THE FEDERAL RESERVE BANK *of* KANSAS CITY
ECONOMIC RESEARCH DEPARTMENT

The Impact of Wildlife Recreation on Farmland Values

Jason Henderson and Sean Moore
December 2005
RWP 05-10

RESEARCH WORKING PAPERS

THE IMPACT OF WILDLIFE RECREATION ON FARMLAND VALUES

Jason Henderson and Sean Moore*
Center for the Study of Rural America

December 11, 2005
RWP 05-10

Abstract: Wildlife recreation – hunting, fishing, and wildlife watching – appears to be an increasingly important past time for many Americans as people continue to increase their spending on wildlife recreation. Land lease and ownership expenditures by wildlife recreation participants are rising and appear to be capitalized into farmland values. This paper analyzes the impact of hunting lease rates on farmland values in Texas. The results indicate that counties with higher wildlife recreation income streams have higher land values.

Keywords: farmland values, wildlife recreation

***JEL Classification*:** Q15

*Authors are Senior Economist and Research Associate, Center for the Study of Rural America, Federal Reserve Bank of Kansas City, 925 Grand Boulevard, Kansas City, MO 64198, USA. The authors benefited from the comments of participants at the Agricultural and Rural Finance Markets in Transition Conference. The views expressed are those of the authors and do not reflect the views of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

Henderson email: Jason.Henderson@kc.frb.org
Moore email: Sean.Moore@kc.frb.org

1. Introduction

Wildlife recreation – hunting, fishing, and wildlife watching – has garnered increasing attention as an engine of economic development in rural communities. The expansion and success of rural outfitter businesses, such as Cabella's and Bass Pro Shop, are clear examples of the economic possibilities of wildlife recreation activity. Other examples are the emerging businesses engaged in hunting and trapping industries. From 1998 to 2003, the hunting and trapping industry grew 25 percent in the number of firms and employment and 50 percent in terms of payroll.[1]

More recently, wildlife recreation has emerged as an increasing influence affecting U.S. farmland as farmers are capturing additional income streams from wildlife recreation. In 2002, more than 2800 farms averaged $7,217 dollars from recreation services, where recreation service income was characterized as hunting and fishing (NASS). Surveys of land values indicate that recreation activity is fueling a surge in land values. In Texas, 68 percent of land market professionals indicated that hunting and fishing was a dominant motive for land buyers in 2003 (Gilliard, Robertson, and Cover). In a survey of agricultural bankers in the Kansas City Federal Reserve District, 57 percent reported that recreation demand was a contributing factor in farmland value gains in December 2004, up from 44 percent in December 2002 (Center for the Study of Rural America).[2]

Wildlife recreation creates additional demand for land and opens up opportunities for additional revenue streams. Since farmland values are capitalized values of expected earnings, increased revenues from wildlife recreation should fuel farmland values gains. Research has

[1] Calculations based on 1998 and 2003 County Business Patterns data for the hunting and trapping industry (NAICS code 1142).

[2] The Kansas City Federal Reserve District covers that states of Nebraska, Kansas, Oklahoma, Colorado, Wyoming, northern New Mexico, and western Missouri.

focused on the impact of recreation and scenic amenities on land values. Wildlife recreation is unique from other recreation activities because it does not necessarily lead to the conversion of farmland to non-farm activities. The land value impacts of wildlife recreation might be different from scenic amenities because wildlife recreation is a public good that may produce private benefits. Similar to scenic amenities, wildlife is a public good. By controlling hunting and fishing access to private land, land owners control access to wildlife and may be able to capture a private benefit. For example, some farmers lease their land for hunting and receive an additional, complementary farm income stream.[3]

Given the apparent rise in recreational demand for farmland, this paper analyzes the impacts of wildlife recreation on farmland values. After reviewing previous literature, a hedonic price model of farmland values is used to identify the impact of hunting lease rates and recreational income on farmland values in Texas. The results indicate that farmland values in Texas are higher in counties with higher hunting lease rates and greater recreational income for farmers, *ceteris paribus*.

2. Literature Review

Farmland is a resource used in a variety of activities, including wildlife recreation, and its value is derived from the capitalized value of its expected future returns. Agricultural income, including farm program payments, is the primary revenue stream for farmland. A large number of studies have analyzed the capitalization of agricultural income streams into farmland values (Barnard et al. 1997; Burt 1986; Chavas and Shumway 1982; Castle and Hoch 1982; Featherstone and Baker, 1987; Herriges et al, 1992; Just and Miranowski, 1993; Moss, 1997;

[3] The presence of wildlife can also present costs to farmers. For example, high densities of wildlife can lead to severe crop damage or increased probability of automobile accidents.

Miranowski and Hammes, 1984; Phipps, 1984). Some of these studies have used time-series data, while others have used cross-sectional data.

