Effects of Energy Development on Agricultural Land Values

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This paper uses multiple regression analysis to examine the effects of energy resource development on sale prices of agricultural land in western North Dakota. The findings suggest that energy resources development has exerted only modest upward pressure on agricultural land values in the northern Great Plains. The land market in this region remains dominated by active farmers who are purchasing farmland as a long-term investment, and energy development has not had a major impact on the structure of that market.

Development of large-scale industrial facilities in rural areas has been demonstrated to result in a variety of economic, demographic, fiscal, and social changes for nearby communities [Summers *et al.*; Lonsdale and Seyler; Murdock and Leistritz]. Over the past decade, many areas of the western states and provinces have been affected by large-scale energy resource development. These areas have often experienced rapid population growth and expansion of local trade and service activity resulting from the influx of energy project workers and their families [Murdock and Leistritz; Halstead *et al.*]. Effects of such development on agricultural producers have been a topic of considerable interest to both researchers and policy-makers; numerous studies have examined reclamation of surface-mined lands [Watts; Leathers], water requirements of energy projects [Anderson and Keith], and effects of rural industrialization on agricultural labor supplies [Scott and Chen]. However, the effects of energy development on land values have received much less attention in the literature.

Industrial development is generally anticipated to exert upward pressure on local land values. Energy development, for example, requires land for mining operations, plant sites, and transportation corridors and indirectly stimulates additional demands for land for residential and commercial purposes. Some local landowners may be able to realize significant wealth increases as a result of development-induced land price appreciation. For instance, a survey of landowners in Wyoming's Powder River Basin indicated that increased income resulting from selling or leasing land to coal developers was the benefit most commonly anticipated by these individuals [Bradley *et al.*]. Although agricultural operators who are able to sell some or all of their land to developers may receive initial benefits, these gains may be partially or completely cancelled if replacement land must be purchased in an area where land values generally have undergone substantial inflation resulting from energy development. Development-related land price appreciation also would increase capital requirements for beginning or expanding farmers in such areas.

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Some aspects of energy or industrial development could have negative effects on local land values. If negative externalities (e.g., smoke, dust, odor, traffic) are associated with a plant or mine, the value of nearby land could be reduced [Blomquist]. Likewise, if local taxing jurisdictions raise rates in order to cope with rising costs resulting from project-related growth or if the quality of local public services deteriorates [Murray and Weber], land values could be negatively affected.

The impact of industrialization on agricultural land values is clearly a highly relevant issue in many rural areas today. While some previous studies have examined the effects of proximity to market centers [Blase and Heseman; Burton and Nelson] and of local population density [Schuh and Scharlach], the effects of large-scale developments on agricultural land values in the local area have received little attention in the literature.

The study reported here uses multiple regression analysis to examine the effects of energy development on sale prices of agricultural land in western North Dakota. Specific objectives of the analysis are to (1) identify factors affecting agricultural land prices in two counties affected by energy resource development and in one county not affected by significant energy or industrial development but with similar agricultural characteristics, and (2) determine whether coal and petroleum exploration and development significantly affect selling prices of agricultural land. The findings have important implications for assessing the impact of industrialization on agricultural operators and rural communities.

The remainder of the paper is organized as follows. First, a conceptual model of the demand for agricultural land is presented. Second, data obtained from a survey of farm real estate buyers are described, and a regression model is specified. Third, results of the empirical analysis are reported. Finally, the conclusions and implications of the study are presented.

Conceptual Model of Demand for Agricultural Land

Previous research has demonstrated that several factors are central to determination of the effective demand for farm land. Over time, agricultural land values are affected by changes in (1) current net returns from farming (net rents), (2) expected capital gains arising from changes in the value of farm products produced, (3) expected gains or losses associated with changes in the general price level (inflation or deflation), (4) other factors affecting financial returns to farm real estate (such as special tax treatment of land), (5) anticipated opportunity cost of land in nonagricultural use, and (6) anticipated rates of return from alternative investments [Melichar; Castle and Hoch; Tweeten; Scott; Pope and Goodwin]. At a given point in time and in a given area, the relative values of different farmland tracts should be influenced by (1) the quality or productivity of the land for agricultural purposes; (2) location of a tract relative to a buyer's other land (if any), markets, and improved roads; (3) method of purchsae and terms of financing; (4) tract size; and (5) attributes which affect the land's consumptive value or its potential to command higher returns in alternative uses [Klinefelter; Duncan; Herdt and Cochrane; Pine and Scofield; Pope and Goodwin]. Among the factors which may influence the potential value of land in alternative uses are a number of energy development-related variables. The nature of the hypothesized relationships between these variables and land prices is discussed below.

