International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
Vol. 4 No. 2, 2016, pp. 11-24

THE FARMLAND VALUATION REVISITED

Xin Li
Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign; 1301 W. Gregory Dr., Urbana IL 61801, USA
E-mail: xinli4@illinois.edu

Abstract

Empirical research is scarce concerning the dynamics of farmland markets which inspire the decision to sell farmlands. This paper explores the real option to postpone the sale of land in farmland valuation. In this article, a real options approach is used to analyze farmland prices behavior using historical cash flow and land price information for Illinois. In general, rising farmland values are primarily dependent on agricultural commodity prices and interest rates. Results suggest that uncertainty about future growth and capital gains is a significant component of farmland market value. Furthermore, this research examines several shift factors of the option value of the state's farmland by taking into account of uncertainty to improve the analysis of farmland market values.
Keywords: *Cash rent, farmland value, present value, real options, uncertainty.*
JEL Codes: G12, Q15

1. Introduction

Farmland occupies a uniquely important role in the performance of the agricultural sector. Farm real estate accounts for 85% of the total value of all farm assets and serves as the primary source of collateral in production loans (Nickerson et al., 2012). The recent unusual appreciation of farmland market values in the central corn-growing region of the United States has drawn considerable interest and concern among both investors and analysts. For example, both Iowa and Illinois cropland values increased 8.2% annually between 2005 and 2010 (Schnitkey & Sherrick, 2011). Soaring farmland values have generated considerable attention among researchers and practitioners, and given rise to questions about whether current farmland prices are reasonable and the farm sector is headed for a repeat of the farmland value bubble that collapsed in the 1980s. Rising land values, cash rents, and the other costs of production could limit profits and raise risk profiles. The problem of increasing land values can be especially critical for farm managers today, because many in the farm sector are questioning the ability of farm income to support current land costs at relatively "normal" agricultural commodity prices. Thus, the main purpose of this paper is to understand the market behavior of farmland and the drivers of both the agricultural and non-agricultural components of farmland values.

One implication of this study is that the farmland "bubble" may not exist or soon deflate if it indeed exists, particularly given that the land value is primarily dependent on agricultural commodity prices and interest rates. Therefore, the current farmland market is not showing the same pattern as the farmland bubble of the late-1970s. In addition, changes of the dynamics can affect farmers' decision and its timing to sell farmlands. Results have important social policy implications in debating issues including speculation, government subsidies, credit risk, land use, ownership, tax treatment, and market efficiency.

2. Literature Review

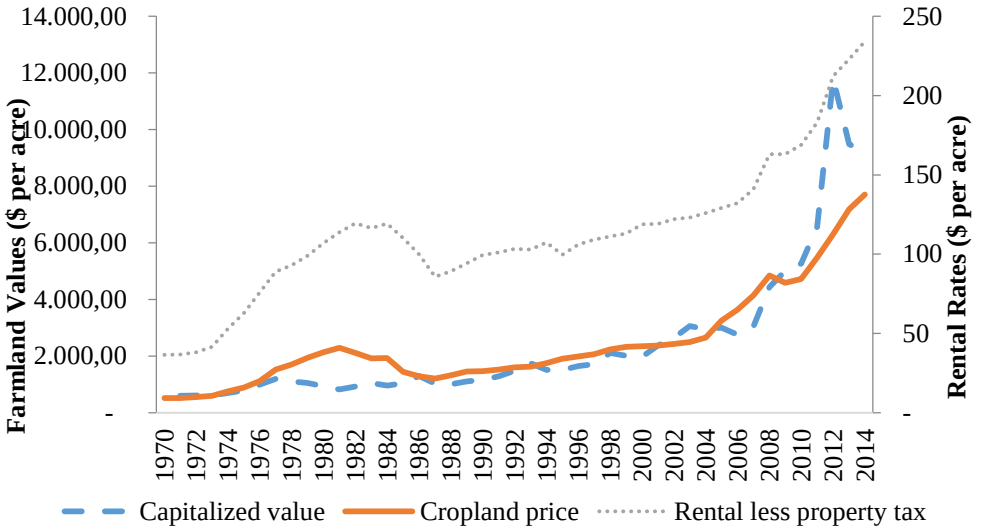
There is a long and rich history leading to the development of empirical models to explain the structural changes and other characteristics of farmland markets. One strand of the literature provides a portfolio model by developing a theoretical link between farmland markets and capital markets (Barry, 1980; Feldstein, 1980; Kaplan, 1985; Arthur et al., 1988; Irwin et al., 1988; Lins et al., 1992; Libbin et al., 2004; Noland et al., 2011; Sherrick, 2011). Another strand of the literature lies in the primacy of the Present Value Model (PVM) in land economics (Melichar, 1979; Castle & Hoch, 1982; Robison et al., 1985; Burt, 1986; Ay & Latruffe, 2013). The PVM suggests that the value of the land is determined by the discounted present value of returns expected from the land.[1] A diversity of opinion arises, however, with the attempt to identify the underlying relations between land prices and economic fundamentals. In the real estate context, influence factors can be estimated from rental yields (where farmland is considered in a similar vein to real estate, stocks and other financial assets) or based on a hedonic regression of actual prices on a set of demand and/or supply variables (Klinefelter, 1973; Palmquist & Danielson, 1989). In agricultural economics, agricultural production variables drive the farmland price and, in some cases, exogenous urban variables and returns to future land development are introduced as shift factors in the analysis of agricultural land market (Capozza & Helsley, 1990; Plantinga et al., 2002; Nickerson et al., 2012; Borchers et al., 2014).

