DO COMMODITY PRICES AFFECT AGRICULTURAL LAND VALUES? IF SO, HOW MUCH?

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Abstract
This paper examines the effect of agricultural commodity price on farmland values using county-level data from Southern Wisconsin. We assembled a unique transaction level dataset that includes farmland sale price, land use information, milk and corn prices and agricultural lending rates. A hedonic price model is used to assess the effect of each of these factors on farmland values. Our results indicate that milk and corn prices have significant but opposite effects on farmland values over the relevant period. Land use, agricultural lending rates and location (county) also impact the value of land.

Introduction

Land is an important asset that impacts producer returns in a variety of ways- capital appreciation, revenue from rent, and income from farming operations (Drescher et al, 2001). The value of agricultural land also influences farm and industry decisions including the decision to own or rent, farm expansion and succession plans, and how much value can be put on land for accounting and lending purposes. While land values traditionally appreciate, there are fluctuations in values that may be linked to factors such as commodity prices which in turn affect producer returns. Commodity prices are volatile and susceptible to a myriad of both local and external factors. If there is a strong and significant linkage between commodity prices and land values, it can expose the agricultural industry to additional vulnerabilities resulting from commodity price decreases and the associated reductions in net farm incomes (Henderson, 2008). Farm real estate is the single largest investment in portfolio of most farmers and the risk posed by commodity price changes is exacerbated if they occur for both input and outputs (Zhang and Irwin, 2014). . Landowners in regions with a higher concentration of livestock production may be particularly susceptible to this dual effect given their dependence on agricultural commodities such as feed crops as inputs. However, despite the potentially important role of agricultural commodity prices on land values, research on the direct effects of commodity prices is limited. To the authors knowledge, the specific focus on livestock dominated agricultural economies has not be done previously. The objective of this paper is to determine the impact of agricultural commodity prices on farmland values. We also assess whether the size of the effects has changed over time. Given the objectives of this study, we focus on six counites in Southern Wisconsin[1]. The choice of Southern Wisconsin is informed by the importance of both dairy and crop sectors (USDA NASS 2017). Considering, the recent trends in the price of key agricultural commodities and the impact it has had on the rural

[1] Wisconsin's agriculture is dominated by the dairy industry, milk from cows made up 45.1% of all the value of agricultural products in Wisconsin in 2019

farm economy in Wisconsin, understanding the effect of commodity prices on land values can provide useful insights to stakeholders (farmers, appraisers, lenders or crop insurers) interested in understanding the factors that influence land values and the changes in these factors over time.

Literature Overview

Agricultural land values are influence by a variety of factors (Herdt and Cochrane 1966; Chicoine, 1981; Drescher et al, 2001; Plantinga et al, 2001; Karakayaci, 2015; Xu and Mittlehammer 1993) Previous work highlights the effect of urbanization and proximity (location) to urban on land values (Chicoine,1981; Drescher et al, 2001; Plantinga et al, 2001; Karakayaci, 2015; Bastian and McLeod, 2001). Other studies have focused on intrinsic land attributes (such as soil productivity, slope of land surface, size) and farm level economic indicators such as net farm returns (Xu et al., 1993; Vasquez and Nelson 2002) Vasquez and Nelson (2002) found that factors such as soil productivity positively impacted the value of land whilst the presence of a slope negatively influenced farm land values. Xu et al., (1993) reported that permanent land improvements positively impacted the value of land. Other factors such as agricultural zoning regulations, seller characteristics (Stewart and Libby 1998) and wildlife (Bastian and McLeod 2001) have also be shown to influence farmland values. In relation the latter, (Bastian and McLeod 2001) reported that the presence of elk had a negative impact on the value of farmlands in Wyoming. Farm economic factors such as net returns, commodity prices and input cost also influence the value of farmland although magnitude of the effect differs depending on the context (Vasquez and Nelson 2002; Adelaja et al., 1998; Branhart, 2014). Adelaja et al., (1998) examined the role of land value in the decline of the dairy industry in the tri-state area. Ahrendsen et al., (2013) identified interest rate amongst a set of covariates considered, as having the most important negative effect on crop land values. Perhaps most relevant to the present study is the report by Barnhart, (2014) which found that corn and soybean commodity prices, interest rate and 10-year US treasury born rate

impacted Kentucky and Iowa farmlands. This study extends the literature on farmland values by examining the case of five selected counties in Wisconsin (Figure 1).