Another group of studies has focused on the impacts of urbanization on farmland values (Chicoine, 1981; Clonts, 1970; Dunford et al, 1985; Folland and Hough, 1991; Reynolds and Tower, 1978; Shi et al, 1997; Shonkwiler and Reynolds, 1986). The primary hypothesis in these studies is that the potential for future urban expansion and the conversion of farmland into residential or commercial use is being capitalized into farmland values. In general, these studies find that the potential for urban development is being capitalized into farmland values with regions closer to large and growing urban centers experiencing higher land values. Most of these studies focus on the spatial variation of farmland values.

Recent literature has also analyzed the impacts of scenic or wildlife amenities on land prices. Research has found higher land prices in places containing or in close proximity to scenic amenities. Irwin (2002) and Irwin and Bocksteael (2001) found that residential prices are higher in areas with more open space. Irwin and Bockstael (2004) indicate that land near preserved or unprotected open space has greater probability to be developed than land in closer proximity to commercial or neighborhood development.

Research has also found that places with greater wildlife amenities have higher land values. Bastian (2002) found that wildlife amenities were associated with higher agricultural land values in Wyoming. Land with scenic views, elk habitat, and sport fishery had higher land values.[4] Pope, Adams, and Thomas (1984) and Pope (1985) using data from a survey of Texas hunters found that land values in Texas were higher in regions with greater deer harvest densities.

[4] Research has also analyzed the impact of the recreation industry on farmland values. Barnard, et. al (1997) found that farmland values were higher in counties with higher per capita wages in the recreation industry - resorts and attractions.

Another body of research has focused on the influence of land attributes on wildlife recreation leases. Livengood (1983) analyzed the value of hunting lease and the marginal willingness to pay for hunting white-tailed deer in Texas in 1978 and 1979. Pope and Stoll (1985) also analyzed the hunting lease prices for white-tailed deer in Texas and found that the location and size of the hunting parcel and the diversity of hunting game influenced hunting leases. Baen (1997) analyzed Texas hunting leases and developed a hunting lease index based on the deer densities, trophy quality deer, and metro proximity of rural lands. Shrestha and Alavalapati (2004) analyzed the impact of various ranchland attributes on Florida hunting leases and find that vegetation cover has a positive impact on hunting revenues.

Despite the research analyzing the impact of land attributes on hunting leases, research analyzing the capitalization of wildlife recreation income streams into farmland values is limited. Pope, Adams, and Thomas (1984) and Pope (1985) combined recreation income with other agricultural income in their models. As a result, these studies were unable to identify the impacts of recreation income from other agricultural income streams.

3. Texas Wildlife Recreation Income

The primary challenge in analyzing the economic impact of wildlife recreation on farmland values is to obtain secondary measures of income from wildlife recreation. However, Baen (1997) provides average per acre hunting lease rates for 115 Texas counties for 1996. These averages were obtained from the 1996 Texas Farm and Ranch Hunting Survey by the office of the Texas Comptroller and Public Accounts. Landowners were randomly selected in each of the Texas counties from landowner tax rolls. The response rate was 16 percent and

responses covered 142 out of the 254 counties.[5] Figure 1A shows the hunting lease rates by county for a 12 month access lease.[6] Over 80 percent of the landowners with lease arrangements reported leases covering deer hunting. As a result, the geographic coverage of the hunting lease rates in Figure 1A appears to overlap with the deer densities in Texas as shown in Figure 1B.

Capitalizing hunting income at a three percent rate, Baen indicates that the hunting value averaged 25 percent of the market value of farmland in the corresponding counties. In some counties, the hunting value accounted for more than two-thirds of the market value of farmland.

While Baen's data series limits analysis to the state of Texas, Texas appears to be a viable state to analyze the impact of wildlife recreation on farmland values. Baen reports that 98 percent of Texas land was privately owned. Pope and Baen indicate that the market for access to wildlife was developed in the 1980s and 1990s. The U.S. Fish and Wildlife Service (1996) reports that over 80 percent of the big game hunters hunted only on private land. Moreover, in 1996 and 2001, Texas ranked first in hunting expenditures with $1.5 billion dollars spent on hunting (Table 1). Texas also ranked first with 1.2 million hunting participants. According to the 2002 Census of Agriculture, Texas ranked first in the number of farms receiving income from recreation services (8,230) and in the total value of income they received ($77.6 million).

4. Empirical Model

Given that farmland values are derived from the capitalization of the expected future income streams derived from multiple and sometimes competing uses, the hunting lease data is used in a hedonic price model to analyze their impact on Texas farmland values. In hedonic

[5] See Baen for more detail on the survey design, sample, and response rates.
[6] Hunting leases can be highly variable in their design ranging from annual, season, day, to gun leases. See Baen (1987) and Pope (1985) for a description of typical lease arrangements in Texas.

models, prices of heterogeneous goods are determined by the goods' characteristics. Hedonic price models have been used extensively to impute the value of agricultural land attributes in farmland prices (Miranowski and Hammes 1984; Palmquist and Danielson 1989; Herriges et al. 1992; Roka and Palmquist 1997). Hedonic models have also been used to analyze residential property values (Irwin 2002).