The traditional PVM provides a straightforward approach to view the economic fundamentals of farmland values and is widely accepted by many appraisers and researchers. However, one of the key elements largely ignored in the land capitalization formula is the impact of uncertainty on land prices. For instance, neither the portfolio model nor the econometric land price models adequately explain the farmland price puzzle caused by a persistent wedge between capitalized values (what is believed to be economically rational by the present value model) and actual prices (see Figure 1). Furthermore, Clark et al. (1993) show that land prices and land rents do not have the same time-series representations, a necessary condition for the simple capital asset pricing theory to hold. It suggests that a fundamental rethinking of the way in which land prices are viewed and modeled is needed. More complex models are needed that can allow for rational bubbles, risk aversion, and future shifts in government policy or/and commodity price volatility, etc.

The validity of the wedge depends on the opportunity cost and speculative behavior in farmland in addition to the fundamental farm income generated from the production process. Many economists have written about "irrational exuberance" and "self-fulfilling" speculative price bubbles (Shiller, 2005). Among the rich literature of the contribution of speculative bubbles to farmland prices, little evidence is found to reject the hypothesis that market fundamentals determine farmland prices based on approaches such as stationary tests, cointegration tests and vector autoregression (Tegene & Kuchler, 1990; Featherstone & Baker, 1987; Falk, 1991). Furthermore, since the conventional land capitalization model includes growth expectations, then bubbles can arise only from speculation that actual growth will exceed expected growth. If conventional approaches are not sufficiently robust to explain the movements of actual farmland price, then there

[1] One measure of the return attributed to land is the rent a tenant would pay for the exclusive right to the output produced from the land and bears all the risk inherent in the farming operation (Ricardo & Hartwell, 1971). The cash rent is therefore considered a certainty equivalent income for the use of land, or the return from the land.

is a need to explore a more robust theory of asset valuation in line with characteristics of farmland transaction and market expectations.



Data Source: TIAA-CREF Center for Farmland Research

Figure 1. Capitalized Values vs. Cropland Prices, 1970-2014

Farmland transaction encompasses a broad and important spectrum of management decisions. For this reason, option should be an important factor in decision-making because selling decisions can be delayed based on future expectations. Turvey (2003), for instance, argues that hysteresis or fad is a component of farmland pricing, and that price bubble can arise if the owner of land postpone sales in the hope of increasing capital gains and real wealth, so that demand exceeds supply.[2] Taking into account the inertia effect could improve the results of policy impact analysis. A growing literature has shown that real-option approach has an explanatory potential for observed experimental investment/disinvestment behaviors (Musshoff et al., 2012; Maart-Noelck & Musshoff, 2013; Tubetov et al., 2013). Despite extensive testing of option-pricing models for financial assets as well as real assets, virtually no research has addressed the empirical implications of option-based valuation models for farmland. To evaluate the value of waiting for incoming information in tune with real-option reasoning can lead to better understanding of optimal entrepreneurship characteristics and farmland management strategies.

3. Model

The theoretical model is a general infinite horizon continuous time model that in form most closely resembles Dixit and Pindyck (1996) and Turvey (2003). In essence, the model proposes that the difference between market values and fundamental values is a problem of

[2] An action has option value if it can be delayed, if uncertainty about future returns exist, and if waiting will resolve some of the uncertainty. Selling a farmland is an irreversible act that generally can be delayed in the hope that the uncertain situation will improve. The decision's option value creates stickiness in the adjustment process towards long run equilibrium.

the optimal timing of a market transaction given uncertainty about future values of the asset, which can be specified as:

$$\mathrm{V}_\mathrm{t}^* = V(\pi_t) + F(\pi_t^*) = \frac{\pi_t^*}{r-\alpha} + \mathrm{F}(\pi_t^*), \tag{1}$$

where V_t^* is the market price for farmland, $V(\pi_t)$ is the present value of cash flow, $F(\pi_t^*)$ is the option to future capital gains under uncertainty, π_t^* is a rational expectation of cash flows generated from the land,[3] α is the anticipated growth rate in cash flow, and r is an appropriate discount rate. The present value structure has been tested quite extensively in the agricultural economics literature that $V_t^* = \frac{\pi_t^*}{r-\alpha}$.

