AN EXAMINATION OF THE RELATIONSHIP BETWEEN CASH RENT AND NET RETURN TO LAND IN INDIANA

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Abstract:

This paper examined the relationship between cash rent and net return to land for Indiana. There was a significant and positive relationship between cash rent and net return to land for medium and high productivity land. The relatively low coefficients on lagged net return to land in the cash rent equations reinforce the existing literature that asserts that cash rent values are sticky. As a result, the recent decline in the net return to land in Indiana will not be fully realized for several years.

Introduction

Over the past four years, corn and soybean producers in the United States witnessed a dramatic decline in commodity prices. In 2012, the price of corn per bushel was $7.34 and the price of soybeans per bushel was $14.67 (USDA-NASS, *Agricultural Prices*, 2016). In 2015, the price for corn was $3.93 per bushel while the price for soybeans was $8.86 per bushel (USDA-NASS, *Agricultural Prices*, 2016). This denotes a price decline of 54 percent for corn and 60 percent for soybeans. Commodity prices for corn and soybeans are their lowest since 2006. Furthermore, low commodity prices will likely be the extended norm for the next five years (Office of the Chief Economist 2016).

Within the state of Indiana, the impacts of low commodity prices are particularly striking. In 2015, USDA estimated the value of Indiana corn production to be approximately $3.16 billion and the value of soybean production to be approximately $2.43 billion (USDA-NASS, 2015). Compared to 2014, these figures represent a 22 percent decrease in the value of corn production and a 21 percent decrease in the value of soybean production from approximately $4.07 billion and $3.08 billion for corn and soybeans, respectively. The declining crop production values have Indiana corn and soybean producers looking for ways to decrease their costs and improve their profitability.

Cash rent is a major production cost for producing corn and soybeans in Indiana. From 1990 to 2015, cash rent accounted for, on average, 25 percent of all corn production costs and 35 percent of all soybean production costs. As the profitability of corn and soybean producers continues to stagnate, it is presently unknown how cash rent values will change across Indiana. Due to the significance of cash rent as a major cost for corn and

soybean producers, it is vital that an effective metric exist for evaluating the potential impact of decreased net returns upon cash rent within the state of Indiana.

The objective of this paper is to examine the relationship between cash rent and net return to land in Indiana. At present, research analyzing the relationship between cash rent and net return to land within Indiana by land productivity category is limited. Quantifying this relationship across the entire state and by land productivity category would help farm operators in planning financial investments and other farm-related activities.

Model Overview

To provide clarity, the key terms frequently used within this paper are defined below.

Net Return to Land:

Crop Revenue per Hectare + Government Crop Payments per Hectare + Crop Insurance Proceeds per Hectare – Crop Costs per Hectare (excluding land).

Crop Revenue:

Commodity Price per Ton x Crop Yield (Metric Tons per Hectare)

Cash Rent:

The market price paid per hectare to rent farmland.

Insurance Payments:

Payments from insurance assuming an 80 percent revenue protection plan. The estimated payments use a predicted yield forecast to project crop revenue per hectare for the year.

Government Payments:

Per hectare payments from the U.S. federal government directly related to crop production.

Crop Costs:

The sum of per hectare costs related to fertilizer, seed, pesticides, dryer fuel, machinery fuel, machinery repairs, hauling, interest, utilities, general farm insurance, crop insurance, machinery ownership, and family and hired labor.

To quantify the relationship between cash rent and net return to land in Indiana, a simple econometric model is utilized. The model is as follows:

$$(1)\ R_t = f3_0 + f3_1 R_{t-1} + f3_2 NCL_{t-1} + f3_3 T + \mu_{1t}$$

where *t* is time period t, T is a time trend, R is cash rent, and NCL is net return to land. It is necessary to use lagged net return to land since when landowners are determining cash rent for the current year, the previous year's net return represents the most recent information. Additionally, lagged cash rent is a useful variable due to the sticky nature of cash rent values,

that is, landowners are unwilling to make large changes in cash rent annually. Although this is almost identical to the model utilized by Featherstone and Baker (1988), it improves upon their results by expanding the analysis from Tippecanoe County to the entirety of Indiana and adding a variable representing the time trend. This time trend, T, depicts the influences of unknown variables affecting the value of cash rent, thus improving the statistical accuracy of the model. This paper also improves upon previous work by running regressions using real values of cash rent and net return to land for low, medium, and high productivity land.