Agricultural Productivity

Productivity or quality of the land for agricultural purposes is generally a major factor in explaining differences in the value of various tracts [Schuh and Schlarlach; Reynolds and Timmons]. In theory, the value of agricultural land, like any production asset, should be influenced by the capitalized value of its marginal product. The net return to land, or net rent, indicates the value of its marginal product in agricultural use, and the capitalization rate reflects buyers' time preference for money. Buyers' expectations of future net returns may fluctuate over time in response to changes in market outlook and production technology [Chaves and Shumway; Tweeten; Scott], and the capitalization rate may vary with changes in the general level of returns available from alternative investments [Klinefelter]. At a given point in time, however, prices of agricultural land should reflect differences in productivity as measured by such variables as net crop returns per acre or pasture carrying capacity [Hammill].

Improvements associated with a tract of land, such as buildings and irrigation systems, often increase its value by increasing the net returns which can be anticipated from its operation [Blase and Heseman]. Even if a buyer does not need the improvements, they often can be leased or sold to another individual.

Location

Prices of agricultural land are also affected by the location of a tract relative to markets, improved roads, and a buyer's other land. As distance from markets increases, transportation costs rise, and the net return to land decreases. Likewise, increasing distance from sources of factor supply raises the cost of transporting production inputs, such as fertilizer and feed, and thus results in lower net returns from agricultural production and lower land prices. Previous research has shown farmland prices to be inversely related to distance from local market centers [Blase and Heseman; Edwards *et al.*]. The quality of roads also affects land values; land located close to improved roads would be expected to command a higher price by reflecting lower transportation costs [Parcher; Edwards *et al.*]. In addition, proximity of a tract of land to a buyer's other holdings should enhance its value. Most purchasers of farm real estate in the northern Great Plains are active farmers, and many already own other tracts [USDA]. If a tract of land is located close to a buyer's existing operation, costs of moving machinery and equipment and caring for livestock will be reduced and net returns correspondingly enhanced.

Method and Terms of Purchase

Most purchases of agricultural land are financed through either a contract for deed or a loan secured by a mortgage on the property. In many cases, the seller provides the financing by holding the contract for deed or mortgage. The terms of financing, such as percentage of purchase price required as a downpayment, interest rate charged, and length of repayment period, may affect the sale price of the land. High downpayment requirements and short repayment periods pose cash flow problems for many potential buyers and may be reflected in lower sale prices. The interest rate charged would also be expected to be inversely related to the sale price.[1]

A substantial proportion of land ownership transfers occur between relatives (for example, sale by a father to a son). In some cases, the sale price established for

[1] Over time, fluctuations in the real interest rate (which can be approximated by the nominal interest rate less the rate of inflation) can have a substantial effect on land values [Scott; Castle and Hoch]. At a given point in time, tracts of land for which financing is available at lower-than-market rates may command premium prices. These situations would most commonly occur when the seller is willing to finance the purchase via contract for deed or mortgage.

such intrafamily transactions may be somewhat less than prevailing market values.

Tract Size

An inverse relationship between tract size and sales price can be anticipated [Burton and Nelson]. The larger capital and debt service requirements associated with purchases of large tracts may exclude many potential buyers whose capital reserves are limited. The extent of the differential in per-acre prices of large and small tracts is constrained, however, by the potential to divide large farm units into smaller tracts for sale.

Potential for Alternative Uses

Attributes which affect the potential of agricultural land to command higher returns in alternative uses are playing an increasingly important role in the determination of rural land values [Pope and Goodwin]. In some areas, the demand for rural land for home sites and vacation retreats has had a substantial effect on property values [Pope]. The study area, however, is sparsely populated and located far from major population centers. Accordingly, the consumptive demand for rural land appears to play a very minor role in this region.