Assume that cash flows evolve randomly over time according to the Brownian motion,

$$d\pi = \pi[\alpha dt + \sigma dz], \tag{2}$$

where z is a standard wiener process, and σ is the volatility of cash flow as measured by the standard deviation of its percentage change. Then by Ito's lemma the value of farmland will evolve stochastically according to:

$$dV(\pi) = \frac{\pi}{r-\alpha}[\alpha dt + \sigma dz]. \tag{3}$$

Given that $V(\pi)$ fluctuates with π, which is the stochastic variable, the option value $F(\pi, t)$ is given by the following Bellman equation:

$$F(\pi, t) = E[F(\pi, t) + dF(\pi, t)]e^{-rdt}. \tag{4}$$

Then by Ito's lemma using the fact that $1 - \mathrm{rdt} \equiv \mathrm{e}^{-\mathrm{rdt}}$:

$$\frac{1}{2}\sigma^2\pi^2\frac{\partial^2 F}{\partial \pi^2} + \alpha\pi\frac{\partial F}{\partial t} - rF = 0. \tag{5}$$

Setting $\frac{\partial F}{\partial t} = 0$ provides the stochastic differential equation used to solve for the real option price $F(\pi)$. Note that $F(\pi) \neq F(\pi, t)$. To obtain this solution, three boundary conditions are added:

$$F(0) = 0; \tag{6}$$
$$F(\pi^*) = V(\pi^*) - V(\pi); \tag{7}$$
$$F'(\pi^*) = V'(\pi^*). \tag{8}$$

Condition (6) says that if cash flows are zero the option will be zero. Condition (7) is a value matching condition. It says that at some level of cash flow π^*, the right hand side of equation (7) gives the capital gain when the trigger is reached. Condition (8) is the smooth pasting condition. It says that the optimal time to sell occurs for some π^* such that the incremental gain in options value exactly equals the incremental gain in net present value.

The solution to (5) is:

[3] Future returns expected to accrue to farmland often are proxied by cash rents.

$$F(\pi^*) = A\pi^{*\beta}, \tag{9}$$

where $A = \frac{\pi^*}{(r-\alpha)\beta\pi^{*\beta}}$, $\beta = \frac{1}{2} - \frac{\alpha}{\sigma^2} + \sqrt{\left(\frac{\alpha}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}}$, and $\pi^* = \frac{\beta}{\beta-1}(r-\alpha)V(\pi)$. $F(\pi^*)$ is the current value of an option to postpone the sale until π rises to π^*.

4. Data

The information of Illinois farm cash rental rates from 1970 to 2014 are originated from Farm Business Farm Management (FBFM) records, a farm accounting and financial consulting service operated as a cooperative in Illinois. The return to farmland varies depending on whether the farmland is owned, share rented, or cash rented. If farmland is cash rented, the cash rent represents the return to the land ownership. Future returns expected to accrue to farmland often are proxied by cash rents.[4] The source of the farmland market values data is the TIAA-CREF Center for Farmland Research.

Prime interest rates are represented by the yields on 10-year Constant-maturity Treasury Notes, which are obtained from the Federal Reserve Bank of St. Louis. Real GDP, annual returns on investment in S&P 500 and Case-Shiller U.S National Home Price Index are incorporated in the model as proxies for macroeconomic conditions. Records of government subsidy payments are obtained from the Environmental Working Group's Farm Subsidy Database released by the US Department of Agriculture. Rates of inflation are calculated using the Consumer Price Index published by the Bureau of Labor Statistics. Since the analysis requires agricultural commodity price volatility data which are difficult to examine for a long sample period,[5] I define absolute values of yearly percentage price change, called simple commodity price volatility, as $\mathrm{CPV} = \log \mathrm{P_t} - \log \mathrm{P_{t-1}}$. These are computed by using weighted Illinois cash prices of corn and soybean.[6] The debt to asset ratio measures the proportion of assets owed to creditors to cover outstanding debt obligations reported by the USDA Economic Research Service. Annual Illinois precipitation data are obtained from the State Climatologist Office for Illinois. CredAbility Consumer Distress Index data for Illinois are obtained from the Federal Reserve Bank of St. Louis.

[4] Higher cash rents usually lead to expectations of higher farmland returns in the future, thereby leading to increases in farmland prices. Cash rent changes typically lag changes in operator and land returns. Operator and land returns are the returns left to split between farmer and land owner. If the operator and land return equals \$240 per acre and cash rent is \$200 per acre, the farmer receives \$40 per acre. Higher prices, higher yields, the availability of crop insurance or lower non-land costs could cause higher returns. The possibility of higher revenues suggests using variable cash lease arrangement so that landowners can share in higher revenues if they occur. Figure 1 shows average cash rents in Illinois from 1970 through 2014. Cash rent increased substantially from 2006 through 2014. On an annual basis, cash rents increased by an average of 7.5% per year between 2006 and 2014. Average cash rents decreased from \$234 per acre in 2014 to \$228 in 2015, a decrease of \$6 per acre (*farmdoc daily* October 20, 2015).

[5] Recently, new risk management instruments such as Volatility Index Futures (VIX) for corn and soybean have been introduced at the Chicago Mercantile Exchange. VIX contracts are designed to manage short-term volatility, and their payoffs are determined by changes in volatility.

[6] Weights are calculated according to each commodity's production per year in Illinois. The reason to use a weighted price is that commodities like corns and soybeans are prominent in Illinois. Corn prices as a result of ethanol mandates were uniquely volatile during many years in the sample period. There were spillover effects on substitute crops, but the volatility was less pronounced. Therefore, a "commodity price index" can serve as a basis for measuring commodity price variability in the sample period.