Figure 1: Map of Wisconsin showing with yellow highlights, counties included in the study (Grant County, Iowa County, Lafayette County, Rock County, Jefferson County, and Walworth County) (Source: Wisconsin Department of Transportation).

Methods

Based on previous studies (Branhart, 2014; Eisenhuer and Mitchell, 2011) we hypothesized that the value of land in a given transaction is determined by factors such as: characteristics of the parcel (e.g. land uses – e.g. cropland, pasture, woodland, wetland), farm economic factors (e.g. commodity prices) and non-farm economic factors (e.g. agricultural lending rates). This framework that attempts to determine the transactional value of a good (in this case land) based on its attributes and other factors is amenable to the application of hedonic price models (Monson, 2009). The farmland value function estimated in this study is specified as:

$$farmlandprice = F[landuse, commodityprices, interestrate]$$

where $farmlandprice$is farmland price ($/acre), $landuse$ is the land use of the parcel. Based on information for the transaction records, six types of land uses were identified- $cropland, pastureland, wetland, woodland, water\ area, developed\ area.$ These variables are included in the hedonic model as a proportion of the overall acreage in a given transaction that can be allocate to a specific use. $Commodityprices$ denote agricultural commodity prices. We consider two commodity prices i.e. the price of milk ($/cwt) $[Mk_p]$ and the price of corn ($/bu) $[C_p]$. We also included the average annual agricultural real-estate interest rate (%) $[AgIR]$ as a measure of $interestrate$. Year and county identifiers were used to capture differences between counties land markets and time-specific effects.

Data

Data were obtained from a variety of sources. Commodity price data were obtained from the National Agricultural Statistics Service of the United States Department of Agriculture. Data on the farmland transactions were obtained from the Transfer Return Database maintained by the Wisconsin Department of Revenue. The farmland transaction data included information on the total acres sold, parcel identification, year sold, and price of the sale. Using parcel information, data on land use from WISCLAND DATABASE maintained by the Wisconsin Department of

Natural Resource could be linked to each transaction. The average annual agricultural real-estate interest rate data were obtained from the Federal Reserve Bank of Chicago. Table 1 is a summary of descriptive characteristics by county. Over the relevant period, land values were highest in Walworth county and lowest in Grant county. Agricultural commodity prices tended to be comparable across the counties. This is not unexpected considering the close proximity of the counties. The mean of agricultural lending rates ranged from 5.29-7.14%. the most common land use was crop production followed by pasture. In contrast, water land used was least in all counties.

