Impacts of U.S. Agricultural and Ethanol Policies on Farmland Values and Rental Rates

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Abstract:

Prices for prime farmland have increased significantly in recent years. But, is the dramatic increase the result of a speculative bubble or is it consistent with market fundamentals with increases driven by growing global demand and recent changes to U.S. agricultural and energy policies? This research investigates the impacts of recent agricultural support policies and ethanol policies on farmland values and rental rates. Using weighted ordinary least squares and two stage least squares, we find that government payments, urban pressure and the proximity of the farm to an ethanol facility have a positive impact on both farmland values and rental rates.

Keywords: capitalization; decoupled payments; ethanol; farmland values; rental rates; subsidies

JEL: Q18; Q15; Q16

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In the third quarter of 2011, land prices for prime farmland increased 25 percent relative to the same quarter of 2010, marking the largest increase since 1977 (Oppedhal 2011). Memories of the 1980s farm financial crisis and the recent subprime mortgage crisis have some economists concerned that the dramatic increase in farmland values is the result of a speculative bubble. Other economists argue that the rise in farmland values is consistent with market fundamentals and is driven by increased demand and recent changes in U.S. agricultural and energy policies. While there is considerable research investigating the impacts of agricultural support policies on farmland values and rental rates (e.g., Lence and Mishra 2003; Kirwan 2009; Goodwin, Mishra, and Ortalo-Magne 2011), very little research has addressed the specific effects of ethanol policies. Thus, this research investigates the impacts of both agricultural support policies and recent ethanol policies on farmland prices and rental rates.

The extent to which U.S. agricultural policies impact farmland values and rental rates is currently debate in the farm policy literature. Kirwan (2009) investigates the impact of agricultural subsidies on rental rates and concludes that approximately 25 percent of these subsidies are captured by landowners in the form of higher rental payments. On the other hand, a recent study by Goodwin, Mishra, Ortalo-Magné (2011) suggests that agricultural payments are almost completely capitalized into farmland values and that landowners capture substantial benefits from agricultural payments even when the policy mandates that the operator is the payment recipient. However, both studies ignore the impacts of ethanol policies on farmland values, land use and rental rates.

Recent U.S. ethanol policies promoting the production of corn have the potential to impact land prices in two ways. The first impact is geographically dispersed but small in magnitude. Policies that promote corn based ethanol increase the demand for corn, driving up the price of corn and hence farmers plant more acres of corn. As other commodities compete with corn for land, farmland prices increase. The second impact is larger in magnitude but more geographically concentrated. Corn ethanol facilities increase the demand for corn locally and decrease the cost of transporting corn to a more distance market. Thus, land near an ethanol facility becomes more valuable and can command a higher price. While there has been some research looking at the influence of the proximity of corn ethanol facilities on land prices

(Henderson and Gloy 2008), the effects of ethanol policies on land use and prices have not yet been fully explored and quantified on a large scale.

In this paper, we use a capitalization model to examine the effects of agricultural support policies and ethanol facility location on farmland values while controlling for other factors. The capitalization model states that the current value of an acre of land should equal the sum of the discounted future returns (both market returns and government payments) to that acre of land. Although capitalization models dominate the farm policy literature, capitalization models are based on the assumption that payments are known with certainty and received in perpetuity; hence, these models are not well equipped to handle changing expectations or changing policy regimes. Therefore, we also examine rental rates, which have the ability to adjust more quickly to the changing policy environment. Specifically, we analyze the impact of market returns, government payments, ethanol plant location, amenities and urban influences on farmland values and rental rates. Using farm-level data from the United States Department of Agriculture (USDA) and regression analyses (weighted ordinary least squares and two stage least squares similar to those employed by Goodwin, Mishra, Ortalo-Magné (2011)), we find that government payments, urban pressure and the proximity of the farm to an ethanol location have a positive impact on both farmland values and rental rates.

The remainder of this paper is organized as follows. The next section provides an overview of recent government policies that may affect farmland values. Specifically, the 1996, 2002, and 2008 Farm Bills are discussed as they pertain to corn. An overview of U.S. ethanol policies is also provided. In addition, the relevant literature is discussed. The third section reviews the capitalization model. The fourth section presents an empirical analysis of factors affecting farmland values and rental rates. The final section discusses offers some concluding remarks.

Overview of Agricultural Policies and Relevant Literature

Although the extent to which agriculture policies are capitalized into land values and rental rates is currently debated in the policy literature, agricultural policies are clearly important factors to consider when modeling farmland prices. This section provides an overview of recent government policies that may affect farmland values. Since we are primarily interested in the impact of recent ethanol policies promoting corn-based ethanol, we focus the discussion on agricultural policies that support corn and ethanol producers.

U.S. Agricultural Support Policies

Prior to the 1996 Farm Bill (P.L. 104-127), agricultural payments were "coupled" or linked to current production with farmers receiving payments based on their current production levels and market prices. To comply with World Trade Organization (WTO) obligations requiring a reduction in trade distorting domestic support, the 1996 Farm Bill was written with the goal of heavily reducing agricultural support programs by 2002. The bill also attempted to remove the link between payment programs and market prices for agricultural commodities. Production flexibility contract (PFC) payments were introduced in the 1996 Farm Bill (Federal Agriculture Improvement Reform Act) in an effort to "decouple" payments from market prices and current production. PFC payments were paid to farm operators based on historic (base) acreage and yields to operators with historic production (acreages and yields) of wheat, feed grains (corn, barley, sorghum and oats), cotton, and rice (commonly referred to as program crops).

The 1996 Farm Bill stipulated the annual PFC payment rate for each crop. The annual payment rates declined over time with PFC payments scheduled to be phased out prior to the 2002 Farm Bill. Thus, farm operators received seven years of fixed, but declining, annual PFC payments. The total payment received by a recipient was equal to the payment rate multiplied by the farm's eligible payment acreage and the program yield established for the particular farm (USDA 1996). Since the payments were supposed to be temporary, they should not be capitalized into land values and should have only a small impact on farmland values.

Marketing assistance loans (MAL) were another form of agricultural support under the 1996 Farm Bill. MAL were designed to assist farmers by providing short-term financing, which enabled farmers to pay their bills soon after harvest but spread their sales over the marketing year. Non-recourse marketing assistance loans allowed recipients to forfeit the commodity pledged as collateral to the Commodity Credit Corporation (CCC) in satisfaction of loan repayment at maturity. Alternatively, in lieu of receiving MAL, eligible producers could receive loan deficiency payments (LDP). LDP paid producers the difference between the market price and the support price (loan rate). LDP were intended to minimize delivery of loan collateral to the CCC thus reducing the costs associated with the MAL program. MAL and LDP are typically classified as coupled payments because they are linked both to current production and current market prices.

Furthermore, the 1996 Farm Bill contained provisions for land diversion programs that removed environmentally fragile acreage from production. An example is the conservation reserve program (CRP), which was continued from the 1990 Farm Bill. Under the program, farmers enter sensitive wetlands or fragile farmland into the program for conservation usage for 10 to 15 years, and in return the producer receives an annual rental payment on the diverted acreage. The program aims to reduce erosion and enhance water quality on agricultural land. The programs also support agricultural commodity prices by reducing the supply of various commodities. In addition, the program provides cost-share assistance for the establishment of approved conservation practices.

In 1999, the ad hoc market loss assistance (MLA) program was introduced. MLA payments are triggered by market prices below target prices with recipients receiving the difference between the target price and the market price. Ad hoc disaster payments have also been a mainstay of U.S. agricultural policy. Disaster payments are frequently implemented following natural catastrophes such as droughts and floods. Because these payments provide benefits that offset adverse market conditions or poor production decisions, they have the potential to alter production decisions and ultimately impact farmland values and rental rates.

Although the PFC and MLA programs were supposed to be temporary, version of both programs were continued in the 2002 Farm Bill (P.L. 107-17). The PFC payment program was replaced with the fixed direct payment program and MLA program was replaced with counter-cyclical payment (CCP) program. Fixed direct payments (FDP), like production flexibility contract payments, were available to eligible producers of wheat, corn, barley, grain sorghum, oats, upland cotton, and rice. Additionally new payments were established for soybeans, other oilseeds, and peanuts. FDP were based on historic yields and acreage with payment rates specified in the 2002 Farm Bill for all covered crops. CCP were paid to covered commodities when the effective price was less than the target price. The effective price was the higher of the national average market price and the national loan rate for that commodity. The target price for corn was \$2.60 per bushel for the 2002-2003 crop years and \$2.63 per bushel for the 2004-2007 crop years (USDA 2002). Counter-cyclical payments were paid to historical production. Therefore, CCP are frequently classified as partially decoupled since they are tied to current market prices but not current production levels. Unlike PFC and FDP, CCP were not known in advance because they were based on current market prices.

In the 2002 Farm Bill, farmers were given the option to update their base acreage and yields to the past four years average acreage planted and harvested, or they could continue to use the base acreage and yields upon which payments were calculated in the 1996 Farm Bill (1991-1995 crop years). Therefore, not only did the government continue the decoupled support payments it claimed to be eliminating, it allowed farmers the opportunity to increase their payments by increasing their base acreage and yields. This set a precedent that subsequent farm bills would allow updating of base acreage and base yields. Although both FDP and CCP were continued in the 2008 Farm Bill, updating was not explicitly allowed. Numerous studies have shown that updating and expectations of potential updating cause producers to alter production decisions in the current period thus calling into question the classification of these payments as decoupled (Goodwin and Mishra 2006; Bhaskar and Beghin 2010; Peckham and Kropp forthcoming).