A set of attributes which influence the potential of rural land tracts in this region to command higher returns in alternative uses are those related to energy development. A major determinant of the benefits which agricultural landowners experience as a result of energy resource development is the ownership of the mineral rights associated with their land. Because ownership of mineral rights can be separated from title to the land surface, many farmers and ranchers in the western United States do not own the mineral rights to their land [Leistritz and Voelker]. Rather, the mineral rights have been retained by the federal government or by previous private owners. Further, in cases where a seller of farm real estate holds title to the mineral rights, he may choose to retain those rights (or a portion of them) when selling the land. In such cases, the farmland buyer will not experience the increased income from mineral royalties or lease bonus payments that could be associated with future energy development.

If part or all of the mineral rights are included in the land transaction, a potential buyer may add the expected revenue from royalties and lease payments to the net returns from agricultural production in determining his bid price. In addition, land located close to present or proposed energy development sites may be viewed as having potential for conversion to higher valued industrial or residential uses [Gamble and Downing]. On the other hand, if negative externalities are associated with energy facilities, values of nearby land could be negatively affected [Blomquist]. It can thus be hypothesized that a direct relationship will exist between land price and the percent of mineral rights transferred and that the relationship between land price and distance to present or proposed energy development sites could be either direct or inverse.

If the mineral rights that are being transferred are currently leased to a development company, the buyer's income expectations may be substantially affected by the expiration date of the lease. Particularly in the case of oil and gas leases, a landowner may receive a substantial payment (termed a bonus or signature bonus) at the time the lease is signed. Subsequent annual payments during the term of the lease are usually small (unless petroleum is discovered, in which case royalty payments may be received), but a new agreement and another bonus payment may be negotiated when the lease expires. It can be hypothesized that land price will be inversely related to the number of years remaining before an existing lease expires.

To summarize, the price of agricultural land in areas experiencing energy development may be affected by several types of causal factors. The relationship can be expressed in terms of the following general theoretical model on which the empirical analysis is based:

$$P = f(R,L,F,S,E)$$

where

P = land price per acre,
R = net return or net rent from agricultural use,
L = location factors,
F = financing terms,
S = tract size, and
E = energy development potential.

Data and Model Specification

Data were obtained from a survey of farmland buyers in three western North Dakota counties. Two of these counties (Mercer and Dunn) had experienced considerable development of their lignite coal and petroleum resources during the 1970s. The third county (Grant) was very similar agriculturally to the other two but had experienced very little development activity. All three counties are semiarid, and their primary agricultural enterprises are spring wheat and feeder cattle production [Wiedrich].

Because only a small number of farmland sales occurred in any given year, the period July 1, 1975, to June 30, 1980, was selected as the data collection period.[2] A search of county records identified land transactions occurring during this period. A brief verification questionnaire was mailed to each buyer who recorded a deed transfer in order to (1) ascertain that the intended use of the land was for agricultural purposes and (2) eliminate transactions which fulfilled an earlier contract for deed (i.e., such that the price had been determined prior to 1975). A telephone survey of nonrespondents was undertaken to assure that the mail survey responses were representative of the population. Through this process, 244 individuals were identified who had purchased farmland during the study period. A more extensive questionnaire was then mailed to these buyers to determine the price paid and salient characteristics of the tract and the terms of sale. Two mailings resulted in 140 responses (57.4 percent), of which 135 were sufficiently complete to enable their use in the analysis.

The specific variables used to operationalize the conceptual model are described below. They fall into the six general categories of sale price, agricultural productivity, location, financing terms, tract size, and energy development.

Sale prices were deflated to the 1975 price level using the Producer Price Index. This deflated sale price was used as the dependent variable in subsequent analysis (see Table 1).

Four indicators of the quality or productivity of land for agricultural purposes were utilized: (1) buyer's estimated gross income per acre of cropland for the first crop year after purchase (X_1); (2) pasture carrying capacity, expressed as the number of acres required per animal unit for the grazing season (X_2); (3) percentage of land in the tract which the buyer classified as cropland (X_3); and (4) value of buildings and improvements per acre estimated by the buyer (X_4).[3]

Land location factors were reflected by

[2] The rationale for selecting this period was that 1975 marked the beginning of intensive energy development in the region and 1980 was the last year for which complete data were available at the time data collection was initiated.

