The Impact of Beef Price and Hunting Pressure on Pasture Values in North Dakota

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Abstract

Anecdotal evidence suggests that agricultural land values are influenced by recreational demands, in particular hunting. This study estimated that the impact that hunting pressure, beef prices, and lagged land values had on county-level pasture values in North Dakota. Using panel data from 1989-2006, a fixed effects model was specified and estimated. Results showed that on average, hunting pressure increased pasture land values by $16.27 per acre or about nine percent of total pasture value.

Introduction

Almost all published studies agree that the value of agricultural land is influenced by a large number of factors, including the price of agricultural outputs. Other factors include differences in productivity, hunting and fishing opportunities, and scenic or other amenities (Torell et al., 2005), development potential (Plantinga, Lubowski & Stavins, 2002), and government program payments (Janssen & Button, 2004).

Research on land valuation is divided into two broad categories. In the first category, articles report analyses of the determinants of individual land values. Actual land sale prices are explained by socio-economic variables. The second category considers more macroeconomic factors and their impact on aggregate land values, such as county-level land values (i.e., averaged across all land within a county), typically based on survey data. Here we followed the second approach to consider the impact of a small number of macroeconomic factors on pasture land values in North Dakota. Specifically, we are interested in pasture land values reported at a county level.

Pasture land in North Dakota has limited alternative uses for beef production. Although there is some sheep production, the numbers are small. Most pasture land is also unsuitable for tillage as it is too rocky, susceptible to erosion, and must comply with government program provisions. However, in some locations there are development pressures. Also, anecdotal evidence suggests that recreational demand for land, specifically hunting, is increasing land values. Our purpose here was to quantify the impact of beef price and hunting pressure on pasture land value. The method employed, panel regression, considered differences in land values across counties.

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Methods and Data

Consistent with Shultz (2007), we considered two potential groups of buyers of pasture land: ranchers and hunters. Derived demand for land by cattle producers is a function of profits from cattle production, primarily calf sales and cull cow sales. Data on profits from individual cattle producers are costly to collect on a county level. Instead, beef price is used as a proxy for profits, as profits are directly tied to beef prices.

Demand for recreational land is also difficult to directly measure as recreational buyers typically lease their land back to agricultural producers (Shultz, 2002). Recreational buyers receive income from the land in addition to recreational amenities. So, hunting pressure is used as a proxy for the impact of recreational demand on agricultural land prices. Unfortunately, county-level hunter days are also difficult to collect, although in some states estimates are available. Instead, we measured hunting pressure using state-level license sales.[1]

Additional variables potentially impacting the value of land include interest rates, measured here using U.S. prime rate, and lagged land value. Interest rates are the cost of borrowing to purchase land and a proxy for the opportunity cost of capital. Lagged land values were included to reflect likely inertia in land value. We used a one-year lag for land values and beef prices. Given the time to purchase a bred heifer, calve her, and wean a calf, a one-year lag is justifiable.[2]

We employed panel regression to estimate the impact of changes in beef prices and hunting pressure on pasture land values.[3] Landowner survey results (NDASS, 1990-2007) reported at the county level were used to measure pasture land values for 50 North Dakota counties (3 other ND counties are omitted due to lack of data) over 18 years (1989-2006). The model is specified as:

$$(1)\quad land\ value_{j,t} = c_1 + k_j + c_2 \cdot land\ value_{j,t-1} + c_3 \cdot beef\ price_t + c_4 \cdot beef\ price_{t-1} + c_5 \cdot hunt\ license_t + c_6 \cdot prime\ rate_t + \varepsilon_{j,t}$$

where $land\ value_{j,t-i}$ denotes average real land value in county j and year t-i, $i \in \{0,1\}$, c_1 is an intercept term; k_j is a fixed effect by county; $beef\ price_{t-i}$ is aggregate real beef price in year t-i, $i \in \{0,1\}$; $hunt\ license_t$ is the number of hunting licenses for residents and nonresidents sold in year t; $prime\ rate_t$ is the real prime rate; and $\varepsilon_{j,t}$ is an error term assumed to be uncorrelated with the explanatory variables.

As suggested by several studies (Torell et al., 2005), the relative productivity of land can influence its value. Additionally, land values may differ across counties due to varying development and recreational demands. So, we use a fixed-effect k_j to measure how individual county land values differ from the mean effect, c_1.

Aggregate beef prices are taken from NDASS (1990-2007). Residential and non-residential hunting license sales are taken from North Dakota Department of Game and Fish (Harmoning, 2007). Nominal prime rate data are taken from the U.S. Federal Reserve (2007). Beef prices, land values, and prime rate data are inflated to 2006 dollars using a beef Producer Price Index (US BLS, 2007). Summary statistics for selected variables are given in Table 1.