MAL and LDP were also continued in the 2002 Farm Bill with minimal changes but these supports were extended to cover additional commodities (USDA 2002). Furthermore, producers no longer had to enter into annual contracts for direct payments to be eligible for MAL as in the 1996 Farm Bill. The CRP program was also continued.

The 2008 Farm Bill (P.L. 110-246) generally continued the 2002 structure of FDP, CCP, CRP and MAL programs. It, however, changed some program eligibility criteria and payment limitations. The bill also adjusted the target prices for CCP and the loan rates for some commodities. However, the target price for corn was not affected. Although updating was anticipated by some producers, updating was not allowed. However, farmers were allowed to adjust yields and acreage to account for newly covered commodities. In addition, the bill introduced the Average Crop Revenue Election (ACRE) program.

The ACRE program, which began in the 2009 crop year, was a new whole farm revenue based program. Producers who enrolled in ACRE must remain enrolled until 2012. To receive an ACRE payment, two triggers must be met. First, the actual state revenue for the supported crop during the crop year must be less than the state-level revenue guarantee amount. Second, an individual farm's actual revenue for the supported crop during the crop year must be less than the farm's benchmark revenue. Benchmark yields at the state and farm-levels are Olympic averages of the most recent five years. Price guarantees are averages of the marketing year price (or the marketing loan rate reduced by 30%, if greater) for the most recent two years. If both triggers are met, the individual farm receives an ACRE payment that is based on the state-level difference between actual revenue and the ACRE guarantee per acre multiplied by a percentage (83.3% or 85% depending on the crop year) of the farm's planted acreage, which is pro-rated based on the individual farm's yield history compared to the state's yield history (Renée 2008).

Under the 2008 Farm Bill, farmers choose between the traditional CCP and the new ACRE programs. If a farmer chooses the ACRE program he continues to receive FDP at eighty percent of the original rate. The farmer also continues to receive MAL but at a thirty percent reduction in the loan rate (Renée 2008). A farmer that participates in the ACRE program is no longer eligible to receive CCP.

Agricultural support programs are designed to benefit producers by 1) increasing agricultural returns and/or 2) decreasing the volatility of returns. Thus, different programs are likely to have different impacts on farmland values and rental rents depending on how the specific program benefits producers and the permanency of the program. This will be discussed more formally in the next section.

U.S. Ethanol Policies

The US has a long history of promoting domestic ethanol production through producer incentives, trade barriers, sustainability standards and tax credits. The Energy Tax Act of 1978 introduced ethanol subsidies that launched the U.S. ethanol industry. When first introduced, the subsidy was in the form of a partial excise-tax exemption for the blended fuel; more recently, the subsidy functioned as a tax credit for the blender. Although policies promoting ethanol production are not new, policies enacted following the Energy Policy Act of 2005 (P.L. 109-58) and the Energy Independence and Security Act of 2007 (P.L. 110-140) have led to a surge in ethanol production since 2005.

The Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 established renewable fuel standards. These standards established sustainability thresholds with targets for reducing carbon dioxide emissions. Biofuel blend and consumption mandates were also established. Blend mandates require each gallon of gasoline to be blended with a predetermined amount of ethanol, while consumption mandates set requirements that a certain number of gallons of renewable fuel be produced and used by a given deadline. Mandates increase the demand for ethanol. More specifically, the Energy Independence and Security Act of 2007 required 36 billion gallons of renewable fuel usage per year by 2022, roughly four times the amount of ethanol produced in 2007 (Tyner 2008). Of the 36 billion gallons, the act mandated that 20 billion gallons must come from "advanced biofuels," which use non-corn feedstock sources such as switch grass or municipal waste (Tyner 2008). Since advanced biofuels are still in their infancy, it is expected that the remaining 16 billion gallons will come from corn-based ethanol.

The policy changes since 2005 created a surge in demand for corn to be used in ethanol production. As a result, demand for corn increased and corn prices rose quickly. Other commodities that compete with corn for acreage or use corn as an input also experienced price increases. As commodity prices rose and these prices were expected to remain high, the higher commodity prices became capitalized into agricultural land prices accounting for higher farmland price across the US.

Furthermore, ethanol production has another affect on farmland values that is larger in magnitude but smaller in scope geographically. An ethanol plant can have a strengthening effect on the local basis. The basis is the difference between the cash market price and the futures market price. The basis normally reflects transportation costs of transporting the commodity to market. When the cash price is under the futures price and the basis is said to be "weak." Strengthening the basis refers to an increase in cash market prices without a corresponding change in the futures market price. An ethanol facility causes the cash price to increase in the local market by increasing the demand for corn. In addition, producers experience higher returns due to lower transportation costs. As increased returns are capitalized in land values, farmland in close proximity to the ethanol plant becomes more valuable.

McNew and Griffith (2005) examine how the construction of an ethanol plant affects the local basis. They find, on average, the basis increases 5.9 cents per bushel of corn over a 150 square mile area around the plant. The change in basis varies largely over distance. The basis increases were largest closest to the plant location, and diminishing basis increases were observed as the distance from the plant increased. The changes in basis, like government policies, can be viewed as permanent or transitory, which affects how basis changes are capitalized into farmland values.

Recent Relevant Land Pricing Studies

Numerous previous studies have investigated the determinants of farmland prices. To date, three major land pricing models have emerged in the agricultural policy literature. These models included supply and demand, capitalization, and hedonic pricing models. However, due to simplicity of estimation and calculation, capitalization models dominate the agricultural policy literature. The capitalization model assumes that the price of an acre of land is the sum of the discounted future returns associated with the acre of land over a specific time period. The model generally assumes that land is an infinitely lived asset. Some studies have shown the validity of capitalization models using cointegration (Campbell and Shiller 1987; Clark, Klein, and Thompson 1993). Cointegration models are used to define the difference between two time series that move together such as the prices of agricultural commodities and agricultural land prices. If the capitalization model, also known as the present value model, is correct, a linear combination of the variables, which is called the spread, is stationary.

Given the large number of previous studies, we focus our discussion on the research most relevant to our analyses. These previous studies highlight the importance of market returns, government payments, urban influences, natural amenities, and ethanol plant locations in determining land values.

Following earlier work, Goodwin, Mishra, and Ortalo-Magné (2003) combine multiple product returns into one market return in their analysis of farmland values using farm-level USDA data from 1998-2001. They also include government payments and urban pressure in their land price models. Urban pressure is a major factor influencing agricultural land values that has become more significant recently. As urban pressures close in on agricultural lands, the opportunity cost of maintaining the farmland in agricultural use increases.

Goodwin, Mishra, and Ortalo-Magné (2003) find a dollar increase in government support payments leads to a $4.69 per acre increase in farmland values. The authors also analyze the impacts of the various types of government payments by disaggregating government payments into loan deficiency, disaster, Agricultural Market Transition Act (MLA and PFC), and CRP payments. Their results suggest that the source of the payment influences the magnitude of the effect. Loan deficiency payments have the largest effect on land prices with an additional dollar of payment raising farmland values $6.55 an acre. An additional dollar of disaster relief payments increase agricultural land values by $4.69 an acre. One additional dollar of Agricultural Market Transaction Act money, which was set to end in 2002 with the FAIR act, raises per acre land values $4.94. This value seems high if farmers truly believed that the benefits would end in 2002. It appears that the agricultural community correctly predicted that the 2002 Farm Bill would continue these payments. The authors find that conservation reserve payments, which involve land removal from production, are negatively correlated with land values. However, these values should be taken cautiously because the magnitude of effect changes from year to year and across regions.

While numerous academic studies have analyzed the effects of agricultural support policies on farmland values, considerably fewer studies focus on the effects of these policies on rental rates. Since 45.3 percent of agricultural land is operated by someone other than the owner (USDA 1999), understanding the impact of agricultural support policies on rental rates is important. Three notable expectations are recent studies by Kirwan (2009), Patton et al. (2008), and Goodwin, Mishra, and Ortalo-Magné (2011). Kirwan, using panel farm-level data taken from the Agricultural Census for the years 1992 and 1997 and an instrumental variables approach, finds 20 to 25 percent of agricultural support payments are capitalized into land rental values (Kirwan 2009). Patton et al. (2008) and Goodwin, Mishra, and Ortalo-Magné (2011) disaggregate agricultural support payments into decoupled and coupled payments and employ an instrumental variables approach to account for payment uncertainty at the time rental agreement terms are negotiate. Their results indicate different types of agricultural payments have different effects on rental rates. Goodwin, Mishra, and Ortalo-Magné (2011) find that landowners extract a large portion of agricultural support program benefits through higher rental rates. We use an instrumental variables approach similar to Goodwin, Mishra, and Ortalo-Magné (2011), while also accounting for the effects of recent ethanol policies.

Henderson and Gloy (2008) examine the impact of ethanol plant location on farmland prices using farmland values estimated by local agricultural bankers. Their empirical results show that agricultural amenities, government payments and urbanization characteristics exhibit a positive relationship with farmland values. The results also indicate that the distance from an ethanol plant is negatively related to farmland values. Therefore, farmland values are higher closer to operating ethanol plants. For every mile increase in distance from an ethanol plant, land prices decrease $1.44 per-acre for the 2006 data. Using the 2007 data, this figure rises to $2.14 per-acre, indicating the affects are increasing as the basis change is viewed as more permanent.