5. Results

5.1. Parameter Calibration

Figure 1 illustrates the prices dynamics of farmland market value, capitalized value, and rental rate. The sample period from 1996 to 2014 reflects considerable structural changes, for example, the advent of government mandates for ethanol (uniquely affecting corn) and the effects this had on profitability. Farmland market values displayed a positive trend in prices beginning at 2005 until 2008, followed by a steep decrease lasting until 2009. The financial crisis that dampened worldwide demand for agricultural commodity was one of the main causes of the sharp decline. However, farmland prices rebounded in 2010. Since that point, farmland prices have increased remarkably. Another structural break is the QE approach taken by the Federal Reserve to add liquidity to financial markets following the 2007-09 recession which has led to historically low interest rates, thus driving up capitalized values as shown in Figure 1. Rental rates exhibit similar dynamics to farmland values, particularly from 2005 to 2008. By 2010 rental rates were near the same levels observed prior to the financial crisis. Capitalized values follow a similar pattern, but exhibit great price variability during 2013 possibly due to mid-western drought spillover effect.

Parameter calibration was conducted in order to calculate option values for Illinois farms at the aggregate level. Results are presented in Table 1. The expected annual growth rate in cash flow α equaled the average value of $\ln\frac{\pi_t}{\pi_{t-1}}$ over 1970 to 2014 period based on a moving window average. For instance, the annual growth rate of 1996 equaled the average value of $\ln\frac{\pi_t}{\pi_{t-1}}$ from 1970 to 1996. Similarly, the annual growth rate of 1997 equaled the average of corresponding values from 1970 to 1997 and so forth. The average of α from 1996 to 2014 equaled 3.89%. Likewise, the volatility $\sigma = 0.002$, was reported as the average of the standard deviations of annual growth rates over the same sample periods. Table 1 reports that the average discount rate r is 10.25% and its associated standard deviation is 0.01.[7]

Table 1. Parameter Values

Parameter	Description	Average Value
α	Expected Annual Growth Rate	3.89%
σ	Standard Deviation of α	0.002
r	Discount Rate	10.25%
σ_r	Standard Deviation of r	0.010

Sensitivity of farmland option values with respect to expected growth rates in cash flow α and discount rates r for three values of risk aversion coefficient (0.2, 0.5 and 1.0) is shown in Figure 2. The patterns under all three scenarios are consistent. Figure 2 shows that the greater the value of r relative to α, the lower the option value. The lowest

[7] The measure of the appropriate discount rate is represented by the prime interest rate plus a risk premium. In the previous study 3% was added to prime interest rates to account for risk and to ensure a positive expected return to equity (Turvey, 2003). Instead of a constant risk premium, this article assumes that the coefficient of risk aversion is 0.2. Then the risk premium was adjusted according to the coefficient of variation for rents in each period (Alhabeeb, 2014). Note that prime interest rate is represented by the yields on 10-year Constant-maturity Treasury Notes.

trend occurs when α = 2% and r = 6%. Conversely, the greater the value of α relative to r, the more pronounced the option trend. The highest trend plotted occurs when α = 4% and r = 2%.