One of the issues that arises when using time series data sets such as those used in this paper is stationarity. An augmented Dickey-Fuller test can be used to check for the presence of a unit root. If a unit root is present, a time series is highly persistent and some of the assumptions associated with the estimation of equation (1) will be violated (Wooldridge, 2012). An augmented Dickey-Fuller test was conducted for each land productivity regression. If a unit root was discovered to be present, a first difference model was estimated. The first difference model can be expressed as follows:

$$(2)\ \Delta R_t = y_0 + y_1 \Delta R_{t-1} + y_2 \Delta NCR_{t-1} + v_t$$

Short-term and long-term adjustment coefficients are computed for each regression. The short-term adjustment coefficient is represented by the coefficient on lagged net return to land or the change in lagged net return to land, depending on whether a unit root exists. The long-term adjustment coefficient is computed by multiplying the coefficient on lagged net return to land (change in lagged net return to land if a unit root exists) by one minus the coefficient on lagged cash rent (change in lagged cash rent if a unit root exists).

Data

This paper utilizes a 50/50 corn/soybean rotation to compute net return to land for low, medium, and high productivity land. Crop revenue per hectare is calculated by multiplying the commodity price per ton for corn and soybeans by the metric ton per hectare yields for corn and soybeans. Data from USDA-NASS are used to determine commodity prices and yields for corn and soybeans.

The value of crop insurance indemnity payments for corn and soybean production is obtained from a model formulated by the authors. This model assumes producers utilize an 80 percent revenue protection plan. Government payments for corn and soybean production are obtained from three separate sources. The first source of data on government payments is from USDA-NASS and contains information on the total value of government payments made in each Indiana county from 1990 to 2002. This dataset includes government payments related to the Conservation Reserve Program (CRP). CRP payments (USDA-FSA) are

subtracted out of the total government payments to obtain the government payments for corn and soybeans used in this paper. The second source of data comes from Purdue's annual Crop Cost & Return Guides from 2003 to 2013 (Purdue Crop Guide Archive). The third source of data originates from ARC-CO government payments related to corn and soybean production for each county in Indiana for the years of 2014 and 2015 (USDA-FSA).

Crop production costs for corn and soybeans from 1990 to 2015 are simulated with the 2015 Purdue Crop Cost & Return Guide (Dobbins et al., 2015) and USDA price indices (USDA-NASS, *Agricultural Prices*). To account for seeding rate changes in corn production over time, an index is created using data from USDA-NASS on corn plant populations per hectare in Indiana.

The dataset used to determine the value of cash rent from 1990 to 2015 within the state of Indiana originates from the Purdue Agricultural Economics Report (Purdue Agricultural Economics Report, Land Values Archive). This report aggregates cash rent data for different qualities of land by region in Indiana.

Finally, the GDP implicit price deflator is used to compute real cash rents and net returns to land by productivity category. The last year of the dataset, 2015, is used as the base year for these computations.

Table 1 presents real gross revenue, production cost, cash rent, and net return to land per hectare for the three land productivity categories. Other income includes government payments and crop insurance indemnity payments. Crop revenue comprises approximately 89 percent of gross revenue for low productivity ground, and 91 percent of gross revenue for medium and high productivity ground. Machinery cost includes fuel, repairs, and ownership costs. Labor cost includes family and hired labor. Miscellaneous cost includes dryer fuel, utilities, hauling, interest, general insurance, and crop insurance. Earnings per hectare, obtained by subtracting cash rent from net return to land, is also presented in the table. Earnings per hectare are negative for each land productivity category indicating that over this time period not all cash and opportunity costs were covered.

Net return to land was considerably more variable than cash rent over the time period. The coefficient of variation (computed by dividing the standard deviation by the mean) for the net return to land for low, medium, and high productivity land was 0.55, 0.51, and 0.44, respectively. In contrast, the coefficient of variation for cash rent for low, medium, and high productivity was 0.14, 0.19, and 0.19, respectively. These coefficients of variation suggest that movements in the net return to land and cash rent are not one to one (i.e., a $1 movement in net return to land does not necessarily correspond with a $1 movement in cash rent).

Table 1. Average Gross Revenue, Production Costs, Cash Rent, and Net Return to Land in Indiana.

	Low Productivity	Medium Productivity	High Productivity
Gross Revenue (per hectare)			
Crop Revenue	1,045	1,160	1,264
Other Income	124	104	115
Production Costs (per hectare)			
Fertilizer	180	190	199
Seed	122	129	134
Pesticides	91	91	91
Machinery	265	265	265
Labor	97	97	97
Miscellaneous	134	141	148
Cash Rent and Net Return to Land (per hectare)			
Net Return to Land	280	351	445
Cash Rent	299	391	459
Earnings	-19	-40	-14

Results and Discussion

The results of the econometric models are presented in table 2. These results indicate a significant and positive relationship between cash rent and lagged net return to land. The coefficients on lagged net return to land range from 0.0502 for low productivity land to 0.1038

for medium productivity land. The lagged cash rent coefficients are positive and significant for each land productivity category. The relatively larger coefficient for the high productivity land suggests that cash rent is more persistent for this land productivity category. The time trend was also positive and significant for each land productivity land.