One shortcoming of Henderson and Gloy's (2008) article is that the farmland value data are gathered from an opinion survey of bankers financing agricultural land sales. The authors argue that these bankers should have a good idea of farmland values in their region. We build upon Henderson and Gloy's (2008) work by using a larger dataset of individual farm-level data collected annually by the USDA in the Agricultural Resource Management Survey (ARMS). We examine both farmland values and rental rates.

Policy Effects on Farmland Values and Rental Rates

Following Goodwin, Mishra, and Ortalo-Magné (2011), we allow the value of a parcel of land to be the present discounted value of expected cash flows from agricultural activities plus the value of the option to convert the land to non-agricultural use.

$$Eq.1\ V_0 = E\left[\sum_{t=1}^{\infty}\frac{Market_t + Gov_t}{(1+i)^t}\right] + OC_0\ (Urban_t, Amenity_t)$$

where V_0 is the value of the parcel of land, E is the expectation operator, $Market_t$ is the sum of market returns at time t, Gov_t is the sum of government payments at time t, OC_0 is equal to the opportunity cost of keeping the land in agricultural use, which is a function of urban pressures and natural amenities on the parcel of land and neighboring parcels, and i is the discount rate. The discount rate reflects the riskiness of the stream of cash flows.

Like returns, urban pressure positively affects agricultural land prices. Urban pressure raises the opportunity cost of keeping the parcel of land in agricultural use. While urban pressure increases the likelihood that the land will be converted to non-agricultural uses, natural amenities decrease the likelihood that the land will be converted to non-agricultural uses. However, both factors increase the value of the parcel.

Market returns can further be divided into commodity specific returns, while government payments can be disaggregated into the various types of payments discussed in the previous section. The various sources of returns are likely to have different discount rates because each type of return has a different level of risk and a different degree of permanency.

In an attempt to analyze the impacts of each payment type on farmland values, we disaggregate government payments into four types of payments in the empirical analysis: 1) decoupled payments (PFC payments, FDP and CCP), 2) CRP payments, 3) LDP and 4) disaster payments (MLA). Total government payments are thus defined as

$$Eq.2\ Gov_t = DP_t + CRP_t + LDP_t + Disaster_t$$

where Gov_t represents government payments, DP_t represents decoupled payments, CRP_t represents CRP payments, LDP_t represents LDP, and $Disaster_t$ represents disaster payments.

In general, government payments increase agricultural returns and reduce agricultural income volatility. Hence, government payments are likely to have a positive impact on land prices. However, as previously discussed some payments are tied to historical averages such as decoupled payments, while others are triggered by current market conditions such as LDP and disaster payment, thus the discount rate for each type of government payment should reflect the certainty and permanency of the payment. Let i_{Gov} be the discount rate associated with aggregate payments and i_{DP}, i_{CRP}, i_{LDP}, and i_{Dis} be the discount rates associated with *DP*, *CRP*, *LDP* and *Disaster* respectively:

$$Eq.3\ \frac{Gov_t}{(1+i_{Gov})^t} = \frac{DP_t}{(1+i_{DP})^t} + \frac{CRP_t}{(1+i_{CRP})^t} + \frac{LDP_t}{(1+i_{LDP})^t} + \frac{Disaster_t}{(1+i_{Dis})^t}$$

Substituting $Eq.3$ into $Eq.1$ yields,

$$Eq.4\ V_0 = E\left[\sum_{t=1}^{\infty} \frac{Market_t}{(1+i_{Market})^t} + \frac{DP_t}{(1+i_{DP})^t} + \frac{CRP_t}{(1+i_{CRP})^t} + \frac{LDP_t}{(1+i_{LDP})^t} + \frac{Disaster_t}{(1+i_{Dis})^t}\right] + OC_0\ (Urban_t, Amenity_t).$$

where i_{Market} is the discount rate associated with market returns. Note, i is not the sum of the individual discount rates because of the non-zero covariance across the various types of government payments and market returns (i.e., disaster payments are received when market returns are low).

Another factor that impacts farmland values, especially in the Midwest, is the location of ethanol facilities. Corn ethanol facilities increase the market returns $Market_t$ associated with corn production on land in close proximity to the facility by increasing the demand for corn and lowering transportation costs. Thus, parcels of land in close proximity to ethanol plants should be more valuable.

The capitalization model assumes returns are known with certainty. However, this is generally not the case, especially when faced with changing policy environments. On the other hand, rental rates reflect the price of land input used in the agricultural production process and rental rates do not face many of the same problems as land values since they are adjusted every few years. Yet, rental rates tend to be effected by the same factors that influence land prices and perhaps provide a better measure of the opportunity costs of the land moving away from agriculture. For these reasons, both land value per acre and rental rates per-acre are analyzed in this paper.

When the price of a commodity increases, this increases the demand for the inputs used to produce the commodity. More formally, a corn producer solves the profit maximization problem:

$$Eq.5 \;\; Max \;\; \pi = pf(x_1,...,x_m) - \sum_{j=1}^{m} r_j x_j$$

where $f(x_1, \ldots x_m)$ is the production function for corn, which is a function of m inputs $(x_1, \ldots, x_m)$, p is the unit price of the corn output and $(r_1, \ldots, r_m)$ are the prices of inputs. Without loss of generality, the j first order conditions that solve Eq. 5 are:

$$Eq.6 \; \frac{\partial \pi}{\partial x_j} = p\frac{\partial f(x_j)}{\partial x_j} - r_j = 0.$$

Eq. 6 indicates that when policies that increase the price of corn are enacted (e.g. ethanol policies), the rental rate for a parcel of land used to produce corn must also increase (assuming the marginal productivity of land, $\frac{\partial f(x_j)}{\partial x_j}$, has not changed).

Empirical Analysis

In this section, we analyze the determinants of farmland values and rental rates.

Measurement Error and Endogeneity:

The capitalization model presented in the previous section states that the value of a parcel of land is the discounted value of expected cash flows from agricultural activities plus the value of the option to convert the land to non-agricultural use. Additionally, rental rate are also determined based on expected returns. However, data available for the analyses consist of the realized values of the cash flows rather than the expected values. As a result, researchers face classic errors-in-variables problems due to measurement error in the variables, which can lead to insignificant and inconsistent estimators (see Goodwin, Mishra, and Ortalo-Magné (2011) for a thorough discussion). In addition, there is an endogenous relationship between farmland values and government payments. To illustrate the endogenous relationship consider the fixed direct payment program: under the FDP program more productive farmland (i.e. farmland with higher yields) receives higher FDP payments. Thus, more valuable farmland tends to receive more government payments. Furthermore, the location of an ethanol facility is also not exogenous. Ethanol facilities tend to be located in areas where land is most suitable for efficient corn production.

The standard approach to overcoming both measurement error and endogeneity is to employ instrumental variables techniques. This requires finding instruments that are correlated with the variable of interest but uncorrelated with the error term. Thus, in addition to weighted ordinary least squares, an instrumental variable approach, similar to the approached used by

Goodwin, Mishra, and Ortalo-Magné (2011) is employed. We use five-year smoothed county averages as the instruments. Using smoothed county averages allows us preserve more observations. We conduct all analyses using aggregate government payments and then repeat the analyses using disaggregated government payments. When disaggregated government payments are used, following Goodwin, Mishra, and Ortalo-Magné (2011), LDP county averages are two-year smooth county average. The results are similar when the five-year smooth county average for LDP is used.

Data

We use the 1998-2008 USDA Agricultural Resource Managerial Survey (ARMS) dataset, which consists of cross-sectional farm-level data collected annually by the USDA's National Agricultural Statistics Service. The dataset includes information such as the estimated market value of land and buildings, acreage, commodity mix, value of production, output quantities, input expenses, governmental payments by program, and farm and farmer characteristics. Similar to Goodwin, Mishra, and Ortalo-Magné (2011), expectations of government payments are measured by a proxy variable constructed from historic average county-level government payments using USDA Farm Service Agency (FSA) data. FSA data is unpublished and was obtained through a Freedom of Information Act (FOIA) request. The data consist of annual government payment information by recipient for each program type and annual county-level acreage reports by commodity. Additionally, using ethanol plant location data obtained from the Renewable Fuels Association (2010) and the American Coalition for Ethanol (2010), we constructed a dataset of all corn-based ethanol facilities. The dataset includes information pertaining to the date of first operation and capacity. The operational date of each ethanol facility was obtained through the facilities website, news articles about the facility, or by calling the facility. All monetary values used in our analyses are deflated by the consumer price index (CPI) to obtain 2008 equivalent real values. Unless otherwise stated, all variables are computed on a per-acre basis. We limit the analysis to farms with more than 50 acres operated.

Since we are primarily interested in the impacts of corn ethanol policies, the analysis is limited to the USDA geographic region defined as the heartland, where the majority of the eight million acres of corn planted in the US annually is grown. Currently, this region also has 128 ethanol facilities using corn as a feedstock. Three states are fully included in the heartland region: Indiana, Illinois, and Iowa. Six other states are partially included in the heartland region: 1) Ohio, 2) Kentucky, 3) Missouri, 4) Nebraska, 5) South Dakota and 6) Minnesota.