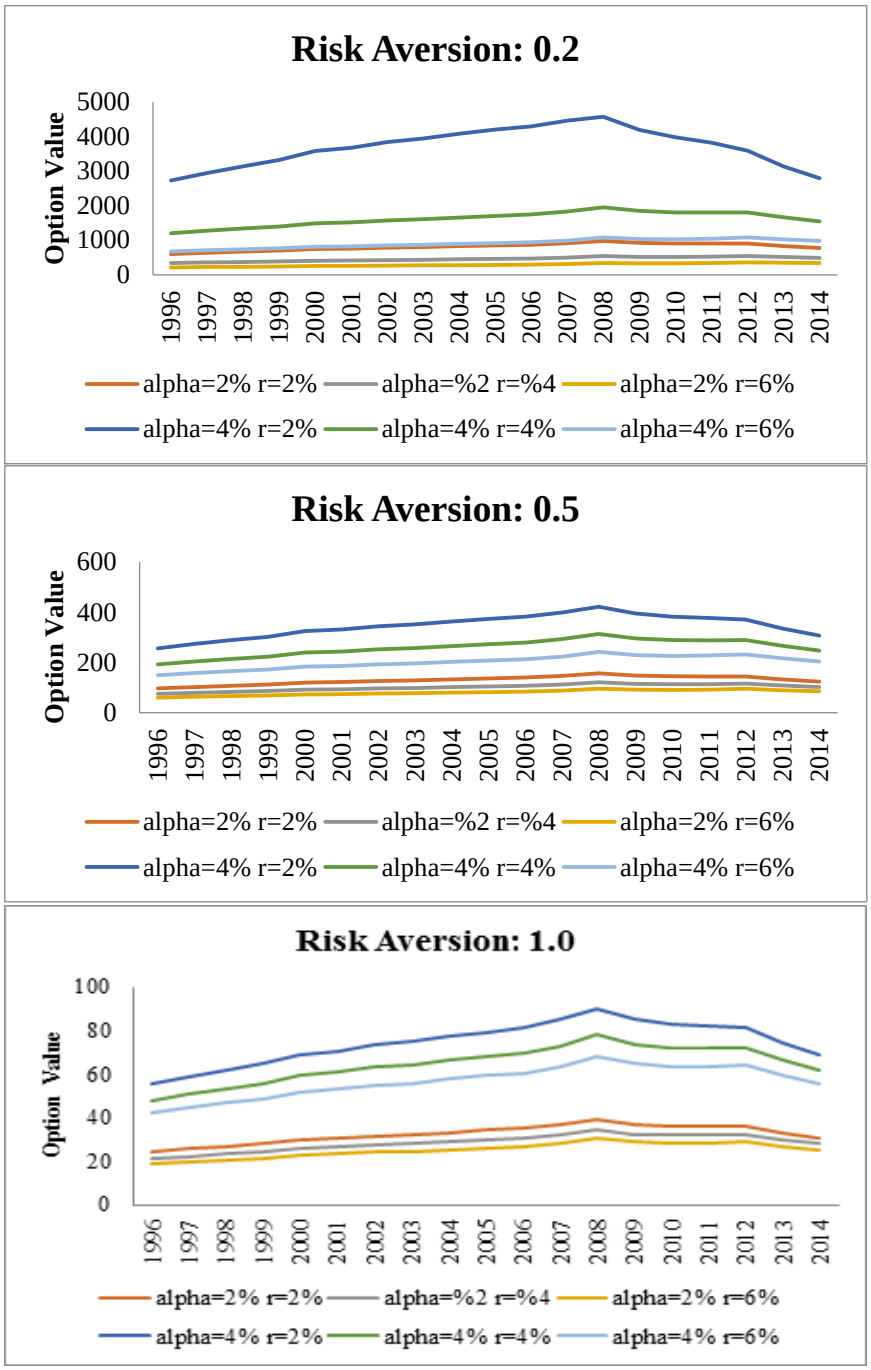


Figure 2. Sensitivity Analysis

The calculus of the option values reveals that as costs of capital decrease, risk increases, or growth rates increase, the option value increases (Dixit & Pindyck, 1996). Farmland is a long-lived asset, having cash flows that often are modeled as occurring into perpetuity. Because of the distinct characteristic of durable property, farmland price is much more sensitive to interest rates than shorter lived assets. As discount rates fall, asset prices increase as future cash are discounted at a lower rate. As risk increases (e.g., yield variability or commodity price volatility), the optimal trigger π_t^* increases, which in turn implies that the sale will be postponed for greater option premium. Likewise, an increase in the expected growth rate in cash flow from farming will increase the value of the option.

5.2. Determinants of Farmland Option Values

Capital assets derive their economic value from future earnings. For this reason, the value placed on farmland should reflect the market consensus of the present value of those future returns, specifically farm-based as well as non-farm returns.[8] In this interpretation, shifts in the expectation of future returns under uncertainty are reflected in the real options on future growth and capital gains. Factors that can explain the option premium for the flexibility to defer land transaction are analyzed in this study, including: government payments (GP), inflation (INF), commodity price volatility (CPV), precipitation (PRE), GDP, annual returns on investment in S&P 500 (SP500), Case-Shiller U.S. National Home Price Index (HI), debt to asset ratio (DR), CredAbility Consumer Distress Index (CDI) and farmland option values per acre (OPT). Table 2 reports the correlations for the nine variables. Over the full sample period, results exhibited high correlations between OPT and GDP (0.97), HI (0.84), DR (-0.88) and CDI (-0.77).

Table 2. Correlations

	OPT	GP	INF	CPV	PRE	GDP	SP500	HI	DR	CDI
OPT	1	0.126	0.036	0.304	0.303	0.973	-0.445	0.840	-0.884	-0.770
GP	0.126	1	0.329	-0.339	-0.139	0.150	-0.283	0.175	-0.168	0.113
INF	0.036	0.329	1	-0.078	-0.344	0.067	-0.446	0.235	-0.245	0.291
CPV	0.304	-0.339	-0.078	1	0.159	0.321	-0.228	0.177	-0.191	-0.229
PRE	0.303	-0.139	-0.344	0.159	1	0.167	-0.139	0.002	-0.009	-0.335
GDP	0.973	0.150	0.067	0.321	0.167	1	-0.359	0.841	-0.927	-0.781
SP500	-0.445	-0.283	-0.446	-0228	-0.139	-0.359	1	-0.263	0.250	0.259
HI	0.840	0.175	0.235	0.177	0.002	0.841	-0.263	1	-0.869	-0.409
DR	-0.884	-0.168	-0.245	-0.191	-0.009	-0.927	0.250	-0.869	1	0.625
CI	-0.770	0.113	0.291	-0.229	-0.335	-0.781	0.259	-0.409	0.625	1

An OLS approach is provided in Table 3 to formally quantify how OPT reacts with respect to multiple determinants. The regressions shown in table 3 are based on the formula expressed in equation (9). R^2-value reflects the goodness of fit of regression. Regression models with respect to dependent variable OPT both present high R^2-values.