Results

Regression results, except the estimated fixed effects, are reported in Table 2. The model appears to be well specified, given an R^2 of 0.868 and an adjusted R^2 of 0.860. Autocorrelation of error terms is not present as measured by the low value (-0.407) for Durbin's h-statistic (Greene, 1993). Coefficient estimates are significant at the one percent level with one exception – the intercept is not significantly different from zero (p=0.692). The lagged dependent variable coefficient is positive and significant (p<0.00001), indicating that there is persistence in land valuations. As is expected, an increase in current beef price increases land values. For every $1 per cwt in current beef price, the impact is about $1.41 per acre. Lagged beef price has negative impacts (-$1.18) on land values. This suggests that the land market might overreact to beef price changes and then adjusts in the following year. Another possible explanation is due to the production lag. Higher past beef prices suggest that it was more expensive to buy heifers in the previous year, resulting in lower current pasture land demand. The prime rate negatively impacts land value, as is expected. Higher borrowing costs increase the cost of financed land purchases. A one percent increase in real interest rates results in a land value decrease of -$2.45 per acre.

As was hypothesized, hunting license sales positively impacted land value. This result was likely measuring the increase in recreational demand for land ownership. Anecdotal evidence in North Dakota suggests that this has a large impact on land values. However, this result is not borne out as land value increases by only about $0.11 per acre for every 1,000 resident licenses sold. The average number of licenses sold (resident and non-resident) during the time period was 147,869, equating to $16.27 per acre. Note that this average impact is only about nine percent of the average price of pasture land over the time period considered.

Conclusions

We investigated the impact of macroeconomic factors – beef price, hunting pressure, and interest rates – and lagged land value on North Dakota county-level pasture values. Through panel regressions, our results show that county-level pasture values as reported via surveys overadjust to beef price changes. The net effect after two years is a positive influence of beef price on land value, as theory suggests. The net impact is a $0.28 per acre increase for every $1 per cwt of beef price. Past land values are positive determinants of current/future prices. It is not surprising that the previous year's land value is a good predictor of current value. Hunter numbers positively impact land values. An increase of 1,000 hunters increased land value by about $0.11 per acre. While the marginal impact of an additional hunter is minimal, the aggregate impact represents about nine percent of average land values. For appraisers, our results provide guidance in forecasting the impact of hunting on North Dakota land value trends. As license sales increase, our results show that the amount that hunting pressure contributes to land value can be found by multiplying license sales and 0.00011.

Previous studies have generally assumed that hunting pressure increases agricultural land values; this study quantifies the amount of land value attributable to hunter land demand. While supporting the hypothesis that hunters increase land values, the average value attributable to hunting pressure in North Dakota was only about nine percent. Our result is consistent with Shultz's (2007) finding that recent large increases in agricultural land values cannot be attributed to recreational demand.

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*Table 1. Summary statistics for selected variables**

	land value ($/acre)	beef price ($/cwt)	prime rate (%)	res (#)	non res (#)
Mean	180.70	77.90	8.07	95020.28	52848.61
Median	167.47	80.25	8.34	94228.00	45705.00
Maximum	607.00	97.94	11.08	108263.00	95140.00
Minimum	77.17	46.26	3.80	81637.00	16228.00
Std. Dev.	58.32	12.11	2.28	7242.55	25101.23
n	900	900	900	900	900

*All dollar denominated variables are in 2006$. The variables are land value = real land value per acre; beef price = real beef price per cwt.; prime rate = US Federal Reserve Bank prime rate in %; res = number of hunting licenses sold to ND residents; and non res = number of hunting licenses sold to non-ND residents.

Table 2. Land value regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	3.13647	7.90783	0.39663	0.69175
value(-1)	0.93649	0.03084	30.36652	0.00000
beef price	1.41799	0.10367	13.67827	0.00000
beef price(-1)	-1.18025	0.11043	-10.68822	0.00000
hunt license	0.00011	0.00004	2.70871	0.00690
prime rate	-2.45410	0.40580	-6.04757	0.00000
R-squared	0.86850			
Adjusted R-squared	0.85957			
Log likelihood	-3801.92002			
F-statistic	97.23298			
Prob(F-statistic)	0.00000			
Durbin's h statistic	-0.40705			

Endnotes

[1] Numerous types of licenses are sold each year to both residents and non-residents. Over time licensing requirements have changed. To maintain consistency and avoid double (or more) counting of hunters, the minimum license requirement for both residents and non-residents is used. For residents, general game license sales, plus combination/sportsman's license sales are used. For non-residents, small game licenses, general game, and non-game licenses are added together.

[2] An argument could be made for using two lags for beef price if the assumption is that heifers are developed, bred, calved, and weaned. Additionally, the Akaike information criterion slightly favors two lags for land value. However, additional lags introduce severe multicollinearity into the model.

[3] Panel regression allows each county to have a separate intercept term while data for all counties are used to determine the slope coefficients. For more details, see Green (1997).