The hedonic price model is specified as:

$$P = f(\boldsymbol{A}, \boldsymbol{U}, S, H) \quad (1)$$

where the dependent variable P is the county level per acre farmland values in Texas counties in 2002. The data was obtained from the 2002 Census of Agriculture at http://www.nass.usda.gov/census/. $\boldsymbol{A}$ is a vector of agricultural attributes, $\boldsymbol{U}$ is a vector of non-agricultural attributes, $\boldsymbol{S}$ is a vector of scenic, environmental, or recreation attributes, and H is the hunting lease rate variable. Table 2 provides descriptive statistics on the data.

4.1. Control Variables

A series of variables are used to control for the non-recreational attributes influencing farmland values. Three variables control for the impacts of the county's agricultural economy on farmland values. The average annual county level per acre crop receipts from 1997 to 2000, *CROP*, is included to measure the economic returns to crop farming. The average county level per acre livestock receipts from 1997 to 2002, *LSTK*, is included to measure the economic return to livestock farming. Counties with larger crop or livestock returns are assumed to have higher capitalized farmland values.

Farm incomes have also been supported by government payments. *GOV*, the average annual per acre value of government payments received in the county between 1998 and 2000, is used to measure the farm income stream derived from federal subsidies. Counties with higher

levels of government payments are expected to have higher demand for farmland and higher land values. A positive relationship between *GOV* and farmland values is expected.

Multiple variables are used to control for the urban impacts on farmland values. A dummy variable, *METRO*, identifies counties that are classified as a metro area. Another dummy variable, *ADJACENT*, identifies non-metropolitan counties are adjacent to metro areas. Both variables are include to measure the impacts of urban sprawl on farmland demand as metropolitan areas grow in size and spread into neighboring non-metropolitan counties. The population density of the county in 1990, *POPDEN*, and the average annual population growth from 1990 to 2000, *POPGROW*, are used to measure the impacts of a large and growth population on the demand for farmland for residential use in larger non-metropolitan counties. In fact, much of the recent economic growth has been emerging from newly classified micropolitan counties, non-metro counties with a city between 10,000 and 50,000 in population (Henderson and Weiler). Farmland values are hypothesized to be positively related to *METRO*, *ADJACENT*, *POPDEN*, and *POPGROW* because of higher demand for land near large and growing populations with more abundant urban amenities.

Natural amenity data are used to control for the impact of scenic and environmental amenities on farmland values. McGranahan (1999) describes the development of the natural amenity index based on various weather and geographic variables. Due to the expected high correlation between crop productivity and weather conditions, we only include a geographic index based on typography and water surface area.[7] Standardized land surface form typography codes and water surface area data for all U.S. counties are obtained from USDA Measuring Rurality Briefing Room. The standardized data are then summed and indexed to 100.

[7] Additional analysis used McGranahan's natural amenity index and found a high correlation between this index and weather measures. Models including these measures found the amenity and weather indexes to be highly significant, but led to insignificant results for crop receipts per acre (*CROP*) variable.

4.2. Wildlife recreation variables

The initial variable used to measure recreation income is the average hunting lease rate in 1996 provided by Baen (1987). The lease rate is based on a twelve month annual access. The hunting lease variable, *HUNTING*, is expected to be positively related to farm land values.

One drawback of the hunting lease variable is that it is derived from a relatively small sample. A total of 414 surveys were obtained in the 1996 survey for an average of roughly three per county.[8] To check for the robustness of the results, alternative specifications are estimated that replace the hunting lease variable with other proxy measures of recreation income. Given the availability of total county recreation service income and farms receiving recreation service income in the 2002 Census of Agriculture, the average recreation service income per farm was calculated. However, a preferred method would identify income on a per acre basis, because farm sizes can be highly variable. Thus, an alternative measure, *RECACRE*, approximates the average income per acre by dividing average recreation service income per farm by the average farm size in the county. *RECACRE* is expected to be positively related to farmland values.

For a further check for reboustness, we included the number of deer per acre for Texas counties. The deer density measure, *DEERDEN*, will not analyze the capitalization of wildlife recreation income, but the capitalization of wildlife attributes into Texas farmland values. *DEERDEN* is expected to be positively related to Texas farmland values.

