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Modeling the effect of off-farm income on farmland values: A quantile regression approach ☆

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ABSTRACT

Using the farm household as a unit of analysis and farm-level data, this study examines the impact of off-farm income on farmland values. In contrast to previous studies that assume a homogeneous relationship across the entire distribution, in this study quantile regression is used to estimate the empirical model. Results of this study show the effect of land attributes—captured by regional location and farm program payments; off-farm income on value of farmland can be better explained by estimating quantile regression across farmland value categories. Results indicate that a 1 percent increase in off-farm income could increase per-acre farmland value between 0.15 and 0.21%.

1. Introduction

The impact of off-farm income on farmland values is important in the market allocation of land between agriculture, urban, and environmental/amenity uses. In addition, the interaction between off-farm income and farmland values may have significant consequences for the sustainability of agriculture in the United States. From one perspective, off-farm income may enhance the economic sustainability of the farming operation, increasing the price that a farmer is willing and able to bid for farmland. Alternatively, increased income may produce an increased utility from the rural lifestyle (i.e., increase the demand for environmental amenities produced by farmland). Finally, the increased demand for farmland may be the result of portfolio/investment decisions.

Regardless of the reason behind the interaction between farmland demand and the availability of off-farm employment, the effect has significant implications for the economic sustainability of agriculture in the United States. In their 1940 text, Ely and Wehrwein (1940) inventoried the land resources in the contiguous United States and found that the majority of the nation's highly productive land is concentrated in the Corn Belt and Lake States. At the same time they concluded that the urban demand for farmland was relatively small. However, the situation changed before the beginning of the twenty-first century. While the area of highly productive farmland has expanded because of changes in technology and investment in infrastructure (i.e., irrigation projects), the rapid growth in population experienced in the United States after World War II coupled with a structural shift in the nature of urban demand for land (i.e., the rise of suburbs with larger lots and some distance from the city core) led to the emergence of urban sprawl as an important policy concern. In addition, some contend that the urban growth is not uniform, but is more heavily concentrated in areas of high quality farmland.

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While the recession of 2008–2010 weakened the housing demand in most regions reducing the rate of urban sprawl, a sustained recovery promises the reemergence of urban sprawl as a policy concern. However, urban pressure which increases the availability of off-farm employment may slow urban sprawl by increasing the demand for farmland by rural households. From an economic perspective, urban sprawl increases the opportunity cost of agricultural production reducing the viability of the sector. This effect may be magnified if urban demand competes for the most productive farmland. This effect of urbanization could be mitigated (at least in part) if urban pressure is accompanied by an increased willingness to pay for farmland due to increased off-farm employment opportunities. Therefore, the objective of this study is to examine the impact of off-farm income on farmland values in the United States.

2. Modeling farmland values

Two basic features of farmland have been largely neglected or at least highly stylized in recent literature: Heterogeneity and Immobility. In the words of Philip Raup:

> When we speak of the market for farmland, we invoke a terminology that invites comparison with other markets that are national in scope and include the stock market, the bond market, the grain markets, the markets for used cars, and the oil and gas markets. The key characteristics of markets other than farmland are the specific identification of what is being traded, and their portability.
> Shifting this terminology to the market for land introduces confusion. Land is site-specific. Although many tracts are similar and their values can be compared, they are still unique because they are immovable.
> This creates limitations on our ability to aggregate the values placed on specific parcels of land as revealed in market transactions. Much effort has been expended and much progress has been made specifying the characteristics of land that give it value (Raup, 2003, p.15).

Some of the efforts to adjust for the heterogeneity of quality include adjusting for quality variables and locational characteristics that among other factors can affect the agronomic capacity of farmland and factors affecting the potential of farmland for conversion to urban uses (Livanis et al., 2006). However, most of the empirical formulations are deeply rooted in the concept that a single market value of farmland exists based on a stylized (possibly hedonic) model of earnings capacity.