[8] In previous studies, the change in farmland prices is identified to be unidirectionally caused by the change in farm-based returns. For instance, Phipps (1984) initiated the empirical investigation of land price/return causality using a variant of Granger causality test. Also, Just and Miranowski (1993) find that the increase in returns to farming explains 30% of the predicted land price change in 1973.

Note that, the complete regression shown in column (1) includes all control variables. Column (2) shows the estimation results for the regression by dropping two variables (GDP (GDP and DR) from column (1) for multi-collinearity consideration. Variance inflation factors (VIF) is used to detect multi-collinearity because some variables are highly correlated correlated with at least one of the other predictors in the model. GDP (VIF=49.75) and DR DR (VIF=16.18) are dropped to remove the violating predictors from the model. The remaining VIFs are acceptable (less than 2). The adjusted R^2-value did not lose much by dropping the two predictors from the model. The adjusted R^2-value decreased to only 0.965 from the original value of 0.979.

Table 3. Estimation Results

	OPT	
	(1)	(2)
Constant	1,782.324 (2,510.819)	7,790.995*** (594.840)
GP	-0.059 (0.073)	0.066 (0.072)
INF	174.534*** (41.848)	189.593*** (42.364)
CPV	444.272 (385.416)	1,132.065** (365.420)
PRE	16.235** (4.838)	17.424** (6.140)
SP500	6.341** (1.909)	6.737** (2.104)
HI	-7.640** (2.314)	-2.549** (1.065)
CDI	-68.220*** (12.878)	-98.183*** (6.033)
GDP	288.966** (110.70)	
DR	62.470 (67.025)	
R^2	0.992	0.982
Adjusted R^2	0.979	0.965
Residual Std. Error	89.383 (df=6)	114.363 (df=8)
F Statistic	78.400*** (df=9;6)	60.955*** (df=7;8)

Note: *p<0.1; **<0.05; ***p<0.01

Statistically significant results in column (1) show that OPT is positively related with inflation rate, commodity price volatility, weather, S&P500 annual return, and GDP, and is negatively related with housing index and consumer distress index. Results suggest that an increase of OPT is not caused by leverage positions but the positive sign is consistent with the expectation nevertheless.[9]

[9] The bubble in the late 1970s and early 1980's was tied to high levels of farm debt accumulated during the 1970's. As net farm incomes fell in the early 1980s to near depression levels in real terms, borrowers could no longer service debt and bankruptcies ensued. Land values fell in half in many

The regression shown in column (2) does not include GDP and DR after correcting for multi-collinearity. The effects of all the other variables remain the same except for government payments in agriculture. Farms with higher government payments have higher option values. The result is consistent with the extensive empirical literature on the capitalization of government subsidies in farmland values (e.g., Shoemaker et al., 1990; Barnard et al., 1997; Goodwin et al., 2003; Lence & Mishra, 2003; Wang et al., 2013). An interesting result emerges from the analysis is that the consumer financial conditions index demonstrates a negative sign. Investors are drawn to farmland primarily because it is widely believed to act as a real estate speculation, preserving the value of invested capital better than most financial assets during financial distress conditions. Therefore, farmland is frequently referred to as "black gold", as "like gold with yield" or "gold with a coupon" by many in the agriculture sector.

There is no evidence of positive housing spillover effect as the sign of housing index is negative. The result, nevertheless, is consistent with what has been observed in the capital markets that investors have acquired a newfound interest in farmland as a portfolio investment since the 2008 housing crisis. The estimated coefficient on inflation shows a positive sign, which further demonstrates farmland's potential to act as an inflation hedge. It is also found that macroeconomic conditions, such as GDP and S&P500 index, can affect farmland values as well. The positive sign of the risk variable CPV supports the theory that a higher risk induces higher option premium. Overall, results are consistent with previous studies which argue that farmland has low systematic risk, high relative returns for the risk, and has provided good inflation insulation (e.g. Sherrick, 2011; Fairbairn, 2014).

6. Conclusion and Policy Implications

In conclusion, this paper applies an option pricing model to quantify the relative importance of various contributing factors in driving farmland price movements, including farm rental rates, interest rates, inflation, leverage positions, consumer financial conditions, weather, price volatility, macroeconomic conditions and government payments. Although the validity of the real options theory has been well assessed by means of economic experiments in the literature, it is difficult to econometrically determine the explanatory power of it on the basis of empirical farm data. For example, grouping landlords with owner-operators can cause aggregation bias given the limitation of FBFM data. Therefore, further research is needed because there is still ample room for improvements on the testing of the option-based model. Explicit modeling of real options, and taking into account uncertainty about growth expectations and capital gains could enhance understanding of farmland markets and have several important policy implications.

6.1. Market Efficiency

Many of the characteristics (e.g., high transaction costs, low turnover, low debt-service capacity, and wide bid-ask spreads) of farmland markets suggest that existing markets display features that likely qualify as "thin markets". Farmland often stays within families for generations. The concept of reservation price reflecting the desire for a way of life also plays a role (in terms of the value options model, the value of π never reaches π^* including a reservation price). The lack of contiguous tracts can also impact

regions, including the Corn Belt. Therefore, one would expect less land price volatility today given low returns due to the relatively low leverage positions existing in the farm sector.

sales. Thus, while real options theory applies well to financial assets, unique characteristics of farmland ownership contribute to the thinness of farmland markets and affects option decisions. The option value theory may be more applicable to landlords than it is to farm owner-operators. Policy makers should pay more attention to partitioning of these two groups of owners and the development of more extensive and higher-quality information through public channels in order to improve the market efficiency.