While average lease rates may influence farmland values, land values may also be influenced by the total size of the wildlife recreation market. For example, a hunting lease rate may be high, but if a single hunting lease transaction occurs in the county, it would have limited impacts on farmland values. The size of the wildlife recreation market is measured by the

[8] According to the 2002 Census, 8230 farms received income from recreation services. Assuming no change in the number of farms receiving recreation services income from 1996 to 2002, means that the lease rates would be derived from approximately 5 percent of the population.

number of farms receiving income from recreation services (hunting, fishing, etc.) in 2002 as reported in the Census of Agriculture. Counties with larger recreation service markets are expected to have greater impacts on farmland values.[9]

5. Empirical Results

Regression results for the estimated farmland price models are presented in Table 4. The model was applied to 114 Texas counties for which hunting lease rates were reported in Baen (1997).[10] The initial model included only the hunting lease rate. To check for robustness of results, alternative specifications placed the hunting lease rate with recreation income measures and wildlife recreation attributes as described previously. Both linear and log-linear forms of the model were estimated, and the log-linear form is used because it minimizes Akaike's Information Criterion (AIC).[11] The model appears to have good fit according to the adjusted R^2 measures. The potential for spatial autocorrelation was addressed following Rappaport (2003).[12]

In Model 1, the control variables are statistically significant at the 0.10 level with the hypothesized sign, except *GOV*. The insignificance of *GOV* may due to collinearity with *CROPS*

---

[9] The total county farm recreation service income in 2002 was also used to measure the size of the wildlife recreation market in the county. The number of farms receiving recreation income (*FARMS*) was used because it would provide a better approximation of the number of recreation lease transactions in the county. Moreover, Akaike's Information Criterion (AIC) was minimized when the *FARMS* measure was used.

[10] Disclosure problems associated with the government payments variable limited the observations to 114 counties.

[11] Theory provides little guidance in the choice of the model's functional form. The common approach is to select the functional form that minimizes goodness of fit criterion for the model (Irwin, 2002).

[12] Rappaport (2003) used a generalization of the Huber-White heteroskedastic-consistent estimator to report standard errors to account for spatial autocorrelation among disturbance terms. The following declining weighting function for estimating the covariance between disturbances is imposed on counties with a Euclidean distance less than 100 kilometers between county centers, where s_{ij} is the estimate of σ_{ij} and u_i is the regression residual.

$$S_{i,j} = g(distance_{i,j})\, u_i u_j \quad \text{where}$$

$$g(distance_{i,j}) \begin{cases} = 1 & : distance_{i,j} = 0 \\ = 1 - \left(\dfrac{\text{distance}_{i,j}}{100}\right)^2 & : 0 < distance_{i,j} \leq 100 \text{ km} \\ = 0 & : distance_{i,j} > 100 \text{ km} \end{cases}$$

as the variance inflation factors for *GOV* and *CROPS* are greater than two (Judge et al 1985).[13] The high degree of collinearity is not surprising given that government payments are primarily received by crop producers and are based on productivity of the land.

Variables controlling for the agricultural attributes of the county are significant with the hypothesized signs and consistent with other research results. Counties that have higher crop and livestock cash receipts per acre had higher land values. Farmland that offers a higher expected return from agricultural production has a higher capitalized value, *ceteris paribus*.

Variables controlling for the impacts of urban attributes of the county are significant with the hypothesized sign. Demand for land in urban use and thus land values are higher in places with larger concentrations of people. Farmland values are higher in counties with higher population density. Moreover, farmland in metro counties and in counties adjacent to metropolitan areas have a higher value because of a higher potential to be converted to urban use due to sprawl. Texas counties that enjoyed stronger population growth in the 1990s also had higher farmland values.

Most importantly, variables associated with wildlife recreation were found to be positive and significantly related to farmland values in Texas counties. In Model 1, hunting lease rates were found to be positive and significantly related to farmland values in Texas counties. The elasticity associated with the hunting lease rate is 0.25, higher than the 0.14 elasticity associated with gross livestock receipts.[14,15] It appears that income from wildlife recreation, especially hunting leases, is being capitalized into farmland values.

---

[13] Variance inflation factors on all other independent variables are less than 2 and do not indicate that multicollinearity is severely impacting other coefficient estimates. Dropping the government payments variable did not significantly alter the coefficient on the crop receipts data. However, dropping the crops receipts variable did lead to a positive and significant coefficient on the government payments variable.

[14] The elasticity for a log-liner model, $\ln y = \beta_0 + \beta_1 x$, is βx and results in a 0.25 elasticity measure, (0.060*4.197).

Texas farmland values appear to be higher in counties with more formal recreation income. The number of farms receiving wildlife recreation income was positively associated with land values. This result suggests that farmland values are higher in locations with more developed markets for recreational activity.

Variables used to check for the robustness of the results were also found to be significant and positively related to Texas farmland values. Farm recreation service income streams from recreation services appear to be capitalized into Texas farmland values. Texas farmland values were found to be higher in counties with higher average recreation income per farm acre (Model 2). The elasticity associated with average recreation service income variable was 0.18, again higher than the elasticity of the gross livestock receipts variable, but lower than the hunting lease rate variable. Wildlife recreation attributes also appear to be capitalized into Texas farmland values. In Model 3, counties with more deer per acre were found to have higher land values.