[3] Inclusion of the value of buildings and improvements as an explanatory variable for land value can raise questions concerning statistical independence. In some areas land quality characteristics may cause structures to be built in order to achieve more intensive use of the land. Under the conditions prevailing in western North Dakota, however, it appears that the problems associated with omitting this variable would be more serious than those associated with its inclusion. Secondary data concerning the land market and agricultural structure in

TABLE 1. Mean Values of Continuous Variables in Control and Energy Counties, North Dakota.

Variable	Description	Control County		Energy Counties		F Statistic for Difference of Means
		Mean	Standard Deviation	Mean	Standard Deviation	
Y	Price Per Acre (Deflated)	162.3	89.8	182.0	101.3	1.25
X_1	Expected Gross Income From Crop Production (Dollars Per Acre)	64.9	52.7	67.4	143.3	7.39**
X_2	Pasture Carrying Capacity (Acres Per Animal Unit)	9.0	7.7	9.0	7.1	1.21
X_3	Cropland as a Percent of Purchased Tract	51.1	30.5	42.8	29.2	1.00
X_4	Value of Improvements (Dollars Per Acre)	51.9	202.0	22.9	63.8	9.68**
X_5	Distance from Previous Land Holdings (Miles)	3.0	14.4	6.4	20.2	2.08**
X_6	Distance from Unimproved Road (Miles)	0.1	0.3	0.1	0.3	1.64*
X_7	Distance from Gravel Road	0.8	1.1	0.7	1.5	1.83*
X_8	Distance from Paved Two-lane Road	7.2	6.5	5.8	5.4	1.46
X_9	Distance from Grain Elevator	12.4	7.7	12.7	7.8	1.10
X_{10}	Distance from Livestock Auction Market	42.8	23.3	31.8	18.3	1.63*
X_{11}	Downpayment Required (Percent)	54.6	40.9	43.1	39.2	1.12
X_{12}	Repayment Period (Years)	11.6	14.4	14.0	12.5	1.35
X_{13}	Interest Paid (Percent)	4.2	4.0	5.2	3.5	1.32
X_{14}	Acres Purchased	512.4	422.2	432.4	352.3	1.43
X_{15}	Acres Operated Before Purchased	1,065.8	1,135.3	1,229.6	1,396.4	1.63*
X_{16}	Acres Owned Before Purchase	568.3	791.2	452.9	720.1	1.19
X_{17}	Percent of Oil Rights Transferred	39.5	37.4	28.8	35.4	1.14
X_{18}	Percent of Coal Rights Transferred	39.9	41.5	22.5	33.6	1.58
X_{19}	Distance from Operating Lignite Mine or Oil Well	[a]	—	14.7	13.8	—
X_{20}	Distance from Major Lignite Reserve	[a]	—	5.7	7.0	—
X_{21}	Distance from Operating Coal Conversion Plant	[a]	—	28.8	35.4	—
X_{22}	Distance from Proposed Lignite Mine or Conversion Plant	20.0	25.8	10.8	17.4	2.18**

* Significant at 5 percent.
** Significant at 1 percent.
[a] Because no operating lignite mines, oil wells, or major lignite reserves are located in the control county, distances to such facilities were not measured.

this region do not suggest a strong relationship between land quality and the value of structures, but the presence of a modern farmstead can substantially enhance the value of a given tract, at least for some buyers.

six variables which measure, respectively, the distance to a buyer's other land holdings (X_5); to unimproved, gravel, and paved roads (X_6, X_7, and X_8); to a grain elevator (X_9); and to a livestock auction market (X_{10}).