6.2. Speculation

Capital gains in farmland investments are central to investors, both as a source of inflation hedging growth and of potentially large speculative profits as shown in this study. Since 2007, capital markets have acquired an unprecedented interest in agricultural land as a newfound portfolio investment, a phenomenon examined through the theoretical lens of financialization (Fairbairn, 2014). As attempts at farmland securitization progress, it would become possible for farmland market to become more liquid markets, and for retail investors to acquire more land assets. The increasing volume and liquidity associated with securitization could greatly lower the bid and ask spreads and may have an impact on the volatility of farmland prices.

6.3. Government Programs

Historic governmental support of agriculture has been an important component in understanding the structure of agricultural-asset markets. An extensive empirical literature has attempted to measure the extent to which farm program benefits are capitalized into land values, hence transferring benefits toward land-owners rather than producers. Potential future green payments could fundamentally alter the degree of stability of direct agricultural payments to producers. Additionally, crop insurance became a key feature of farm program policy in 2015. Crop Insurance is becoming more important to farmers than direct payments. The future role of government in agriculture is a major source of uncertainty affecting agricultural production and farmland markets.

6.4. Land Use

The effects of many controversial policies concerning greenhouse gas mitigation, ecological destruction, and agricultural policy depend crucially on how land use patterns respond to economic changes. In addition, any policy affecting agricultural markets can have indirect land use effects. In the US, biofuels mandates effectively increased crop demand with a staggering 35-40% of corn production used to produce ethanol in recent years (US EPA, 2011). Today, land use has become a central concern in evaluating agri-environmental policy and regulation.

6.5. Credit Risk

Farmland values in the US have experienced periods of boom and bust cycles. The agricultural crisis of the early 1980s remains a vivid memory for many in the farm sector. The farm crisis resulted in a credit collapse causing widespread bankruptcy and foreclosures. The inherent non-liquidity of leveraged investments in farmland is illustrated by low returns to farmland because during financial downturns debt-service requirements may exceed the cash flow generated. Further evidence of the relationship between farmland value and risk bearing is needed to better understand how farmers and landowners are compensated for risks in agriculture.

6.6. Tax Treatment

Agricultural land is given preferential tax treatment, in which the taxable value of the land is based on the agricultural use value (Anderson, 2012). This has important implications for public finance. If the difference between market prices and agricultural-use value increases (which can be shown in option values), while farm incomes are high, states and localities may reconsider this potential tax revenue to fix state budget problems. A number of states have recently revised the tax treatment of agricultural properties (Sherrick & Kuethe, 2014). Therefore, understanding the drivers of the nonfarm components in farmland markets may help inform this policy.

References

Alhabeeb, M. J. (2014) *Entrepreneurial finance: fundamentals of financial planning and management for small business*. John Wiley & Sons.

Anderson, J. E. (2012). Agricultural use-value property tax assessment: Estimation and policy issues. *Public Budgeting & Finance*, 32(4):71–94.

Arthur, L. M., Carter, C. A., & Abizadeh, F. (1988). Arbitrage pricing, capital asset pricing, and agricultural assets. *American Journal of Agricultural Economics*, 70(2):359–365.

Ay, J.-S., & Latruffe, L. (2013). The empirical content of the present value model: A survey of the instrumental uses of farmland prices. Technical report.

Barnard, C. H., Whittaker, G., Westenbarger, D., & Ahearn, M. (1997). Evidence of capitalization of direct government payments into us cropland values. *American Journal of Agricultural Economics*, pages 1642–1650.

Barry, P. J. (1980). Capital asset pricing and farm real estate. *American Journal of Agricultural Economics*, 62(3):549–553.

Borchers, A., Ifft, J., & Kuethe, T. (2014). Linking the price of agricultural land to use values and amenities. *American Journal of Agricultural Economics*, 96(5):1307–1320.

Burt, O. R. (1986). Econometric modeling of the capitalization formula for farmland prices. *American Journal of Agricultural Economics*, 68(1):10–26.

Capozza, D. R., & Helsley, R. W. (1990). The stochastic city. *Journal of Urban Economics*, 28(2):187–203.

Castle, E. N., & Hoch, I. (1982). Farm real estate price components, 1920–78. *American Journal of Agricultural Economics*, 64(1):8–18.

Clark, J. S., Fulton, M., & Scott, J. T. (1993). The inconsistency of land values, land rents, and capitalization formulas. *American Journal of Agricultural Economics*, 75(1):147–155.

Dixit, A. K., & Pindyck, R. S. (1996). *Investment under uncertainty*. Princeton university press.

Fairbairn, M. (2014). like gold with yield: Evolving intersections between farmland and finance. *Journal of Peasant Studies*, (ahead-of-print):1–19.

Falk, B. (1991). Formally testing the present value model of farmland prices. *American Journal of Agricultural Economics*, 73(1):1–10.