In sum, wildlife recreation has emerged as another income stream for farmers who rent land to hunters, anglers, and other outdoor enthusiasts. It appears that the value of wildlife recreation is capitalizing the value of hunting leases into farmland values. Texas farmland values in 2002 were higher in counties that had higher hunting lease rates in 1996, *ceteris paribus*. Moreover, farmland values were higher in counties with higher farm recreation income. Wildlife attributes appear to be capitalized into farmland values as counties with greater deer densities had higher farmland values.

---

[15] Additional analysis incorporated interaction terms between the hunting lease rate variable and the metro and adjacent dummy variable to determine if the capitalization of the hunting lease rate variable varied by distance to metro area. We hypothesized that the capitalization of hunting lease rates would be lower in metro areas or adjacent to metro locations because the future of the hunting lease would be limited as urban expansion encroached on the hunting lands. In other words, the time frame for hunting leases is more finite. An alternative hypothesis would be that that the capitalization of hunting lease rates would be higher as demand for hunting land would be higher near metro locations as a greater number of people would less access to land for hunting purposes. While the interaction terms were negative in sign, they were insignificant and were dropped from the analysis in order to present a more parsimonious model.

6. Conclusion

Wildlife recreation is clearly a large and expanding industry. U.S. residents spend billions of dollars each year to hunt, fish, and watch wildlife. Farmers are reaping some of the benefits of this burgeoning industry by building revenue streams from recreation services. Income from wildlife recreation and strong demand for land for wildlife recreation are transforming some rural land markets.

Empirical analysis of Texas farmland values finds that hunting leases and recreation income are being capitalized into farmland values. The capitalization of hunting lease incomes and other wildlife recreation revenues into farmland values could have various implications for farmers, bankers, agribusiness owners, and other stakeholders in wildlife recreation areas. The capitalization of wildlife recreation income means that farmers and bankers may need to account for this income stream in their land price appraisal. Land appraised solely on its value from agricultural production may be undervalued. Farmers may need to account for this income stream while bidding on farmland. Bankers may need to include this income stream when approving farm real estate loans or when using farm real estate for collateral.

While the results indicate that wildlife recreation provides a positive net income stream to farmers in Texas, wildlife recreation could alter the costs of agricultural production costs in a variety of ways. By boosting land values, wildlife recreation may raise the fixed costs of agricultural production. Wildlife recreation may increase the costs associated with crop loss or property destruction by wildlife or wildlife recreation participants. Farmers may also face increased costs associated with liability risk as landowners that allow free pubic access for

recreational use often have some liability protection not afforded to fee-based use.[16] Farmers may also have the burden of managing access to the property.

The capitalization of wildlife recreation income has implications for future research. Researchers may want to analyze the impacts of an expanding wildlife recreation industry on changing farm production patterns if certain crops are more supportive of the wildlife recreation industry. If wildlife recreation is bringing a new non-farm buyer to farmland markets, researchers may want to explore changes in farm ownership structure in wildlife recreation areas. Researchers may also want to explore the impact of wildlife recreation on non-farm businesses. In addition to boosting the local leisure and hospitality businesses, wildlife recreation could bring agricultural supply companies a different customer that demand wildlife friendly or safe farm products. Finally, this study analyzed the impacts of wildlife recreation in Texas. Researchers may also want to explore the impacts of wildlife recreation in other geographic areas.

Wildlife recreation is a multi-billion dollar business that appears to be expanding. The broad impacts of wildlife recreation in rural places remain uncertain. But wildlife recreation is creating another source of income for farmers and changing the way people explicitly value farmland.

[16] Baen (1997) lists five ways (insurance, lease provisions, release of liability or indemnity agreements, landownership form, and master leases with sublease tenants) farmers can limit their liability risk.

REFERENCES

Baen, John S. 1997 "The Growing Importance and Value Implications of Recreational Hunting Leases to Agricultural Land Investors" *Journal of Real Estate Research*, vol. 14, iss. 3, pp. 399-414.

Barnard, C.H., G. Whittaker, D. Westenbarger, and M. Ahearn, "Evidence of Capitalization of Direct Government Payments into U.S. Cropland Values," *American Journal of Agricultural Economics*, vol. 79, iss. 5 (1997): pp. 1642-1650.

Bastian, Chris T. "Environmental Amenities and Agricultural Land Values: A Hedonic Model Using Geographic Information Systems Data" *Ecological Economics*, March 2002, v. 40, iss. 3, pp. 337-49.

Burt, O.R., "Econometric Modeling of the Capitalization Formula for Farmland Prices," *American Journal of Agricultural Economics*, vol. 68, iss. 1 (1986): pp. 10-26.

Castle, E.N. and I. Hoch, "Farm Real Estate Price Component, 1920-78," *American Journal of Agricultural Economics*, vol. 64, (Feb 1982): pp. 8-18.