Dependent variables

The first dependent variable analyzed is the real per-acre value of land (*LAND*). ARMS respondents are asked to estimate the total value of land and buildings. Respondents are also asked to report the total value of buildings. Using these two responses, land value is constructed as the difference between the value of land and buildings and the value of buildings. Negative values resulting from this calculation are most likely due to confusion about the questions or poor estimation on the part of the respondent. Hence, negative land values are eliminated from the analysis. To obtain land value on a per acre basis, land value is divided by total acres owned (*ACRESOWN*). While our measure of farmland value relies on producers' estimates, we assume that farmland owners tend to track local land sales and thus should be able to provide a valid assessment of the value of their land. Following Goodwin, Mishra, and Ortalo-Magné (2011), we eliminate outliers by dropping observations with *LAND* values less than \$200 or greater than \$20,000. The truncation removes outliers due to poor estimation or confusion on the part of respondents, non-typical agricultural properties such as vineyards, and properties with non-typical parcel characteristics such as river frontage (Goodwin, Mishra, and Ortalo-Magné 2011). The land value truncation removed only two percent of the observations. As shown in table 1, the average value for *LAND* in the restricted sample is \$2,228.44 per-acre.

The second dependent variable is real cash rental expense per-acre (*RENT*). The real rental rate per-acre (*RENT)* is obtained by dividing the total dollar amount paid for cash rent by total the number of acres rented on a cash basis. To remove outliers, observations where *RENT* is less than \$0 or greater than \$2,000 are dropped from the analysis. As shown in table 1, the average value for *RENT* in the heartland region after truncation is \$81.73 per acre.

Independent Variables

Table 1 contains two sets of summary statistics for the independent variables. The first set of summary statistics corresponds to the sample for the farmland value (*LAND*) analyses, while the second set corresponds to the sample for the rental rate (*RENT*) analyses.

Table 1 also presents summary statistics for five variables which are not regressors: *ARCES*, *CORN*, *ARCESOWN*, *TENURE* and *FARM ACRES*. *ARCES* represents the total number of acres operated by the farm operator. *CORN* is the number of acres of corn harvested by the farm. On average, farms in the rental rate sample operate more acres and harvest more acres of corn than farms in the farmland value sample. *ACRESOWN* is the number of acres owned by the farm operator. *TENURE* is the ratio of acres owned to acres operated. *TENURE* is lower for farms in the rental rate sample, suggesting these farms rent a higher proportion of operated acres. *FARM ACRES* is the total farmland acres in the county calculate from FSA data. This value is used to compute county-level historic averages on a per-acre basis.

As suggested by the capitalization model, market returns are included as independent variables in all regression models. Market returns are disaggregated into real livestock sales (*LIVESTOCK*) and real crop sales (*CROP*) per-acre operated. All variables are constructed on a per-acre operated (*ACRES*) basis unless otherwise specified.

Farm-level government payments are also reported on ARMS. We conduct the analyses using real aggregate government payments per-acre (*GOV*) and then repeat the analyses by disaggregating government payments into decoupled payments (*DP*), conservation payments *(CRP)*, loan deficiency payments (LDP), disaster payments *(DISASTER)* and other government payments (*OTHER*) to examine the impact that each type of payment has on farmland values and rental rates. *DP* include PFC payments, FDP, and CCP in years where they exist. *CRP* consists of wetland conservation payments and conservation reserve program payments. *LDP* and *DISASTER* are as previously defined. *OTHER* represents all other government payments. On average, farms in the farmland value sample received $23.39 of real government payments per-acre, while farms in the rental rate sample received $26.27 of real government payments per-acre.

Urban influence is measured through the 1993 Rural-Urban Continuum Code (*URBAN*), commonly referred to as the 1993 Beale Code. The Rural-Urban Continuum Code is a county level classification (0-9) determined by the county population and if the county is a metropolitan area, adjacent to a metropolitan area, or not. An *URBAN* score of 0 indicates the county is a metropolitan area with an urban population greater than 1 million. An urban population means a population that lives in cities or suburbs. An *URBAN* score of 1 indicates the county is a fringe county close to a metropolitan area with an urban population greater than 1 million. A score of 2 indicate the county is a metropolitan area with an urban population between 250,000 and 1 million. A score of 3 indicates the county is a metropolitan area with an urban population less than 250,000. Non-metropolitan area scores range from 4-9. A score of 4 indicates the county is adjacent to a metropolitan area with an urban population of 20,000 or more. A score of 5 indicates the county is not adjacent to a metropolitan area with an urban population of 20,000 or more. A score of 6 indicates the county is adjacent to a metropolitan area with an urban population of between 2,500 and 19,999. A score of 7 means the county is not adjacent to a metropolitan area with an urban population of between 2,500 and 19,999. A score of 8 indicates the county is adjacent to a metropolitan area with an urban population of less than 2,500. A score of 9 means the county is not adjacent to a metropolitan area with an urban population of less than 2,500. Beale Code classifications are contained in the ARMS dataset.

County-level population growth and population per farmland acre are included as additional measures of urban pressure. County-level population estimates are intercensal estimates obtained from the U.S. Census Bureau (2011). County-level population growth rates ($POPGROWTH_t$) are calculated as the change in county population divided by the county population at the beginning of the period. Population per farmland acre ($POPULATION_t$) is calculated by dividing the county-level population estimate by the total farmland acres ($FARM\ ACRE_t$) in the county. Farmland acres were obtained from unpublished USDA FSA data.

Like urban pressure, natural amenities should have a positive effect on farmland values. County-level natural amenities (*AMENITY*) are measured by a z score constructed by the USDA (2004). The z score accounts for average temperatures, topography, and surface water.

Another factor influencing agricultural land values is the proximity of the parcel to an operating local ethanol plant. Following the implementation of policies promoting corn-based ethanol, numerous additional ethanol plants began operating in the heartland region. As previously discussed, a local operating ethanol plant can reduce transportation costs and increase agricultural returns for nearby farms. Ideally, we would include the distance of the parcel to the closest corn-based ethanol facility as an independent variable. While we have the exact location of ethanol facilities, we do not know the exact location of each ARMS respondent and hence cannot construct this variable. To protect the confidentiality of the respondent, researchers are only allowed to view ARMS respondents' zip codes. Thus, we create a series of variables used to proxy for the distance to the closest ethanol facility.

Using the zip code of the ethanol facility, an indicator variable ($ETHANOLCOUNTY_t$) was created that assumed a value of 1 if there is an operating ethanol facility in the same county as the farm at time t and zero otherwise.[1] Unfortunately, zip codes and counties do not form a one to one matching; a zip code can be partially contained in multiple counties. Thus, when creating $ETHANOLCOUNTY_t$, the county that contains the largest area of the zip code was the county deemed to contain the ethanol facility. However, because zip codes can span more than one county, it is possible that the ethanol facility is actually located in a different county and $ETHANOLCOUNTY_t$ is incorrect. Less than 10 percent of the counties in the sample had an operating ethanol facility. An additional variable, $NUMCOUNTY_t$, was created that represents the number of ethanol facilities in the county at time t; some counties have more than one ethanol facility and multiple ethanol facilities are likely to further increase farmland values. We recognize that an ethanol plant within the county may not be the best proxy since there could be a plant closer in an adjacent county.

Also, the impact of an ethanol facility on farmland values is likely to extend beyond the county in which the facility is located. McNew and Griffith (2005) find, on average, the basis increases 5.9 cents per bushel over a 150 square mile area around the plant. Hence, an indicator variable, $ETHANOLMULT_t$, was created that takes a value of 1 if there is an ethanol facility in the county or neighboring county. $NUMMULT_t$ represents the number of ethanol facilities in the county or neighboring county.

Weighted Ordinary Least Squares Regression Results

Using weighted ordinary least squares (OLS), we conduct separate analyses using farm-level actual realized aggregate government payments, farm-level actual realized disaggregated government payments, historic county-level smoothed average aggregate government payments, and historic county-level smoothed average disaggregated government payments. For each of these analyses, we conduct separate analyses for $ETHANOLCOUNTY_t$, $ETHANOLMULT_t$, $NUMCOUNTY_t$ and $NUMMULT_t$. The analyses are conducted for both dependent variables. The results are summarized in tables 2-13.

All monetary values contained in the dataset are in $100/acre. Thus, in all regression analyses, coefficient estimates associated with non-monetary variables must be adjusted by

[1] We also conducted the analyses using an indicator variable that assumed a value of 1 if there is an operating ethanol facility in the same zip code as the as the farm at time t and zero otherwise. The results are similar but larger in magnitude. This confirms that the effect of the ethanol plant is largest closest to the ethanol facility location. These results are available from the authors upon request.

multiplying by 100 to determine the impact on farmland values or rental rates per-acre. For example, if the coefficient on $ETHANOLCOUNTY_t$ is 7.4058 (model 1), then, on average, the value of an acre of farmland in a county with an ethanol facility is $740.58 higher than an acre of similar farmland in a county without an ethanol facility. No adjustment is needed to interpret the coefficients on monetary values such as *CROP* or *GOV*. Furthermore, if we assume that the discount rate is constant and the various returns (from market sales and government payments) are expected to grow at a constant rate, then the inverse of the regression coefficients on returns in the models of farmland values are capitalization rates. The regression coefficients on returns in the models of rental rates can simply be interpreted as the proportion of the return passed on to the landlord in the form of higher rental payments.

URBAN is included in all regression analyses as a categorical variable. In all models, the coefficients are significant, indicating that urban influence has a positive impact on farmland values and rental rates. Coefficient estimates for *URBAN* are not reported in the tables to due to space constraints.