The augmented Dickey-Fuller tests (Z statistic in table 2) indicate that a unit root is present for all three of the land productivity regressions in table 2. The first difference results are presented in table 3. The coefficients on the first difference of lagged net return to land range from 0.024 to 0.076. However, the F-statistic for low productivity land is not significant. The 0.076 and 0.074 coefficients on lagged net return to land for medium productivity land and high productivity land indicates that a $100 change in net return to land results in a $7.60 and $7.40 change in the subsequent year's change in cash rent, respectively, for medium and high productivity land. The coefficient on lagged cash rent is

significant for high productivity land. This coefficient indicates that a $10 change in lagged cash rent results in a $7.70 change in the subsequent year's cash rent.

The short-term and long-term adjustment coefficients in response to a change in net return to land are presented in table 4. The short-term adjustment coefficient in table 4 represents the coefficients on lagged net crop returns in the regressions illustrated in table 3. The short-run adjustment coefficient for low productivity land is not shown in table 4 because the coefficient on lagged net return to land for this land category was not significant in table 3. The long-term adjustment coefficients are computed using the regression coefficients on the lagged net return to land and lagged cash rent coefficients. The coefficients depicting long-term cash rent adjustments are only shown for the cases in which the coefficients related to lagged net return to land and lagged cash rent in table 3 are significant.

The short-term adjustment coefficient for medium productivity land category was 0.076. Using the short-term adjustment coefficient, a $100 drop in net return to land would result in a $7.60 drop in cash rent in the subsequent year. The coefficient on lagged cash rent for the medium productivity land category is insignificant. As result, the long-term impact on the medium quality land category is unknown.

Table 2. Cash Rent Model Results by Land Quality Category.

Variable	Low Productivity	Medium Productivity	High Land Productivity
Intercept	36.73**	19.55**	3.01
NRL_{t-1}	0.0502***	0.1038***	0.1010***
R_{t-1}	0.5335***	0.7078***	0.8513***
Time Trend	1.0891***	1.0166***	0.6855***
F(3,21)	65.29	179.01	339.06
Prob > F	0.0000	0.0000	0.0000
Adjusted R^2	0.889	0.957	0.977
Z(t)	0.044***	0.141***	0.915***

Note: * depicts 10% significance level; ** depicts 5% significance level; and *** depicts 1% significance level

Table 3. First Difference Cash Rent Model Results by Land Quality Category.

Variable	Low Productivity	Medium Productivity	High Land Productivity
Intercept	2.377	2.556	0.723
Δ NRL_{t-1}	0.024	0.076***	0.074***
Δ R_{t-1}	-0.126	0.287	0.771***
F(2,21)	1.03	6.62	17.47
Prob > F	0.3731	0.0059	0.0000
Adjusted R^2	0.003	0.589	0.589

Note: * depicts 10% significance level; ** depicts 5% significance level; and *** depicts 1% significance level

Table 4. Short-Term and Long-Term Adjustment Coefficients in Response to a Change in Net Return to Land.

Time Frame	Low Productivity	Medium Productivity	High Land Productivity
Short-Term	N/A	0.076	0.074
Long-Term	N/A	N/A	0.323

N/A = not applicable (i.e., regression coefficients were not significant)

For the high productivity land category, the short-term and long-term adjustment coefficients are 0.074 and 0.323. Using the short-term adjustment coefficient, a $100 drop in net crop returns would result in a $7.40 drop in cash rent in the subsequent year, which is very similar to the drop for medium productivity land. The long-run coefficient indicates that a permanent drop of $100 in net return to land would result in a drop of $32.30 in cash rent for the high productivity land category. Using the coefficients on short-term and long-term adjustment coefficients for high productivity land, only 23 percent of the total adjustment in response to a drop in net return to land occurs in the first year.

Conclusions and Implications

This paper examined the empirical relationship between cash rent and net return to

land in Indiana. The results indicate a positive relationship between cash rents and net return to land. The low F-statistic exhibited for the low productivity land regression indicates that factors other than net lagged net return to land and lagged cash rent drive the value of cash rent for low productivity land in Indiana. The relatively low coefficients for lagged net return to land in the regressions for medium and high productivity land suggest that cash rent values are sticky, that is landowners are unwilling to make large changes in annual cash rent. Using the coefficients on lagged net return to land, a $100 drop in net return to land would result in a drop in the subsequent year's cash rent of approximately $7 to $8 for medium and high productivity land. The significant coefficient on lagged cash rent for high productivity land suggests that the impact of a drop in net return to land would have a long-term impact on cash rent for high productivity land.

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