Table 1: Estimates of mean and standard deviations of variables by county

Variable	Definition of variables	County					
		Grant	Iowa	Jefferson	Lafayette	Rock	Walworth
Farmland price	price per acre	$3998.11 ($2572.03)	$5440.27 ($5540.72)	$4833.37 ($2218.59)	$4833.37 ($2218.59)	$4839.26 ($2470.67	$6936.19 ($9506.73)
Commodity prices							
Milk	price received, measured in $ / cwt	$18.46 ($2.72)	$16.67 ($2.35)	$18.30 ($2.77)	$18.30 ($2.77)	$17.42 ($2.61)	$17.61 ($2.47)
Corn	price received, measured in $ / bu.	$4.28 ($1.15)	$3.64 ($1.35)	$4.43 ($1.26)	$4.43 ($1.26)	$5.01 ($1.47)	$4.30 ($1.80)
Lending rate							
Agriculture real-estate interest	average agricultural real estate loan interest rate	5.30 (0.76)	5.78 (0.87)	5.29 (0.72)	5.29 (0.72)	5.95 (0.64)	6.11 (0.79)
Land use							
Cropland	in acres	13.07 (14.99)	5.09 (9.54)	25.28 (17.90)	20.88 (18.63)	72.27 (62.88)	45.89 (59.20)
Pastureland	in acres	11.23 (13.99)	13.06 (15.33)	6.54 (9.16)	13.77 (13.74)	7.25 (14.34)	8.96 (16.40)
Woodland	in acres	15.44 (17.09)	17.56 (16.22)	2.34 (4.18)	7.26 (13.26)	5.45 (13.55)	5.88 (17.21)
Wetland	in acres	0.44 (3.02)	2.38 (9.82)	9.06 (14.58)	1.02 (6.03)	3.14 (11.87)	2.70 (7.02)
Water area	in acres	0.11 (1.03)	0.03 (0.11)	0.37 (1.84)	0.03 (0.29)	0.63 (3.98)	0.04 (0.30)
Developed area	in acres	0.56 (1.49)	0.46 (1.24)	1.42 (3.57)	0.18 (0.60)	2.11 (4.46)	2.62 (5.97)

Estimation Results

The results of the regression analysis are presented in Table 2. pasture land and Grant county[2] were selected as the reference (base) county and land use and the estimated coefficients are interpreted relative to this reference point[3]. In general, the results indicate that commodity price, agricultural lending rates, selected land use attributes and location impacted the value of land across time. As compared to a parcel of pasture land in Grant county: developed land was higher (by about $24,300), and wetland had a lower value (by about -$3100). Farmlands located in Walworth and Iowa country tended to be valued higher, $3,300 and $2400 per acre respectively. We also find that a unit increase in agricultural leading rates reduced farmland values by about $1313. Consistent with the income capitalization framework, the negative effect lending rate is not unexpected as it represents the cost of capital to acquire farmland. With respect to the effect of agricultural commodity prices, the results indicate that both milk and corn prices do in fact have a significant effect of farm land values. The effects are however opposite. Whilst a one dollar increase in corn price resulted in a decrease of ~$1300 in land values, a unit increase in milk prices led to an increase of $895. These contrasting effects may be due to the fact that dairy production is a predominant agricultural activity in this area. Higher corn cost leads to higher feed cost and lower net incomes and indirectly influences land values. Milk prices on the other hand are associated with higher net incomes.

The base land use was pasture land. Compared to pasture, cropland is estimated to have a higher value, although the estimated coefficient was not significant. However, woodland and wetland had lower estimated value per acre. The significance of the of time dummies capture changes in economic environment and farmland market over the years that are not accounted for by other time variant regressors included in the model.

[2] Land values tended to be lowest in Grant county and is furthest away from major urban centers such Madison (Dane county)