Featherstone, A. M., & Baker, T. G. (1987). An examination of farm sector real asset dynamics: 1910–85. *American Journal of Agricultural Economics*, 69(3):532–546.

Feldstein, M. (1980). Inflation, portfolio choice, and the prices of land and corporate stock. *American Journal of Agricultural Economics*, 62(5):910–916.

Goodwin, B. K., Mishra, A. K., & Ortalo-Magn´e, F. N. (2003). What's wrong with our models of agricultural land values? agricultural land values, government payments, and production (allen featherstone, kansas state university, presiding). *American Journal of Agricultural Economics*, 85(3):744–752.

Irwin, S. H., Forster, D. L., & Sherrick, B. J. (1988). Returns to farm real estate revisited. *American Journal of Agricultural Economics*, 70(3):580–587.

Just, R. E., & Miranowski, J. A. (1993). Understanding farmland price changes. *American Journal of Agricultural Economics*, 75(1):156–168.

Kaplan, H. M. (1985). Farmland as a portfolio investment. *The Journal of Portfolio Management*, 11(2):73–78.

Klinefelter, D. A. (1973). Factors affecting farmland values in illinois. *Illinois Agricultural Economics*, pages 27–33.

Lence, S. H., & Mishra, A. K. (2003). The impacts of different farm programs on cash rents. *American Journal of Agricultural Economics*, 85(3):753–761.

Libbin, J. D., Kohler, J. D., & Hawkes, J. M. (2004). Does modern portfolio theory apply to agricultural land ownership? concepts for farmers and farm managers. *Journal of the American Society of Farm Managers and Rural Appraisers*, 67(1):85–96.

Lins, D. A., Sherrick, B. J., & Venigalla, A. (1992). Institutional portfolios: diversification through farmland investment. *Real Estate Economics*, 20(4):549–571.

Maart-Noelck, S. C., & Musshoff, O. (2013). Investing today or tomorrow? An experimental approach to farmers decision behaviour. *Journal of agricultural economics*, 64(2):295–318.

Melichar, E. (1979). Capital gains versus current income in the farming sector. *American Journal of Agricultural Economics*, 61(5):1085–1092.

Musshoff, O., Odening, M., Schade, C., Maart-Noelck, S. C., & Sandri, S. (2012). Inertia in disinvestment decisions: experimental evidence. *European Review of Agricultural Economics*, page jbs032.

Nickerson, C. J., Morehart, M., Kuethe, T., Beckman, J., Ifft, J., & Williams, R. (2012). *Trends in US farmland values and ownership*. US Department of Agriculture, Economic Research Service.

Noland, K., Norvell, J., Paulson, N. D., & Schnitkey, G. D. (2011). The role of farmland in an investment portfolio: analysis of Illinois endowment farms. *Journal of the ASFMRA*.

Palmquist, R. B., & Danielson, L. E. (1989). A hedonic study of the effects of erosion control and drainage on farmland values. *American Journal of Agricultural Economics*, 71(1):55–62.

Phipps, T. T. (1984). Land prices and farm-based returns. *American Journal of Agricultural Economics*, 66(4):422–429.

Plantinga, A. J., Lubowski, R. N., & Stavins, R. N. (2002). The effects of potential land development on agricultural land prices. *Journal of Urban Economics*, 52(3):561–581.

Ricardo, D., & Hartwell, R. M. (1971). *On the principles of political economy, and taxation*, volume 165. Penguin Books Middlesex.

Robison, L. J., Lins, D. A., & VenKataraman, R. (1985). Cash rents and land values in us agriculture. *American Journal of Agricultural Economics*, 67(4):794–805.

Schnitkey, G. D., & Sherrick, B. J. (2011). Income and capitalization rate risk in agricultural real estate markets. *Choices*, 26(2).

Sherrick, B., & Kuethe, T. (2014). Impact of recent changes in the Illinois farmland assessment act. *Farmdoc Daily*.

Sherrick, B. J. (2011). *Illinois Farmland Investment Performance Revisited Again*. Illinois AgriNews - August 2011.

Sherrick, B. J., & Barry, P. J. (2003). Farmland markets: Historical perspectives and contemporary issues. *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth*, pages 27–49.

Shiller, R. J. (2005). *Irrational exuberance*. Random House LLC.

Shoemaker, R., Anderson, M., & Hrubovcak, J. (1990). Us farm programs and agricultural resources. *Agriculture Information Bulletin-United States Department of Agriculture*, (614).

Tegene, A., & Kuchler, F. (1990). *The contribution of speculative bubbles to farmland prices*. Number 1782. US Dept. of Agriculture, Economic Research Service.

Tubetov, D., Christin Maart-Noelck, S., & Musshoff, O. (2013). Real options or net present value? An experimental approach on the investment behavior of kazakhstani and German farmers. *Agricultural Finance Review*, 73(3):426–457.

Turvey, C. (2003). Hysteresis and the value of farmland: A real-options approach to farmland valuation. *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth*, pages 179–207.

Wang, B., & Escalante, C. (2013). *An Analysis of Farmland Option Value: Ascertaining the Nature of the Recent Farmland Bubble Phenomenon.* (Unpublished master's thesis), University of Georgia.