This article departs from the standard farmland valuation problem by assuming that each individual has a different value for a parcel of farmland depending on the characteristics of the farmer and his perception of the characteristics of the farmland. The characteristics of the farmland follow the standard common value model of Milgrom and Weber (1982). Hence, following the auction literature we would assume that the winning bid would converge to the standard single market value for farmland based on hedonic characteristics similar to Livanis et al. (2006)

$$B_i(a) = \frac{R_A(a)}{r} \tag{1}$$

where $B_i(a)$ is the single bid price resulting from an auction, R_A is return on assets, and a is the set of hedonic characteristics for that parcel of land, and r is a fixed interest rate. In this case, the heterogeneity of the sample of land is simply a function of the heterogeneity of the set of characteristics. However, in addition to differences in the hedonic characteristics of farmland, we also envision differences between the individuals bidding on the farmland. These differences involve differences in financial position (i.e., wealth) and lifestyle preferences (i.e., some individuals may desire a rural lifestyle). Labeling the differences in the characteristics across individuals as b, we rewrite the bid equation as

$$B_i(a,b) = \frac{R_A(a) + V(b)}{r(b)} \tag{2}$$

where $V(b)$ is the value individuals place on the rural amenities generated by the farmland, and $r(b)$ depicts the cost of capital as a function of the characteristics of the individual.

In developing these characteristics, the hedonic values of farmland include a host of soil characteristics such as the soil texture, cation exchange capacity, soil reaction, organic matter, T-Factor tolerance, water table depth, bulk density, permeability, salinity, drainage, soil depth, and percentage of three inch rocks used by Livanis et al. (2006). In this application, we replace these characteristics along with such concepts of crop choice and operating costs with the predicted cash flow elicited as a part of the survey. Other land specific factors are determined by historical participation in U.S. farm programs such as the conservation reserve program (CRP) and the level of direct and indirect payments (for more detail on each of these programs see Schmitz et al., 2010). Finally, the present study uses whether the land is located in a metro county and whether the county is characterized by the U.S. Department of Agriculture as a farming county as hedonic variables for urban pressure.

The characteristic of particular interest in this study is whether the farmer (or farm households) has off-farm income. From a financial perspective, farmers with off-farm income may be perceived as better credit risks. However, from a profitability perspective, farmers with off-farm occupations may sacrifice farm profitability under the terms of their off-farm employment. Finally, farmers with off-farm income may receive a portion of their return through rural amenities (i.e., value living the rural lifestyle).

Given that the bid structure presented in Eq. (2) does not yield a single value across individuals, we envision an auction framework such as the model of likelihood orderings proposed by Jewitt (1991). Further, the likelihood ordering approach supports the quantile regression framework explained in the empirical model section. The typical ordinary least squares (OLS) regression may not provide useful information for either farmland value range since it is based on the mean of the entire farmland value distribution. In contrast to the OLS regression, which describes the "average" shape of the data, the set of quantile regressions offers many shapes that better characterize the farmland value. Finally, there may be reason to believe that farmland attributes are not valued the same across a given distribution of farmland prices (Livanis et al., 2006).

3. Data

The data used in this analysis are from the 2004, 2005, and 2006 Agricultural Resource Management Survey (ARMS), Costs and Returns Report (CRR) version. The CRR version includes sample farm households that, when used with the sample weights, are designed to be representative of the U.S. farm operator household population. ARMS is USDA's primary vehicle for collecting and disseminating data on a wide range of issues about resource use and costs and farm financial conditions. Generally, it is used to gather information about the relationships between agricultural production, resources, and the environment. It also provides the data for the estimation of production costs and returns of agricultural commodities and in the measurement of net-farm income of farm businesses. Yet another aspect of the contribution made by ARMS is the information it provides on the characteristics and financial conditions of farm households, including information on management strategies and off-farm income. The target population of the survey is operators of farm businesses representing agricultural production in the 48 contiguous states. A farm is defined as an establishment that sold or normally would have sold at least $1000 in