[3] A value of approximately $5325

Table 2: Hedonic Price Estimates of the determinants of farmland values

	Variable	Coef.	std. Err.	t	P>|t|	[95% Conf. Interval]	
	Intercept	1473.50	3864.38	0.38	0.703	-6119.61	9066.61
Land use	*Cropland*	484.52	748.22	0.65	0.518	-985.65	1954.70
	Woodland	-740.43	883.89	-0.84	0.403	-2477.18	996.31
	Wetland	-3107.835***	1128.91	-2.75	0.006	-5326.03	-889.64
	Water area	7367.20	7206.86	1.02	0.307	-6793.55	21527.95
	Developed	24258.42***	3842.67	6.31	0.00	16707.96	31808.88
County	*Iowa*	2401.35**	1047.93	2.29	0.022	342.27	4460.43
	Jefferson	699.55	589.20	1.19	0.236	-458.17	1857.27
	Lafayette	756.46	608.12	1.24	0.214	-438.44	1951.35
	Rock	903.05	612.16	1.48	0.141	-299.79	2105.88
	Walworth	3286.836***	818.88	4.01	0.00	1677.83	4895.84
Lending rate	*Agriculture interest rate*	-1313.075**	535.79	-2.45	0.015	-2365.85	-260.30
Commodity prices	*Milk price*	895.64***	362.98	2.47	0.014	182.43	1608.85
	Corn price	-1332.92***	537.62	-2.48	0.014	-2389.29	-276.54
Year	*2003*	-4592.58***	1572.21	-2.92	0.004	-7681.81	-1503.34
	2004	-1058.38	1242.43	-0.85	0.395	-3499.63	1382.87
	2006	2868.37	1746.97	1.64	0.101	-564.24	6300.98
	2008	-1328.28	1067.80	-1.24	0.214	-3426.40	769.84
	2009	1584.15	1433.33	1.11	0.27	-1232.20	4400.49
	2010	1719.66	1091.29	1.58	0.116	-424.62	3863.94
	2011	495.72	738.54	0.67	0.502	-955.43	1946.86
	2013	-3297.972*	1719.91	-1.92	0.056	-6677.42	81.47
	2014	-8945.588***	3490.21	-2.56	0.011	-15803.50	-2087.68
	2015	-3241.69**	1532.83	-2.11	0.035	-6253.54	-229.83
	2016	-1772.69	1265.06	-1.4	0.162	-4258.40	713.03
	2017	-2363.66	1527.28	-1.55	0.122	-5364.61	637.30
N	508						
F(25,482)	4.62 (P-value=0.00)						
R^2	0.19						
Root MSE	3694.40						

NB: Data from 2003-2018, some years omitted to avoid collinearity

Conclusions

Agricultural commodity prices impact farm incomes and the general health of many rural economies dependent on agriculture. Farmland is an important asset the valuation of which is closely linked to net incomes which are in turn dependent on commodity prices. While most studies

look at the role of farmer net incomes/sales on farmland values (e.g. Drescher et al., 2001;), few have attempted to decompose this effect in order to identify the constituent commodity price effects (e.g. Branhart, 2014). However, given the perennial volatility in commodity prices understanding the direct impact of commodity prices on land values is important. The present study examined the impact of agricultural commodity prices in six counties in Wisconsin. Our results suggest that commodity prices significantly impacted the value of land in the relevant counties. The direction and size of the effect however seems to be contingent on the type of commodity and the dominant land use. In the present study, milk price, given the preponderance of milk production in the study area, had a positive effect on land values whilst the effect of corn price was negative. The latter however had larger effect as cropland use was the most common form of land use in the study area. The link between commodity prices and farmland values identified in this study suggests that landowners face substantially vulnerability in periods of commodity price busts especially if they are accompanied by input price booms. The identified links between commodity prices and land values suggest that commodity price support policies can have important impacts on land values and holdings (Kropp and Peckhman, 2012). The role of capitalized policy benefits was however not addressed in this study. In general, the type of land use characteristics of a parcel of land seems to have a larger impact of land values. For example, relative to pastureland, developed land commanded a premium of ~ $24,300. In contrast, wetlands were discounted perhaps suggesting that the need to meet regulatory requirements or the cost of developing land for agricultural purposes is capitalized into land values. Considering the relevance of land use identified in this study, policy makers need to mindful of the implications this may have conversion of land from low to higher value uses. These also present opportunities for land owners to capture the value of permanent improvements/development of farmlands (Xu et al., 1993). Agricultural lending rates, location (county) and time effects were also significant.

Our results on the role of commodity prices are consistent with Branhart (2014) and supports the role of sales/net incomes identified in other studies (e.g. Drescher et al., 2001; Vasquez and Nelson 2002) The negative effect of agricultural lending rates is supported by Eisenhuer and Mitchell, (2011)and Ahrendsen et al., (2013). Future extensions of the present work will incorporate soil characteristics and other relevant land market factors.

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