Three variables reflected financing terms. These were the percent of purchase price required as a downpayment (X_{11}), length of the loan or contract period in years (X_{12}), and rate of loan or contract interest (X_{13}).[4]

The number of acres in the tract (X_{14}) was included to determine the significance of land parcel size in determining price. Two related variables were also included in the model, acres operated before the purchase (X_{15}) and acres owned before the purchase (X_{16}). Inclusion of these variables allowed a test of the competing hypotheses that (1) economies of size enable large farmers to bid higher prices for additional land or, alternatively, (2) higher marginal tax rates and/or diseconomies of scale cause larger operators to have lower bid prices [Harris and Nehring].

The last six variables in Table 1 represented possible influences of energy development on land values. These were the percentage of oil rights transferred (X_{17}), the percentage of coal rights transferred (X_{18}), distance from an operating lignite mine or oil well (X_{19}), distance from a major lignite reserve (X_{20}), distance from an operating coal conversion plant (X_{21}), and distance from a proposed lignite mine or conversion plant (X_{22}).[5]

In addition to the variables listed in Table 1, a number of proxy and dummy (i.e., zero–one) variables were included in the model. Among the proxy variables included were the year in which the land was purchased (to reflect the trend in real land values) and the number of years which the buyer expects to retain the purchased tract (to reflect speculative demand for land in rapidly developing areas). The dummy variables included in the model measured (1) the date when the oil lease on the property expires, (2) the relationship of buyer and seller,[6] (3) the method of purchase (cash, contract for deed, or mortgage), and (4) the principal crops grown on the tract prior to purchase (e.g., cash crops vs. feed crops). Finally, a dummy variable was included to distinguish impact area and control area observations in order to allow for pooling of the observations.[7]

Empirical Results

Preliminary analysis of the survey results indicated that the average sale price of farmland was somewhat higher in the energy counties than in the control county but that the expected gross income from crop production was also slightly higher in the energy counties (Table 1). Pasture carrying capacity was similar in the two areas while the percentage of cropland in the average tract was somewhat higher in the control county. The value of improvements per acre was substantially higher in the control county than in the impact counties (Table 1).

Most of the buyers in both areas were

[4] Two alternative specifications of the interest rate were used. The first was the nominal interest rate (i or X_{13}). The second specification approximated the real interest rate and was computed by the formula $r = \frac{1 + i}{1 + f} - 1$ where r = real interest rate, i = nominal interest rate, and f = rate of inflation. Variable f was measured by the average rate of change in the Consumer Price Index over the two years prior to the year in which a sale occurred.

[5] To test for possible nonlinear effects of distance from an energy facility, quadratic terms were included for the four distance variables (X_{19}–X_{22}).

[6] The relationship of the buyer and seller was categorized as follows: (1) seller is an immediate family member; (2) seller is a relative, but not a member of the immediate family; (3) seller is a neighbor; (4) seller is an unrelated individual and not a neighbor; and (5) seller is a real estate broker or financial institution. In specifying the set of dummy variables, the fifth category was omitted from the equation.

[7] This dummy variable should reflect inter-area differences in service quality, amenities, and other factors not measured by the variables previously specified.

active farmers seeking land for expansion. In the control county, 73 percent of the buyers were established farm operators while in the energy counties this group accounted for 80 percent of all buyers. In the control county, 61 percent of the buyers owned farmland prior to the purchase, compared to 56 percent in the energy counties. At least 60 percent of the buyers in both areas expected to retain the land for 26 years or more, and most buyers acquired tracts quite close to their previous holdings. More than two-thirds of the buyers purchased land located less than one mile from their previous holdings [Wiedrich].

The average rate of interest paid by buyers was 5.2 percent in the energy counties and only 4.2 percent in the control county (Table 1). A probable explanation for these relatively low (nominal) interest rates is the fact that 53 percent of the sellers were members of the buyer's immediate family.

The percentages of mineral rights transferred were considerably lower in the energy counties than in the control area (Table 1). Only 22.5 percent of the coal rights were transferred in the energy counties, compared to 39.9 percent in the control county. The average distances of tracts from existing or proposed energy facilities or identified lignite deposits were, of course, substantially greater for the control area.

Regression Model Results

Two regression models were estimated using data from both energy and control counties. Both models were estimated by ordinary least squares (OLS) regression using the stepwise regression option of the Statistical Analysis System (SAS). The partial F probability level to exclude a variable was specified at 0.10.

