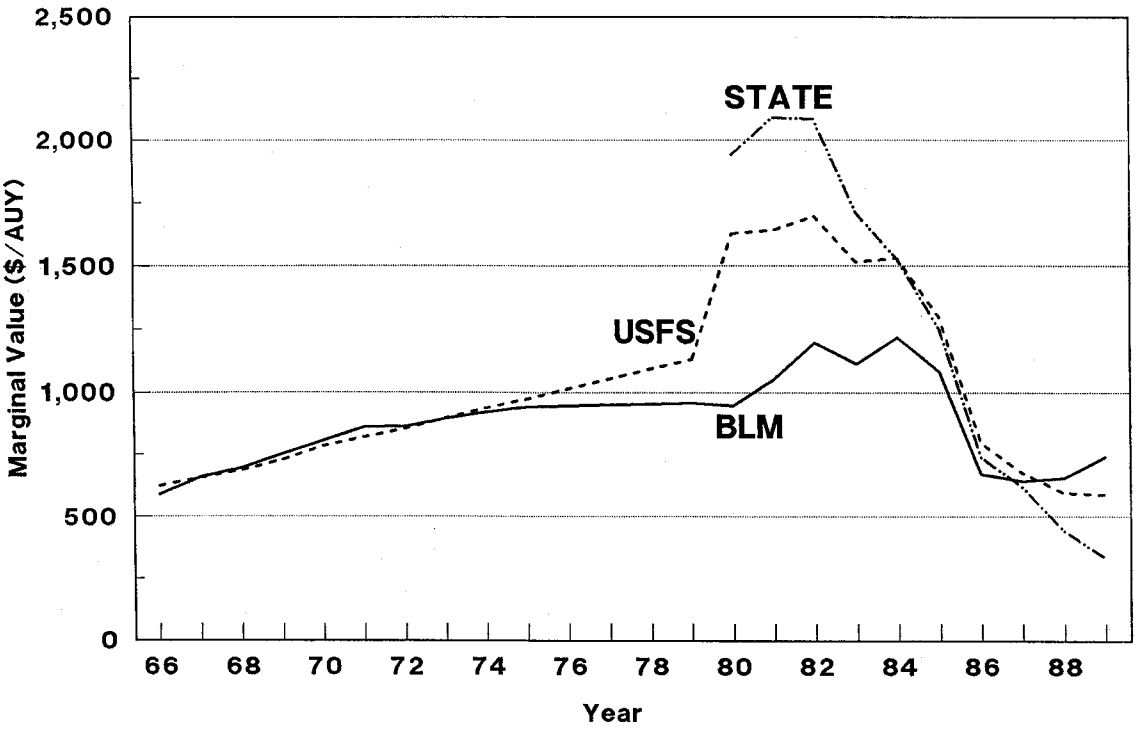

Figure 1. Estimated trend of marginal permit values, $/AUY, 1966-79 estimates from Fowler and Gray; 1980-89 estimates from Model II

italized permit value estimated for New Mexico state trust lands during 1989 was $17.66 × $29.81 = $526.44/AUY ($43.87/AUM). The marginal permit value estimated using equation (6) is less, $334/AUY ($27.83/AUM). The diminished value of grazing permits in recent years, relative to the value implied by the capitalization formula, would be expected given the changing and controversial policies of land agencies and the decreased emphasis on livestock grazing on public lands.

New Mexico state land leases moved from being the most valuable grazing permit to the least valuable permit within seven years. While no specific reason can be assigned for certain, this decline in value would be expected given the changing policies and increased fees of the NMSLO after 1982.

The cost advantage of grazing on federal lands has not substantially declined (table 2), but the estimated value of BLM and USFS permits has decreased through time, following the downward trend of ranch values in general. During the early 1980s, when BLM was preparing EISs throughout the West and proposing major reductions in allowed stocking rates, BLM permits were less valuable than USFS or state land permits. When the agency did not implement these cuts, and moved to a period of rangeland monitoring, the value of BLM permits stabilized. Similarly, more recent studies and proposals of the USFS apparently have reduced the market value of USFS permits, as would be expected.