Center for the Study of Rural America, Federal Reserve Bank of Kansas City, "Survey of Agricultural Credit Conditions," Fourth Quarter 2003. www.kansascityfed.org/agcrsurv/AGCR4Q03.pdf

Chavas, J-P. and C.R. Shumway, "A Pooled Time-series and Cross-section Analysis of Land Prices," *Western Journal of Agricultural Economics*, vol. 7, (July 1982): pp. 31-41.

Chicoine, D.L., "Farmland Values at the Urban Fringe: An Analysis of Sales Prices," *Land Economics*, vol. 57 (Aug. 1981): pp. 353-62.

Clonts, H.A., Jr., "Influence of Urbanization on Land Values at the Urban Periphery," *Land Economics*, vol. 46, (Nov. 1970): pp. 489-97.

Dunford, R.W., C.E. Marti, and R.C. Mittelkammer, "A Case Study of Rural Land Prices at the Urban Fringe Including Subjective Buyer Expectations," *Land Economics*, vol. 61, (1985): pp. 10-16.

Featherstone, A.M., and T.G. Baker, "An Examination of Farm Sector Real Estate Dynamics," *American Journal of Agricultural Economics*, vol. 69 (August 1987): pp. 532-46.

Folland, S.T. and R.R. Hough, "Nuclear Power Plants and the Value of Agricultural Land," *Land Economics*, vol. 67 (Feb. 1991): pp. 30-36.

Gilliland, Charles E., John Robertson, and Heath Cover. "Texas Rural Land Prices, 2003" Real Estate Center, Texas A&M University, May 2004.

Henderson, Jason and Stephan Weiler. "Defining "Rural" America" *Main Street Economist,* Federal Reserve Bank of Kansas City, July 2004.

Herriges, J.A., N. E. Barickman, and J.F. Shogren, "The Implicit Value of Corn Base Acreage," *American Journal of Agricultural Economics,* vol. 74, (1992): pp. 50-58.

Irwin, Elena G. "The Effects of Open Space on Residential Property Values**"** *Land Economics*, November 2002, v. 78, iss. 4, pp. 465-80

Irwin, Elena G.; Bockstael, Nancy E. "Land Use Externalities, Open Space Preservation, and Urban Sprawl" *Regional Science and Urban Economics*, Special Issue Nov. 2004, v. 34, iss. 6, pp. 705-25

_____. "The Problem of Identifying Land Use Spillovers: Measuring the Effects of Open Space on Residential Property Values" *American Journal of Agricultural Economics*, August 2001, v. 83, iss. 3, pp. 698-704.

Judge, G.G., W.E. Griffiths, R.C. Hill, H. Lutkepohl, and T.-C. Lee. The Theory and Practice of Econometrics. New-York, 1985.

Just, R.E. and J.A. Miranowski, "Understanding Farmland Price Changes," *American Journal of Agricultural Economics*, vol. 75, iss. 1 (1993): 156-168.

Livengood, Kerry R.; "Value of Big Game from Markets for Hunting Leases: The Hedonic Approach" By *Land Economics*, August 1983, v. 59, iss. 3, pp. 287-91.

McGranahan, David A., "Natural Amenities Drive Rural Population Change," Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 781, (1999).

Miranowski, J.A. and B.D. Hammes, "Implicit Prices of Soil Characteristics of Farmland in Iowa," *American Journal of Agricultural Economics*, vol. 66 (1984): 745-749.

Moss, C.B., "Returns, Interest Rates, And Inflation: How They Explain Changes In Farmland Values," *American Journal of Agricultural Economics*, vol. 79, iss. 4 (1979): pp. 1311-1318.

NASS, USDA "2002 Census of Agriculture" data available at http://www.nass.usda.gov/census/.

Phipps, T.T. "Land Prices and Farm-based Returns," *American Journal of Agricultural Economics*, Vol. 66, (Nov. 1984): pp. 422-29.

Pope, C. Arden III, Clark E. Adams, and John K. Thomas. "The Recreational and Aesthetic Value of Wildlife in Texas" Journal of Leisure Research, v. 16, issue (1) 1984, pp. 51-60.

Pope, C. Arden III and H.L. Goodwin, Jr. "Impacts of Consumptive Demand on Rural Land Values. *American Journal of Agricultural Economics, v67, no 1 feb 1985, pp.81-86.*

Pope, C. Arden III and John R. Stoll. "The Market Value of Ingress Rights for White-tailed Deer Hunting in Texas" *Southern Journal of Agricultural Economics*, July 1985, v. 17, iss. 1, pp. 177-82.

Rappaport, Jordan. 2003. "Moving to Nice Weather," Federal Reserve Bank of Kansas City, Research Working Paper 03-07, September.

Reynolds, J.E. and D.L. Tower, "Factors Affecting Rural Land Values in an Urbanizing Area," *Review of Regional Studies*, vol. 8, (Winter 1978): 23-34.