Table 2 presents the results for the determinants of farmland values when aggregate farm-level actual realized returns are used as regressors. The results indicate that an additional dollar of government payments per-acre tends to increase farmland values by approximately $2.80 per-acre. This suggests a capitalization rate of approximately 34 percent. The regression results also suggest that ethanol facilities significantly impact farmland values and that multiple ethanol facilities in close proximity intensify the effect. Holding other parcel characteristics constant, on average, the value of an acre of farmland in a county with one ethanol facility is $708.32 higher than an acre of similar farmland in a county without an ethanol facility, while the value of an acre of farmland in a county with two ethanol facilities is $1,869.52 higher than a similar parcel in a county without an ethanol facility.

The results for the determinants of farmland values when disaggregated farm-level actual realized returns are used as regressors are summarized in table 3. The results indicate that the type of government payments influences the magnitude and size of the effect on farmland values, confirming previous research (Goodwin, Mishra, and Ortalo-Magné 2003; Goodwin and Mishra 2006; Goodwin, Mishra, and Ortalo-Magné 2011; Patton 2008). Decoupled payments have the largest impact on farmland values; an additional dollar of decoupled payments per-acre tends to increase farmland values by approximately $22 per-acre. This suggests a capitalization rate of approximately 4.5 percent. Disaster payments and LDP have a negative impact on farmland values. Both LDP and disaster payments are received when market returns are low, which may explain the negative relationships. Again, the results suggest that ethanol facilities have a positive impact on the value of nearby farmland.

Tables 4 and 5 present the results for the determinants of farmland values when historic county-level (smoothed) averages are used as independent variables. County-level averages are used as a proxy for expectations. The capitalization model is based on expected cash flows, while ARMS data consist of actual values. Actual realize values can differ significantly from expected values for a variety of reasons, including unexpected adverse market conditions, drought, disease or discontinuation of a government program. In addition, individual realized values can vary substantially from year to year. Thus, the county averages may provide a better measure of true expected values. The results suggest that government payments and ethanol plants significantly impact farmland values. However, as shown in table 5, when disaggregated government payments are used, the impacts of ethanol facilities are smaller than in previous models.

Tables 6-9 present the results for the determinants of rental rates. As shown in table 6, an additional dollar of government payments per-acre tends to increase rental rates by approximately $0.32 per-acre. When historic county-level averages are used to proxy for payment expectations, the results indicate that government payment recipients pass on approximately 80 percent of the payment to the landlord in the form of higher rental payments, as shown in table 8. These results are similar to the findings of Goodwin, Mishra, and Ortalo-Magné (2011). When aggregate government payments are used, ethanol facilities have a positive impact on rental rates of land in close proximity to the plant; however, when disaggregated government payments are used, the majority of the coefficients on the ethanol plant variables are no longer significant. Surprisingly, population growth exhibits a negative effect on rental rates in most of the models.

Instrumental Variables Regression Results

To further account for measurement error stemming from differences between expected values and realized values, we employ an instrumental variables approach similar to Goodwin, Mishra, and Ortalo-Magné (2011). The county-level smoothed averages serve as the instruments. When government payments are disaggregated, we assume that *DP* and *CRP* are exogenous because these payment types are predetermined. Similar results are obtained when these variables are treated as endogenous. The results are summarized in tables 10-13. As shown in table 10, there is a positive and significant relationship between government payments and farmland values. However, the magnitude does not seem plausible. In addition, the majority of the effects of the ethanol variables are not significant. Similar problems arise when rental rates are analyzed, as shown in tables 12 and 13. Inspection of the Shea's partial R-squared values and first-stage F-statistics (table 14) suggest the instruments may be weak, leading to imprecise and biased estimates. Given that we use similar instruments to those used by Goodwin, Mishra, and Ortalo-Magné (2011), we are surprised that the instruments may be problematic. However, the authors do not discuss the tests conducted to determine the validity of their instruments. In addition, we recognize that we have only addressed the error-in-variables problems stemming from measurement error due to differences between expected and actual values and we do not fully address the endogenous relationship between ethanol plants and farmland. Identifying valid instruments to address this endogenous relationship presents challenges, which we have not yet overcome.

Robustness Check Using 2008 Biofuels Supplement Data

As previously stated, the ideal variable to construct to determine the impact of ethanol facilities on farmland values and rental rates would be the actual distance of the parcel to the closest ethanol facility. While the ARMS dataset does not contain this information, in 2008 select respondents were asked to provide additional supplemental data pertaining to biofuels. This supplemental survey asked respondent to report the distance from the operation's main storage facility to the closet ethanol facility. We use the response to this question as a proxy for the distance from the parcel to the closest ethanol facility. The weighted OLS results are presented in tables 15 and 16. Models 49 and 52 use farm-level aggregate government payments as regressors. Unfortunately, there are insufficient observations to conduct the analyses using farm-level disaggregated government payments because many of the respondents in the sample did not report disaggregated government payments. The remaining models use historic county-level averages as the regressors. The results indicate that farmland values are significantly higher when the parcel is located in close proximity to an operating ethanol production facility. Farmland values decrease by $26-37 per-acre for every mile between the parcel and the closest ethanol plant. Rental rates are also significantly impacted by the distance of the parcel from an ethanol facility in models using historic county-level averages as regressors. These models suggest that for every mile of increased distance rental rates decline by $0.06-0.39.

Conclusions and Implications

While the results are preliminary, they indicate farmland values and rental rates are significantly higher for parcels located in close proximity to ethanol facilities. Depending on the model, an ethanol facility in the same county as the parcel increases the value of the parcel by $226-741, while an ethanol facility in the same county as the parcel may impact rental rates by as much as $10 per-acre. Furthermore, our findings confirm earlier research that government payments significantly impact farmland values and rental rates with payment effects dependent on the type of the payment. The results suggest that U.S. agricultural policies can significantly impact farmland values.

Ultimately, we would like to be able to answer the question posed in the introduction regarding whether the recent increase in farmland value is due to changes in government policy and increased demand or if the increase is due to a speculative bubble. To this end, we use iterative Chow tests to reveal structural breaks due to the introduction of U.S. ethanol policies and changes in farm policy regimes. While these results are preliminary, there is evidence that recent changes in U.S. policies have had a significant impact on farmland uses, prices and rental rates. We do not report the results of the iterative Chow tests here because we are still refining the regression analysis. Although our use of historic county-level returns makes some progress towards correcting the bias associated with the errors-in-variable problems stemming from differences in actual versus expected values of returns, we have yet to properly instrument for endogeneity of ethanol facility locations. Identification of a valid instrument is challenging. Once these identification issues are overcome, a comparison of actual 2011 and predicted farmland prices generated by the model can be conducted to determine if the current prices are consistent with fundamentals or if the high prices reflect a speculative bubble. In addition, the robustness of the model can be examined by comparing changes in farmland values predicted by the model and basis changes.

In this paper, we ignore differences in ethanol facility capacity levels. Ethanol facilities vary substantially in terms of their capacity. Future research should also address the impact of capacity on farmland values and rental rates.

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Table 1 Variable Definitions and Summary Statistics

Variable	Description	Land value sample		Rental rate sample	
		Mean	Std Dev	Mean	Std Dev
ACRES	Acres operated	462.78	6858.14	705.32	7457.48
CORN	Acres of corn harvested	150.23	2902.51	269.13	3213.56
ACRESOWN	Acres owned	240.41	4375.97	232.94	4577.21
TENURE	ACRESOWN/ACRES	0.73	5.15	0.38	2.99
LAND	Real farmland value per-acre ($/acresown)	2228.44	184.93	2988.73	894.94
RENT	Real rental rate per-acre ($/rented acres)	94.99	96.49	81.73	5.81
CROP	Crop sales ($/acres)	110.18	65.96	155.38	17.49
LIVESTOCK	Livestock sales ($/acres)	100.34	152.08	104.20	58.93
GOV	Total government payments to operator and landlord ($/acre)	23.39	2.43	26.27	1.99
DP	Decoupled payments to operator and landlord ($/acre)	7.92	0.10	8.20	0.10
CRP	CRP payments to operator and landlord ($/acre)	4.62	1.51	0.99	0.43
DISASTER	Disaster payments to operator and landlord ($/acre)	2.32	0.70	3.17	0.65
LDP	LDP to operator and landlord ($/acre)	5.64	1.26	8.22	1.23
OTHER	Other government payments to operator and landlord ($/acre)	1.85	0.98	2.11	0.82
FARM ARCES	Total farmland in county	246978.10	113063.04	258942.45	111804.53
AVG GOV	County average government payments ($/farm acres)	25.24	0.25	27.18	0.25
AVG DP	County average decoupled payments ($/farm acres)	15.35	0.06	16.16	0.06
AVG CRP	County average CRP payments ($/farm acres)	4.15	0.04	3.73	0.04
AVG DISASTER	County average disaster payments ($/farm acres)	4.74	0.04	4.82	0.04
AVG LDP	County average LDP payments ($/farm acres)	9.39	0.05	9.78	0.05
AVG OTHER	County average other government payments ($/farm acres)	3.04	0.05	2.91	0.04
AMENITY	Amenity z score	2.18	1.29	2.36	1.23
ETHANOLCOUNTY	Indicator variable (ethanol facility in the county)	0.07	2.54	0.09	2.38
ETHANOLMULT	Indicator variable (ethanol facility in the county or neighboring county)	0.12	3.20	0.15	3.00
NUMCOUNTY	Number of ethanol facilities in the county	0.07	2.65	0.09	2.49
NUMMULT	Number of ethanol facilities in the county	0.13	3.71	0.17	3.57
POPGROWTH	Annual population growth rate	0.00	0.01	0.00	0.01
POPULATION	Ratio of county population in farm acres	0.45	5.82	0.46	5.73
DISTANCE	Distance from storage facility to closest ethanol facility	25.74	19.33	25.01	18.04

Means calculated using ARMS data are weighted. Means calculated from other data sources are unweighted.