Table 5 shows the $/AUM grazing fee estimated to equate permit values to zero for different years of the analysis. These estimates were obtained by setting equations (4), (5), and (6) to zero and solving for $FEEFED_{t-1}$ and $FEESTAT_{t-1}$, using the average ranch considered earlier. It can be seen that, with the lower value of BLM permits in the early 1980s, a fee of about $5/AUM would have eliminated permit value. Higher fees of between $6 and $7/AUM, comparable to private land lease rates, would have been required to set USFS and state permit values at zero over the same period. After 1986, a grazing fee between $3 to $4/AUM eliminates permit values on all three lease types.

The zero permit value fees in table 5 provide an estimate of the market value of public land

Table 5. Grazing Fees that Would Force Permit Value to Zero, versus Actual Fees Paid and Private Lease Rates, $/AUM

Sale Year (July)	Fee For Zero Permit Value			Actual Fee Paid		Private Lease Rate[a]	Forage Value[a]
	BLM	USFS	State	BLM/USFS[a]	State[a]		
1980	4.59	6.50	6.59	2.42	1.26	6.85	4.80
1981	5.36	7.01	7.10	2.31	1.31	6.98	4.89
1982	5.66	7.05	7.14	1.86	1.41	6.26	4.38
1983	4.97	6.10	6.19	1.39	1.49	6.63	4.64
1984	4.80	5.66	5.76	1.37	1.60	6.80	4.76
1985	4.40	5.01	5.10	1.35	1.60	5.77	4.04
1986	3.22	3.58	3.67	1.35	1.60	5.98	4.19
1987	3.14	3.24	3.33	1.35	1.87	5.82	4.07
1988	3.18	3.02	3.11	1.54	2.35	5.46	3.82
1989	3.62	3.19	3.28	1.86	3.13	6.26	4.38

[a] From table 2.

forage imputed from the ranch market. After 1985, this imputed value is about $3.25/AUM for all three lease types, less than half the $7–8/AUM value suggested by more radical grazing fee proposals recently introduced in Congress (Torell and Fowler 1989).

Discussion

It is well established that public land grazing fees are below the market value of the forage (USDA/USDI; Torell, Ghosh, and Fowler; Workman; Gardner 1962). Several reasons can be given for this, including the need to encourage good stewardship and private investment on public lands (Torell, Ghosh, and Fowler) and the higher nonfee costs of grazing on public lands (Obermiller and Lambert; Torell, Godfrey, and Nielsen). This cost differential has been capitalized into sizeable permit values, as indicated by value estimates derived in this study as well as by others (Collins; Fowler and Gray; Martin and Jefferies).

Original leaseholders received a capital gift from public land agencies. They received a leasehold interest entitling them to a grazing use valued higher than the annual grazing fee paid. However, most current leaseholders were not so fortunate; they had to buy the grazing permit. For these leaseholders, the cost of grazing permits is not only an opportunity cost but is an out-of-pocket expense. It has been argued by ranchers and their supporters that this investment should be considered when setting grazing fee policy.

Some writers argue that the solution to the public land subsidy is to compensate ranchers for the loss in wealth incurred when grazing fees are increased or when forage is reallocated to other uses (Gardner 1989; Quigley and Thomas; Huffaker, Wilen, and Gardner). It can also be argued that this value (cost) has never been recognized by public land agencies and thus has never belonged to ranchers. From this vantage point, the "right" to purchase and transfer grazing permits is revocable and ranchers do so at their own risk.

A major implication of the research reported here is that increases in grazing fees, and the current environmental emphasis of public land management, has diminished the market value of public land grazing permits. We expect continued depreciation of this value as debate continues and intensifies about public land management. The challenge to policymakers will be to resolve these public land management issues in an equitable manner, while balancing the concerns of disparate interest groups.

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