Shretha, Ram K. and Janaki R.R. Alavalapati. "Recreational Hunting Value of Ranchland" *Journal of Agricultural and Applied Economics,* Vol. 36 no 3, pp. 763-772.

Shi, Y.J., T.T. Phipps, and D. Colyer, "Agricultural Land Values Under Urbanizing Influences" *Land Economics*, vol. 73, iss. 1 (1997): pp. 90-100.

Shonkwiler, J.S. and J.E. Reynolds, "A Note on the Use of Hedonic Price Models in the Analysis of Land Prices at the Urban Fringe," *Land Economics*, vol. 62, (Feb. 1986): pp. 58-61.

U.S. Fish and Wildlife Service. "1996 National Survey of Fishing, Hunting, and Wildlife-Asociated Recreattion: Texas" Available at http://www.census.gov/prod/3/98pubs/txfhw698.pdf

_____."2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation." Available at http://www.census.gov/prod/2003pubs/fhw01-us.pdf

Figure 1A: Texas Hunting Lease Rates, 1996

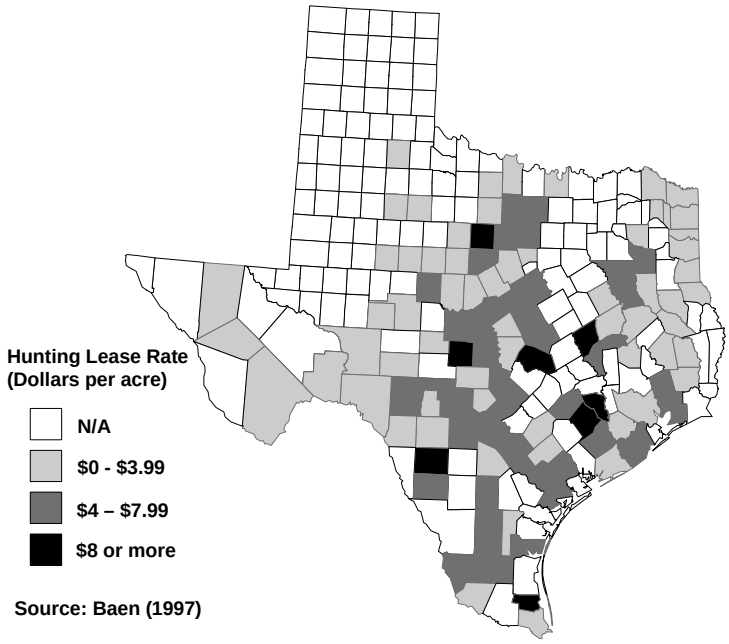

Figure 1B: Texas Deer Densities, 1999 to 2003 average

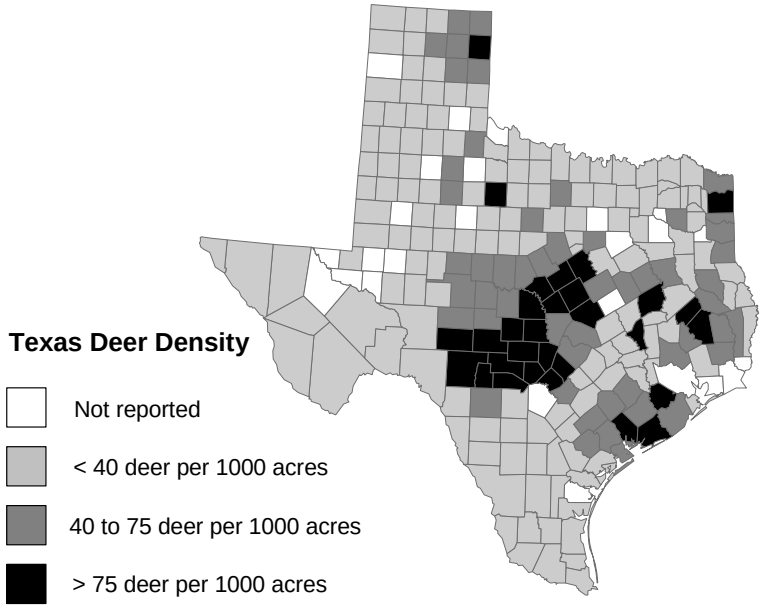

Table 1: Wildlife Recreation Expenditures and Farm Level Recreation Service Income by State

		Wildlife Recreation[A]		Farm Recreation Services[B]	
	State	Expenditures (millions)	Participant (thousands)	Income (1000s)	Farms (number)
1	Texas	1,513.9	1,201.0	77,616	8,230
2	Pennsylvania	941.0	1,000.0	2,209	303
3	New York	822.2	714.0	1,420	419
4	Wisconsin	801.0	660.0	1,876	628
5	Alabama	663.6	423.0	5,216	839
6	Ohio	636.5	490.0	2,198	299
7	Tennessee	588.7	359.0	2,416	637
8	Arkansas	517.2	431.0	3,119	478
9	Georgia	503.7	417.0	6,117	1,059
10	Michigan	490.3	754.0	3,295	615
11	Minnesota	482.6	597.0	1,843	400
12	Illinois	450.9	310.0	3,668	606
13	Louisiana	446.2	333.0	2,346	307
14	North Carolina	438.1	295.0	1,870	622
15	Missouri	424.8	489.0	3,222	773
16	Florida	394.2	226.0	2,844	278
17	Colorado	382.6	281.0	12,042	867
18	Kentucky	373.2	323.0	1,153	421
19	Oregon	364.9	248.0	3,000	350
20	Mississippi	360.3	357.0	3,475	608