Table 2 Land Value Determinants: Farm-level Actual Realized Aggregate Government Payments

	Model 1	Model 2	Model 3	Model 4
CROP	0.1921	0.188	0.1916	0.1857
	(0.1023)	(0.0997)	(0.1020)	(0.0984)
LIVESTOCK	0.0330*	0.0325*	0.0332*	0.0325*
	(0.0141)	(0.0139)	(0.0141)	(0.0138)
GOV	2.9163***	2.7882***	2.9293***	2.8191***
	(0.7765)	(0.7736)	(0.7764)	(0.7725)
POPGROWTH	9.284	14.5617	9.5693	15.218
	(20.1192)	(20.0866)	(20.1141)	(20.0447)
POPULATION	-0.0054	-0.0056	-0.0056	-0.0066
	(0.0325)	(0.0325)	(0.0325)	(0.0324)
AMENITY	1.9198***	1.7921***	1.9094***	1.7406***
	(0.1403)	(0.1400)	(0.1402)	(0.1392)
ETHANOLCOUNTY	7.4058***			
	(0.7649)			
ETHANOLMULT		7.2782***		
		(0.5713)		
NUMCOUNTY = 1			7.0832***	
			(0.7776)	
NUMCOUNTY = 2			18.6952***	
			(3.2126)	
NUMMULT = 1				6.1180***
				(0.5617)
NUMMULT = 2				18.1549***
				(2.4291)
NUMMULT = 3				11.5833
				(6.9849)
CONSTANT	31.7185***	31.8467***	31.7296***	31.9173***
	(2.4455)	(2.4487)	(2.4458)	(2.4494)
No. of observations	28,204	28,204	28,204	28,204
R-squared	0.0902	0.095	0.0909	0.0994

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 3 Land Value Determinants: Farm-level Actual Realized Disaggregated Government Payments

	Model 5	Model 6	Model 7	Model 8
CROP	0.1396	0.1384	0.1393	0.137
	(0.0789)	(0.0779)	(0.0787)	(0.0768)
LIVESTOCK	0.0487**	0.0482**	0.0488**	0.0484**
	(0.0177)	(0.0176)	(0.0177)	(0.0176)
DP	22.2137***	21.5312***	22.0860***	20.6813***
	(2.6566)	(2.6658)	(2.6573)	(2.6939)
CRP	4.9597	4.9374	4.8993	4.5239
	(2.8287)	(2.8370)	(2.8305)	(2.6756)
DISASTER	-15.4654***	-15.1906***	-15.6574***	-15.1118***
	(3.4568)	(3.4524)	(3.4710)	(3.4454)
LDP	-6.1395**	-5.7919**	-5.9908**	-5.3065**
	(1.9028)	(1.9060)	(1.9048)	(1.9107)
OTHER	8.6804*	8.7032*	8.7051*	8.8111*
	(3.8939)	(3.8804)	(3.8955)	(3.8814)
POPGROWTH	20.5817	22.5387	20.9132	22.1173
	(24.6280)	(24.6268)	(24.6225)	(24.4434)
POPULATION	0.0811	0.0805	0.0806	0.0758
	(0.0972)	(0.0972)	(0.0972)	(0.0969)
AMENITY	1.3814***	1.3306***	1.3756***	1.2826***
	(0.1751)	(0.1761)	(0.1750)	(0.1731)
ETHANOLCOUNTY	6.1415***			
	(1.3911)			
EHTANOLMULT		5.5107***		
		(1.0129)		
NUMCOUNTY = 1			5.8633***	
			(1.4030)	
NUMCOUNTY = 2			27.6467**	
			(8.4026)	
NUMMULT = 1				4.0160***
				(0.8863)
NUMMULT = 2				30.8637***
				(8.8623)
NUMMULT = 3				13.6285**
				(4.7673)
CONSTANT	26.0624***	26.1235***	26.0710***	26.2481***
	(2.5776)	(2.5802)	(2.5780)	(2.5811)
No. of observations	11,442	11,442	11,442	11,442
R-squared	0.1136	0.1151	0.1147	0.1271

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 4 Land Value Determinants: Historic County-level Average Aggregate Government Payments

	Model 9	Model 10	Model 11	Model 12
CROP	0.1695	0.1666	0.1691	0.1646
	(0.0900)	(0.0881)	(0.0897)	(0.0869)
LIVESTOCK	0.0305*	0.0302*	0.0307*	0.0302*
	(0.0131)	(0.0129)	(0.0131)	(0.0128)
AVG GOV	36.7712***	36.1882***	36.7407***	36.0030***
	(2.6029)	(2.5835)	(2.6030)	(2.5774)
POPGROWTH	47.1548*	51.0004*	47.3675*	51.3654*
	(20.6081)	(20.5515)	(20.6059)	(20.5129)
POPULATION	-0.0375	-0.0371	-0.0376	-0.0379
	(0.0343)	(0.0342)	(0.0343)	(0.0343)
AMENITY	1.3337***	1.2385***	1.3253***	1.1957***
	(0.1619)	(0.1601)	(0.1619)	(0.1594)
ETHANOLCOUNTY	6.4511***			
	(0.7407)			
ETHANOLMULT		6.1241***		
		(0.5508)		
NUMCOUNTY = 1			6.1547***	
			(0.7543)	
NUMCOUNTY = 2			16.8639***	
			(3.0164)	
NUMMULT = 1				5.0547***
				(0.5437)
NUMMULT = 2				16.1443***
				(2.3764)
NUMMULT = 3				12.1709
				(6.3686)
CONSTANT	22.2506***	22.4926***	22.2709***	22.6128***
	(2.5031)	(2.5044)	(2.5035)	(2.5044)
No. of observations	28,204	28,204	28,204	28,204
R-squared	0.1475	0.1503	0.1481	0.1541

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 5 Land Value Determinants: Historic County-level Average Disaggregated Government Payments

	Model 13	Model 14	Model 15	Model 16
CROP	0.1393	0.1383	0.1392	0.1374
	(0.0716)	(0.0710)	(0.0716)	(0.0704)
LIVESTOCK	0.0287*	0.0286*	0.0288*	0.0286*
	(0.0126)	(0.0124)	(0.0126)	(0.0124)
AVG DP	95.8399***	94.4277***	95.6324***	93.5300***
	(5.5314)	(5.5413)	(5.5297)	(5.5200)
AVG CRP	13.6243**	14.6344***	13.6631**	15.7918***
	(4.2481)	(4.2306)	(4.2472)	(4.2158)
AVG DISASTER	-25.7591***	-24.1288***	-25.4049***	-22.2961**
	(7.2746)	(7.2936)	(7.2765)	(7.3295)
AVG LDP	12.5433***	12.3205***	12.4984***	12.2241***
	(2.5373)	(2.5307)	(2.5353)	(2.5267)
AVG OTHER	47.0202***	45.7096***	46.8735***	44.5928***
	(8.8315)	(8.7288)	(8.8298)	(8.6408)
POPGROWTH	43.2169*	46.1248*	43.3365*	47.0139*
	(19.5118)	(19.5240)	(19.5114)	(19.5281)
POPULATION	-0.0393	-0.0381	-0.0393	-0.0377
	(0.0310)	(0.0309)	(0.0310)	(0.0308)
AMENITY	0.6232***	0.5785***	0.6212***	0.5513***
	(0.1552)	(0.1539)	(0.1551)	(0.1528)
ETHANOLCOUNTY	4.3402***			
	(0.7528)			
EHTANOLMULT		4.0072***		
		(0.5838)		
NUMCOUNTY = 1			4.1936***	
			(0.7643)	
NUMCOUNTY = 2			9.8482**	
			(3.0037)	
NUMMULT = 1				3.2122***
				(0.5673)
NUMMULT = 2				12.1471***
				(2.4665)
NUMMULT = 3				7.4945
				(5.8961)
CONSTANT	19.1626***	19.3362***	19.1855***	19.4276***
	(2.4987)	(2.5004)	(2.4987)	(2.5003)
No. of observations	28,204	28,204	28,204	28,204
R-squared	0.1678	0.1687	0.1679	0.1711

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 6 Rental Rate Determinants: Farm-level Actual Realized Aggregate Government Payments