Variables considered for inclusion in Model 1 were the continuous variables reflecting a tract's agricultural productivity, location, terms of sale, and size (i.e., variables X_1–X_{16}), and the proxy and dummy variables reflecting such attributes. The variables reflecting potential future revenues related to energy development were not considered for inclusion in this model, but the dummy variable distinguishing energy area and control area observations (i.e., $D = 1$ if tract is in energy counties) was allowed to enter if it satisfied the significance criterion. The purpose of estimating this model was to determine whether there were systematic differences in land values between the energy development counties and the control county which could not be explained by differences in the factors that are hypothesized to influence the value of a tract for agricultural purposes. A significant coefficient for the energy area dummy variable would indicate that such a difference in land values does exist.

In Model 2 the energy development variables were eligible for inclusion, in addition to all of the variables considered in Model 1. The purpose of estimating this model was to determine which of the energy variables would prove to be significant in explaining intertract differences in land prices and also to determine whether these variables would explain any difference in land values between energy and control areas that might be indicated by Model 1.

The results of model estimation are shown in Table 2. Only variables that were significant in one of the two models are shown in Table 2.[8] In Model 1, seven independent variables were significant at the ten percent level. Pasture carrying capacity (X_2) and value of improvements (X_4) reflect the potential net returns that a tract will provide. The negative sign on variable X_2 indicates that pastures with greater productivity (i.e., fewer acres required

[8] Results of fitted equations with all the independent variables included are available on request from the authors.

TABLE 2. Regression Results Explaining Land Value Per Acre.

Variable	Description	Model 1		Model 2	
		Estimated Coefficient	t-Statistic	Estimated Coefficient	t-Statistic
X_0	Constant	210.87	—	200.63	—
X_2	Pasture carrying capacity	−2.86**	−4.00	−2.05*	−2.41
X_4	Value of improvements	0.20**	2.73	0.16*	2.29
X_6	Distance to unimproved road	—	—	−54.36**	2.60
X_7	Distance to gravel road	−9.20*	−2.47	—	—
X_{11}	Downpayment required	−0.79**	−3.08	−0.81**	−3.24
$(X_{20})^2$	Distance from lignite reserve, squared	—	—	0.09**	2.39
D_1	Seller is a family member	−65.41**	−6.49	−50.75**	−4.35
D_2	Seller is an unrelated individual	—	—	38.00*	2.39
D_3	Oil lease expires 1984–1988	—	—	−29.00*	−2.03
D_4	Cash purchase	27.35*	2.50	30.73**	2.87
D_5	Energy or control county	19.62	1.88	19.69	1.75
		N = 123[a]		N = 112[a]	
		R^2 = 0.45		R^2 = 0.54	

** Significant at 1 percent.
* Significant at 5 percent.
[a] Missing observations were omitted.

per animal) will command higher prices. The importance of location is indicated by the variable, distance to gravel road (X_7); tracts which are less accessible command lower prices. Higher downpayment requirements (X_{11}) also are associated with lower land prices. The negative sign of the coefficient of dummy variable D_1 (seller is a family member) supports the hypothesis that transactions between family members often occur at prices substantially below market value. The coefficient of variable D_4 (cash purchase) indicates that such transactions tend to occur at above-average prices. Two possible explanations are that (1) buyers with liquid assets sufficient to make such a purchase, perhaps because of a sale of other property or receipt of a lease bonus payment, may be less price sensitive than other potential purchasers; and/or (2) buyers with sufficient liquidity to make a cash purchase tend to apply lower discount rates than those who must borrow a large percentage of the purchase price (because the interest rates received by individuals as lenders usually are lower than those paid by individuals as borrowers). Finally, the positive sign of the coefficient of variable D_5 (energy or control county) indicates that there is a systematic difference in land values between the energy and control areas which cannot be explained by differences in agricultural productivity, location, or terms of sale. Prices of agricultural land tracts in the energy counties appear to be about $19 per acre higher than can be explained by differences in attributes affecting their agricultural value.