[A] Source: U.S. Fish and Wildlife Service
[B] Source: 2002 Census of Agriculture

Table 2: Descriptive Statistics

Variable	Description	Source	Mean	St. Dev.	Min	Max	N
Dependent Variable							
County farmland value	Dollars per acre	Calculations based on 2002 Census of Agriculture data	1099.16	633.99	83.00	2877.00	114
	Log of dollars per acre	Calculations based on 2002 Census of Agriculture data	6.79	0.72	4.42	7.96	114
Independent Variable							
HUNTING	Hunting lease rates (dollars per acre)	Baen (1997)	4.20	2.29	0.50	12.50	114
POPDEN	Population per square mile, 1990 (thousands)	Calculations based on US Counties 1998 data	0.06	0.18	0.00	1.64	114
POPGROW	Populaton growth, 1990-2000 (annualized rate)	Calculations based on REIS data	1.38	1.50	-2.59	6.14	114
ADJACENT	Nonmetro counties adjacent to metropolitan area (dummy=1)	Identification based on USDA rural-urban continuum codes	0.43	0.50	0.00	1.00	114
METRO	Metropolitan counties, 1990 (dummy=1)	Identification based on USDA rural-urban continuum codes	0.22	0.42	0.00	1.00	114
CROP	County crop receipts, average 1997 to 2000 (thousand dollars per farm acre)	Calculations based on REIS and 1997 Census of Agriculture data	0.03	0.07	0.00	0.46	114
LSTK	County livestock receipts, 1997 to 2000 (thousand dollars per farm acre)	Calculations based on REIS and 1997 Census of Agriculture data	0.07	0.11	0.00	0.87	114
GOV	County government payment receipts, 1997 to 2000 (thousand dollars per farm acre)	Calculations based on REIS and 1997 Census of Agriculture data	0.01	0.01	0.00	0.06	114
GEOG	Natural amenity geography index	Calculations based on USDA natural amenity index	-0.52	0.98	-3.09	1.97	114
FARMS	Farms receiving recreation service income	2002 Census of Agriculture	51.94	46.52	1.00	295.00	114
RECACRE	Average county recreation service income per average farm acre	Calculations based on 2002 Census of Agriculture	14.19	10.80	0.60	77.82	107
DEERDEN	Deer per 1000 acres	Texas Parks and Wildlife	54.15	42.99	0.00	211.29	111

Table 3: Empirical Results

Dependent Variable: Log of County Farmland Value (lnland)

	Model 1	Model 2	Model 3
Hunting Lease Rates *(HUNTING)*	0.060 ***		
	(0.02)		
Recreation Service Income per acre (*RECACRE*)		0.013 ***	
		(0.005)	
Deer Density (*DEERDEN*)			0.004 ***
			(0.001)
Farms Receiving Recreation Service Income (*FARMS)*	0.002 *	0.003 ***	0.001
	(0.001)	(0.001)	(0.001)
Pop. Density *(POPDEN)*	0.553 ***	0.350 ***	1.996 *
	(0.108)	(0.136)	(1.382)
Pop. Growth *(POPGROW)*	0.207 ***	0.199 ***	0.182 ***
	(0.037)	(0.036)	(0.038)
Rural counties adjacent to metropolitan areas *(ADJACENT)*	0.315 ***	0.292 ***	0.312 ***
	(0.126)	(0.123)	(0.126)
Metropolitan counties *(METRO)*	0.388 **	0.353 **	0.260
	(0.178)	(0.177)	(0.207)
Crop Receipts *(CROP)*	0.941 ***	1.209 ***	0.613 *
	(0.344)	(0.449)	(0.388)
Livestock Receipts *(LSTK)*	2.027 ***	2.037 ***	1.844 ***
	(0.451)	(0.413)	(0.411)
Government Payments *(GOV)*	0.723	1.577	3.827
	(3.807)	(4.826)	(3.927)
Geography *(GEOG)*	0.092 *	0.060	0.073
	(0.061)	(0.063)	(0.062)
Intercept	5.788 ***	5.788 ***	5.896 ***
	(0.208)	(0.18)	(0.174)
Observations	114	107	111
Adjusted R-square	0.594	0.603	0.592

Note: Results corrected for spatial autocorrelation following Rappaport (2003).
Standard errors are in parentheses
* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level