	Model 17	Model 18	Model 19	Model 20
CROP	0.0907***	0.0898***	0.0906***	0.0894***
	(0.0071)	(0.0070)	(0.0070)	(0.0070)
LIVESTOCK	0.0057**	0.0057**	0.0057**	0.0056**
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
GOV	0.3171***	0.3195***	0.3179***	0.3202***
	(0.0382)	(0.0382)	(0.0382)	(0.0382)
POPGROWTH	-2.5951***	-2.5287***	-2.5886***	-2.5131***
	(0.7158)	(0.7154)	(0.7157)	(0.7154)
POPULATION	-0.0007	-0.0006	-0.0007	-0.0007
	(0.0061)	(0.0061)	(0.0061)	(0.0061)
AMENITY	0.0717***	0.0698***	0.0716***	0.0691***
	(0.0067)	(0.0068)	(0.0067)	(0.0068)
ETHANOLCOUNTY	0.1028***			
	(0.0196)			
ETHANOLMULT		0.1071***		
		(0.0164)		
NUMCOUNTY = 1			0.0987***	
			(0.0197)	
NUMCOUNTY = 2			0.2339*	
			(0.0942)	
NUMMULT = 1				0.0931***
				(0.0167)
NUMMULT = 2				0.2166***
				(0.0424)
NUMMULT = 3				0.2247*
				(0.0936)
CONSTANT	0.3960***	0.3996***	0.3963***	0.4017***
	(0.0477)	(0.0477)	(0.0477)	(0.0477)
No. of observations	20,165	20,165	20,165	20,165
R-squared	0.1523	0.1534	0.1524	0.1539

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 7 Rental Rate Determinants: Farm-level Actual Realized Disaggregated Government Payments

	Model 21	Model 22	Model 23	Model 24
CROP	0.0830***	0.0827***	0.0829***	0.0822***
	(0.0085)	(0.0085)	(0.0085)	(0.0085)
LIVESTOCK	0.0071	0.0071	0.0071	0.0071
	(0.0041)	(0.0041)	(0.0041)	(0.0041)
DP	0.6194***	0.6140***	0.6193***	0.6087***
	(0.1027)	(0.1026)	(0.1027)	(0.1025)
CRP	-0.4933*	-0.4871*	-0.4943*	-0.4865*
	(0.2190)	(0.2179)	(0.2189)	(0.2172)
DISASTER	0.5195**	0.5242**	0.5207**	0.5275**
	(0.1785)	(0.1785)	(0.1785)	(0.1786)
LDP	0.2096**	0.2129**	0.2107**	0.2160**
	(0.0788)	(0.0788)	(0.0788)	(0.0788)
OTHER	0.3728	0.3731	0.3729	0.3735
	(0.2633)	(0.2631)	(0.2634)	(0.2636)
POPGROWTH	-2.3808*	-2.3654*	-2.3763*	-2.3631*
	(0.9826)	(0.9829)	(0.9827)	(0.9835)
POPULATION	0.0029	0.003	0.0029	0.003
	(0.0096)	(0.0096)	(0.0096)	(0.0095)
AMENITY	0.0623***	0.0617***	0.0622***	0.0612***
	(0.0093)	(0.0094)	(0.0093)	(0.0094)
ETHANOLCOUNTY	0.0362			
	(0.0280)			
EHTANOLMULT		0.0457*		
		(0.0226)		
NUMCOUNTY = 1			0.0327	
			(0.0281)	
NUMCOUNTY = 2			0.331	
			(0.1875)	
NUMMULT = 1				0.0327
				(0.0222)
NUMMULT = 2				0.2599*
				(0.1246)
NUMMULT = 3				0.2317
				(0.1427)
CONSTANT	0.3180***	0.3194***	0.3182***	0.3214***
	(0.0608)	(0.0608)	(0.0608)	(0.0608)
No. of observations	8,540	8,540	8,540	8,540
R-squared	0.1411	0.1414	0.1413	0.1421

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 8 Rental Rate Determinants: Historic County-level Average Aggregate Government Payments

	Model 25	Model 26	Model 27	Model 28
CROP	0.0836***	0.0830***	0.0835***	0.0827***
	(0.0066)	(0.0065)	(0.0066)	(0.0065)
LIVESTOCK	0.0055*	0.0055*	0.0055*	0.0054*
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
AVG GOV	0.8165***	0.8094***	0.8163***	0.8078***
	(0.0771)	(0.0765)	(0.0771)	(0.0765)
POPGROWTH	-2.1299**	-2.0922**	-2.1267**	-2.0814**
	(0.6685)	(0.6678)	(0.6685)	(0.6680)
POPULATION	-0.0023	-0.0023	-0.0023	-0.0023
	(0.0061)	(0.0060)	(0.0061)	(0.0060)
AMENITY	0.0721***	0.0709***	0.0720***	0.0703***
	(0.0068)	(0.0068)	(0.0068)	(0.0068)
ETHANOLCOUNTY	0.0756***			
	(0.0189)			
ETHANOLMULT		0.0774***		
		(0.0157)		
NUMCOUNTY = 1			0.0729***	
			(0.0190)	
NUMCOUNTY = 2			0.1603	
			(0.0933)	
NUMMULT = 1				0.0653***
				(0.0160)
NUMMULT = 2				0.1710***
				(0.0419)
NUMMULT = 3				0.2044**
				(0.0746)
CONSTANT	0.2548***	0.2595***	0.2551***	0.2618***
	(0.0460)	(0.0460)	(0.0460)	(0.0460)
No. of observations	20,165	20,165	20,165	20,165
R-squared	0.1615	0.1621	0.1616	0.1625

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 9 Rental Rate Determinants: Historic County-level Average Disaggregated Government Payments

	Model 29	Model 30	Model 31	Model 32
CROP	0.0681***	0.0680***	0.0681***	0.0679***
	(0.0057)	(0.0057)	(0.0057)	(0.0057)
LIVESTOCK	0.0052*	0.0052*	0.0052*	0.0052*
	(0.0022)	(0.0021)	(0.0022)	(0.0021)
AVG DP	3.1195***	3.1086***	3.1214***	3.1001***
	(0.2102)	(0.2107)	(0.2106)	(0.2109)
AVG CRP	0.0191	0.032	0.0192	0.0436
	(0.1776)	(0.1785)	(0.1776)	(0.1789)
AVG DISASTER	0.5407*	0.5578*	0.5372*	0.5773*
	(0.2692)	(0.2698)	(0.2695)	(0.2705)
AVG LDP	0.4343***	0.4315***	0.4349***	0.4314***
	(0.0937)	(0.0936)	(0.0936)	(0.0937)
AVG OTHER	0.2502	0.2362	0.2514	0.2236
	(0.1639)	(0.1630)	(0.1640)	(0.1629)
POPGROWTH	-1.1381	-1.1234	-1.1393	-1.1118
	(0.6475)	(0.6480)	(0.6476)	(0.6482)
POPULATION	0.0001	0.0001	0.0001	0.0001
	(0.0056)	(0.0056)	(0.0056)	(0.0056)
AMENITY	0.0385***	0.0382***	0.0385***	0.0378***
	(0.0068)	(0.0069)	(0.0068)	(0.0069)
ETHANOLCOUNTY	0.0248			
	(0.0185)			
EHTANOLMULT		0.0265		
		(0.0156)		
NUMCOUNTY = 1			0.0259	
			(0.0186)	
NUMCOUNTY = 2			-0.0128	
			(0.0935)	
NUMMULT = 1				0.0194
				(0.0157)
NUMMULT = 2				0.0856*
				(0.0418)
NUMMULT = 3				0.0932
				(0.0671)
CONSTANT	0.0167	0.0184	0.0165	0.0196
	(0.0499)	(0.0499)	(0.0499)	(0.0499)
No. of observations	20,165	20,165	20,165	20,165
R-squared	0.1910	0.1911	0.1910	0.1912

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 10 Land Value Determinants: Instrumental Variables and Aggregate Government Payments

	Model 33	Model 34	Model 35	Model 36
CROP	0.1435*	0.1432*	0.1428*	0.1402*
	(0.0674)	(0.0672)	(0.0670)	(0.0657)
LIVESTOCK	0.0577***	0.0577***	0.0579***	0.0577***
	(0.0159)	(0.0158)	(0.0159)	(0.0158)
GOV	234.7195***	234.1720***	234.3762***	233.0032***
	(28.2130)	(28.5289)	(28.1571)	(28.3860)
POPGROWTH	315.2306***	315.4965***	315.2132***	314.7668***
	(67.6083)	(67.4492)	(67.5048)	(67.1062)
POPULATION	0.2113*	0.2107*	0.2106*	0.2082*
	(0.1024)	(0.1022)	(0.1021)	(0.1012)
AMENITY	-9.5823***	-9.5679***	-9.5811***	-9.5768***
	(1.5251)	(1.5284)	(1.5232)	(1.5242)
ETHANOLCOUNTY	2.2600			
	(2.3399)			
ETHANOLMULT		1.6008		
		(1.8800)		
NUMCOUNTY = 1			1.7438	
			(2.3771)	
NUMCOUNTY = 2			20.6178	
			(11.1544)	
NUMMULT = 1				0.0918
				(1.9641)
NUMMULT = 2				14.6696**
				(4.7170)
NUMMULT = 3				44.5506***
				(8.7736)
CONSTANT	-5.2107	-5.1167	-5.1347	-4.8289
	(7.0571)	(7.0853)	(7.0455)	(7.0499)
No. of observations	28,204	28,204	28,204	28,204

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 11 Land Value Determinants: Instrumental Variables and Disaggregated Government Payments