Several other variables had t-ratios with absolute values of 1.0 or greater (corresponding to significance levels of 0.1 to about 0.3). Acres owned by the buyer prior to purchase (X_{16}) had a positive sign while distance to a livestock auction market (X_{10}) had the expected negative sign. The buyer's anticipated duration of ownership of the tract was negatively related to the price paid. Contrary to expectations, both the nominal and real interest rates were found to be positively related to sale price (in alternative formulations of the equation). A probable explanation is that very low interest rates were common in instances where the seller was an immediate family member (i.e., situations in which the sale price also tended to be relatively low). The coefficient of the dummy variable, contract for deed purchase, indicated that such transactions occurred at prices lower than were typical for cash purchases but higher than for those financed by mortgage loans.

The results of Model 2 are quite similar to those of Model 1 with respect to the nonenergy variables. Distance to an unimproved road (X_6) enters the equation, replacing variable X_7, distance to a gravel road. Variable D_2 (seller is an unrelated individual) also enters the equation, and its coefficient indicates that purchases from unrelated persons tend to be at somewhat higher prices than those from relatives or neighbors. Two energy variables appear in Model 2: (1) the quadratic term of distance from a lignite reserve (X_{20}) and (2) oil lease expires in the period 1984–1988 (D_3). The signs of the coefficients for these variables are consistent with theory and *a priori* reasoning. Land located closer to a lignite reserve commands lower prices, perhaps attributable to externalities associated with mining operations.[9] Tracts with oil leases that are due to run for several years are less attractive than those with shorter term contracts because they lack the potential for renegotiation and possible bonus payments in the near term. The dummy variable D_5 (energy or control county) remains significant at the ten percent level in Model 2, indicating that even after including the energy variables a significant amount of unexplained difference in land values between the energy and control areas remains. Possible explanations for this difference include (a) expectations of potential capital gains from conversion of lands to nonenergy uses which are not adequately explained by the explanatory variables included in this analysis, and (b) additional purchasing power available to potential land buyers in the energy area as a result of past receipts of lease bonus and royalty payments. This model explains 54 percent of the total variability in land prices.

Several variables, which were not significant at the ten percent level, had t-ratios with absolute values of 1.0 or greater. The nonenergy variables which fell into this category were the same ones discussed with respect to Model 1. In addition, the percent of coal rights transferred is included in this group. This variable had a positive sign, consistent with prior expectations.

[9] As noted earlier, the distance variables were included as quadratic functions. Each equation was estimated twice; one solution included all eligible variables while the other included only those variables that met the statistical criteria for retention. Inspection of the signs for both linear and quadratic terms of distance from the equation with all variables included indicates that land values reach a minimum at a distance of about 0.28 miles from a lignite reserve, increasing as the distance becomes greater than that.

Conclusions and Implications

Forces which affect the value of agricultural land in alternative uses are playing an increasingly important role in rural land markets. In regions where extensive energy resource development is occurring, the enhanced potential for conversion of agricultural land to higher valued uses may place upward pressure on rural land values. The findings of this study, however, suggest that energy resource development has exerted only modest upward pressure on agricultural land values in the northern Great Plains. The land market in this region remains dominated by active farmers who are purchasing farmland as a long-term investment. Thus, energy development has not, to date, had a major impact on rural land values or the structure of the farm real estate market in this area. Additional research would be desirable, however, to explore possible long-term effects on farm structure which may result from energy development.

The differential in land prices between the energy and control areas was partially explained by tract-specific attributes which affect the potential to receive energy-related revenues or to be exposed to development-induced externalities. A significant part of the differential, however, is not explained by these attributes. A task for future research is to more precisely identify the factors affecting agricultural land values in areas experiencing major resource or industrial developments. Specific topics which should be addressed in greater detail include (a) the extent to which development-related windfalls such as lease bonus payments are reinvested in farmland, and (b) the relative influence of capital gains expectations and apprehensions concerning negative externalities in determining values of tracts located near energy facilities.

With respect to the latter, it would appear relevant to examine the effects of factors such as (1) the form of development (e.g., petroleum vs. coal, mine vs. conversion facility), (2) the pattern of mineral rights ownership, and (3) the status of the development activity (e.g., proposed, under construction, operational) on the relationship of energy facilities to values of nearby farmland.

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