	Model 37	Model 38	Model 39	Model 40
CROP	0.1428	0.14	0.1399	0.1358
	(0.0877)	(0.0859)	(0.0872)	(0.0838)
LIVESTOCK	-0.0191	-0.0182	-0.0191	-0.0167
	(0.0504)	(0.0500)	(0.0521)	(0.0506)
DP	-834.4957	-851.0105	-897.4143	-893.4448
	(1010.1232)	(1015.3781)	(1107.5937)	(1054.9780)
CRP	317.1943	329.8865	348.5748	360.6108
	(455.3637)	(460.0877)	(501.1653)	(481.8884)
DISASTER	889.0395	878.4914	911.474	884.5592
	(509.1709)	(505.1969)	(546.0907)	(519.4274)
LDP	-20.8866	-24.1916	-26.2348	-31.2589
	(68.0392)	(69.5254)	(75.0757)	(73.5040)
OTHER	26.2723	26.2754	26.8675	26.7972
	(17.7402)	(17.6594)	(18.7750)	(18.1927)
POPGROWTH	373.3843	378.2461	392.8357	391.7071
	(318.3848)	(320.0813)	(347.5575)	(332.8943)
POPULATION	0.2892	0.2924	0.3002	0.2978
	(0.2862)	(0.2880)	(0.3034)	(0.2956)
AMENITY	-1.7894	-1.9217	-1.9972	-2.2205
	(3.3021)	(3.3728)	(3.5770)	(3.5435)
ETHANOLCOUNTY	6.0354			
	(4.9743)			
EHTANOLMULT		6.6152		
		(4.5974)		
NUMCOUNTY = 1			4.7859	
			(5.4449)	
NUMCOUNTY = 2			98.4838	
			(94.2793)	
NUMMULT = 1				4.3519
				(4.4838)
NUMMULT = 2				46.3330*
				(22.2058)
NUMMULT = 3				78.3478
				(68.4204)
CONSTANT	11.1999	11.0297	10.2609	10.2616
	(16.3266)	(16.3950)	(17.7475)	(17.0958)
No. of observations	11,442	11,442	11,442	11,442

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 12 Rental Rate Determinants: Instrumental Variables and Aggregate Government Payments

	Model 41	Model 42	Model 43	Model 44
CROP	0.0667***	0.0650***	0.0661***	0.0643***
	(0.0108)	(0.0106)	(0.0108)	(0.0107)
LIVESTOCK	-0.0026	-0.0024	-0.0025	-0.0024
	(0.0039)	(0.0037)	(0.0039)	(0.0037)
GOV	8.1559***	7.8371***	8.1309***	7.8237***
	(1.8476)	(1.7262)	(1.8357)	(1.7230)
POPGROWTH	8.6390*	8.2557*	8.6447*	8.2609*
	(3.5827)	(3.4027)	(3.5702)	(3.3984)
POPULATION	0.0139	0.0135	0.0138	0.0134
	(0.0116)	(0.0112)	(0.0115)	(0.0112)
AMENITY	-0.2587**	-0.2498***	-0.2588**	-0.2507***
	(0.0798)	(0.0753)	(0.0795)	(0.0754)
ETHANOLCOUNTY	0.0585			
	(0.0716)			
ETHANOLMULT		0.1582**		
		(0.0569)		
NUMCOUNTY = 1			0.0267	
			(0.0735)	
NUMCOUNTY = 2			1.0835***	
			(0.2962)	
NUMMULT = 1				0.1287*
				(0.0572)
NUMMULT = 2				0.3583*
				(0.1548)
NUMMULT = 3				1.1856**
				(0.4115)
CONSTANT	-1.3247**	-1.2428**	-1.3160**	-1.2353**
	(0.4480)	(0.4194)	(0.4448)	(0.4182)
No. of observations	20,165	20,165	20,165	20,165

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 13 Rental Rate Determinants: Instrumental Variables and Disaggregated Government Payments

	Model 45	Model 46	Model 47	Model 48
CROP	0.0867***	0.0853***	0.0861***	0.0844***
	(0.0148)	(0.0151)	(0.0151)	(0.0155)
LIVESTOCK	0.0073	0.0085	0.0077	0.0089
	(0.0160)	(0.0168)	(0.0165)	(0.0174)
DP	-12.4043	-13.5887	-13.0284	-14.3434
	(18.7893)	(19.6018)	(19.3333)	(20.2344)
CRP	7.0563	7.5825	7.3165	7.9531
	(7.4176)	(7.7334)	(7.6364)	(7.9875)
DISASTER	1.9715	1.5192	1.8327	1.4006
	(5.6766)	(5.9032)	(5.8472)	(6.0784)
LDP	-0.7444	-0.8628	-0.7963	-0.9436
	(1.5715)	(1.6416)	(1.6189)	(1.6971)
OTHER	0.0258	0.0395	0.0273	0.0579
	(0.3526)	(0.3720)	(0.3625)	(0.3850)
POPGROWTH	2.8405	3.1377	2.9967	3.3812
	(4.4247)	(4.6187)	(4.5409)	(4.7750)
POPULATION	0.0073	0.0077	0.0074	0.0079
	(0.0115)	(0.0116)	(0.0116)	(0.0117)
AMENITY	0.028	0.0266	0.0276	0.0246
	(0.0195)	(0.0209)	(0.0202)	(0.0217)
ETHANOLCOUNTY	0.0968			
	(0.0878)			
EHTANOLMULT		0.1029		
		(0.0616)		
NUMCOUNTY = 1	0.0919		0.0919	
	(0.0908)		(0.0908)	
NUMCOUNTY = 2			0.6544*	
			(0.2611)	
NUMMULT = 1				0.0849
				(0.0645)
NUMMULT = 2				0.389
				(0.2450)
NUMMULT = 3				1.1539
				(0.9395)
CONSTANT	0.0879	0.082	0.0843	0.0757
	(0.1847)	(0.1972)	(0.1912)	(0.2061)
No. of observations	8,540	8,540	8,540	8,540

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 14 Tests for Weak Instruments

	First-Stage F-statisic				Shea's partial R-squared			
	AVG GOV	AVG DISASTER	AVG LDP	AVG OTHER	AVG GOV	AVG DISASTER	AVG LDP	AVG OTHER
Model 33	51.8117				0.0068			
Model 34	50.7827				0.0066			
Model 35	51.8703				0.0068			
Model 36	50.8029				0.0066			
Model 37		19.2243	19.6474	4.41042		0.0005	0.0008	0.0005
Model 38		19.2422	19.3448	4.4462		0.0004	0.0008	0.0005
Model 39		19.3381	19.4176	4.40874		0.0004	0.0007	0.0005
Model 40		19.2433	18.9205	4.43782		0.0004	0.0007	0.0005
Model 41	15.2413				0.0028			
Model 42	16.0109				0.0030			
Model 43	15.3361				0.0028			
Model 44	16.0116				0.0030			
Model 45		22.5757	32.6694	12.7822		0.0002	0.0003	0.0016
Model 46		22.3208	32.1141	12.7300		0.0002	0.0003	0.0016
Model 47		22.5125	32.4543	12.7313		0.0002	0.0003	0.0016
Model 48		22.1617	31.6066	12.4979		0.0002	0.0003	0.0017

Table 15 Land Value Determinants: Robustness Check

	Model 49	Model 50	Model 51
CROP	1.3782*	0.8950**	0.8437**
	(0.5760)	(0.3416)	(0.3203)
LIVESTOCK	-0.2828	-1.0246	-0.9416
	(0.8304)	(0.7045)	(0.7279)
GOV	4.0838	156.6502***	
	(12.8794)	(32.5887)	
DP			211.4380***
			(55.2506)
CRP			186.1446
			(94.4096)
DISASTER			35.1403
			(443.7852)
LDP			291.0618
			(176.5233)
OTHER			272.7921
			(334.1481)
POPGROWTH	980.0605*	1297.1270**	1278.7534**
	(470.6745)	(397.3041)	(424.2238)
POPULATION	7.8384	6.0199	5.1241
	(6.5595)	(4.6243)	(4.1223)
AMENITY	2.7065	-0.951	-0.7856
	(2.5809)	(1.9434)	(2.4373)
DISTANCE	-0.2638**	-0.3366***	-0.3737***
	(0.0888)	(0.0730)	(0.0814)
CONSTANT	29.1216	-10.5071	-13.1047
	(16.0154)	(17.3324)	(20.7679)
No. of observations	152	152	152
R-squared	0.2563	0.3935	0.4148

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.

Table 16 Rental Rate Determinants: Robustness Check

	Model 52	Model 53	Model 54
CROP	0.0346**	0.0299***	0.0275**
	(0.0110)	(0.0081)	(0.0082)
LIVESTOCK	-0.0002	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)
GOV	0.6181*	4.4249***	
	(0.2866)	(0.5003)	
DP			6.0444***
			(1.1646)
CRP			3.9413*
			(1.6391)
DISASTER			13.8681
			(9.8103)
LDP			-3.1328
			(4.2435)
OTHER			8.7986
			(6.3934)
POPGROWTH	-7.6316	6.2444	3.3664
	(6.2282)	(4.8164)	(5.5149)
POPULATION	-0.0469	0.044	-0.0417
	(0.0636)	(0.0503)	(0.0708)
AMENITY	0.0239	-0.0481	-0.0507
	(0.0668)	(0.0488)	(0.0487)
DISTANCE	-0.0006	-0.0029**	-0.0039**
	(0.0016)	(0.0011)	(0.0013)
CONSTANT	0.5847*	-0.6846*	-0.7387
	(0.2510)	(0.2827)	(0.3781)
No. of observations	130	130	130
R-squared	0.3821	0.5780	0.5945

Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses. Coefficient estimates for *URBAN* (1-9) are not presented, but are negative and significant in all models. These coefficient estimates are available from the authors upon requests.