Comparing Net Return to Land and Risk for Alternative Leasing Arrangements

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Abstract

This paper examined the net return to land and risk for crop share, fixed cash rent, and flexible cash lease arrangements. Specifically, certainty equivalent analysis was used to compare the risk-adjusted net return to land for each leasing arrangement, and a downside risk model was used to determine the optimal mix of leasing arrangements from a landlord perspective. The preferred leasing arrangement for a risk neutral landlord was the flexible cash lease arrangement. Landlords that were slightly, moderately, and strongly risk averse preferred the fixed cash rent arrangement. Results of the downside risk model emphasized the importance of using a combination of the leasing arrangements for landlords with multiple land tracts. A relatively large reduction in downside risk with little change in net return to land could be achieved by utilizing a combination of the fixed cash rent and flexible cash lease arrangements, rather than just utilizing the flexible cash leasing arrangement, which had the highest expected net return.

INTRODUCTION

Obtaining control of land through leasing has a long history in the United States. Leases on agricultural land are strongly influenced by local custom and tradition. However, in most areas, landowners and operators can choose from several types of lease arrangements. These lease arrangements include crop share arrangements, fixed cash rent arrangements, and flexible cash lease arrangements. With crop share arrangements, crop production and often government payments and crop insurance indemnity payments are shared between the landowner and the operator. These arrangements also involve the sharing of at least a portion of crop expenses. Fixed cash rent arrangements, as the name implies, provide landowners with a fixed payment per year. Flexible cash lease arrangements provide a base cash rent plus a bonus, which typically represents a share of gross revenue in excess of a certain base value.

Several previous studies have compared the net return and risk of alternative leasing arrangements. Barry, Escalante, and Moss (2002) examined the rental spread between cash and share leases in Illinois from 1995–1998 and determined how these spreads were related to risk and other farm characteristics. Share leases included government payments and crop insurance proceeds. In north and central Illinois for high productivity soil, share rents were $3.39 per acre higher than cash rents. For southern Illinois, share rents were $2.63 lower than cash rents. The rental spread tended to be lower when cash rents were relatively high on more productive soils and for farmers with relatively higher net worth.

Davis (2004) used a simulation model to examine net returns for landowners and tenants under cash, share, and flexible leases in South Carolina. Flexible leases that accounted for crop price variability, yield variability, and crop price and yield variability were included in the analysis. Landowners received the largest rent from a crop share lease, and the fixed cash lease was ranked as the least preferred lease arrangement.

A simulation model was also used by Edwards and Hart (2013) to examine the financial risk borne by tenants and landlords under 10 different types of flexible cash leases. Flexible lease types examined included those based on yield variability; crop price variability; yield and crop price variability; and yield, crop price, and cost variability. They referred to a flexible cash lease that computed rent using a base cash rent plus a fixed percent times actual gross revenue in excess of the actual cost of production as a "profit share" lease. This lease type is similar to the flexible cash lease examined in this study. Of the flexible lease arrangements examined, the profit share lease was found to shift the most risk from the tenant to the landowner and provided the tenant with the lowest probability of suffering a loss in a given year.

Paulson (2012) noted that the returns for a flexible cash lease are a hybrid of the returns realized under fixed cash and share rent leases. The flexible cash leases examined in the analysis included a base cash rent and a share of realized crop revenue. Schnitkey (2015) proposed examining a similar flexible cash lease as an alternative to reducing fixed cash rents. The idea behind this notion is straightforward. A landowner may be willing to reduce their base cash rent if there is a nontrivial chance that they could share in higher crop revenues if they occur. The flexible cash leases discussed by Paulson (2012) and Schnitkey (2015) are similar to the flexible cash lease examined in this study.

The objective of this paper is to examine the net return and risk of crop share, fixed cash rent, and flexible cash leasing arrangements. Comparisons are made from a landlord perspective using data for west central Indiana. The west central region of Indiana contains some of the best soils in Indiana and has trend corn yields that are slightly above the U.S. average. In addition to determining the risk-adjusted net return to land for each leasing arrangement, tradeoffs are developed so that alternative leases can be compared from both a net return to land and risk perspective.

RISK ANALYSIS

Landowners with different degrees of risk aversion may prefer different leasing agreements. Recognizing this, we incorporated landowners' risk attitudes into the decision-making framework. Thus, in addition to comparing the average, standard deviation, and coefficient of variation (standard deviation divided by the average) between leasing arrangements, the risks associated with net return to land for the leasing arrangements are compared. The certainty equivalent of net return represents a risk-adjusted return and is computed using expected utility theory, which requires a specific utility function and specific levels of risk aversion. As risk aversion increases, the certainty equivalent of net return decreases. In essence, higher risk aversion increases the potential cost of risk, resulting in a lower certainty equivalent or risk-adjusted net return. For each level of risk aversion, a leasing arrangement with a higher certainty equivalent is preferred to a leasing arrangement with a lower certainty equivalent.

To calculate the certainty equivalent requires information pertaining to the utility function and the risk aversion coefficients. The power utility function was used to compute certainty equivalents in this study. This utility function is often referred to as the constant relative risk aversion utility function and is widely used for modeling risk aversion in production agriculture (e.g., Liu et al., 2018). In addition to constant relative risk aversion, this utility function exhibits decreasing absolute risk aversion as wealth increases. Relative risk aversion levels of 0, 1, 3, and 5 were used in this study. A relative risk aversion level of 0 is applicable to a risk neutral decision-maker. Risk aversion levels of 1, 3, and 5 represent slightly, moderately, and strongly risk averse preferences (Hardaker et al., 2015). Using a range of risk aversion coefficients captures the wide range of risk preferences exhibited by landowners.

Sensitivity analyses involving the crop share percentage and flexible cash lease parameters were also conducted using slightly risk averse preferences. Specifically, for the crop share leasing arrangement, the crop share percentage that would yield the same or a higher certainty equivalent of net return as the fixed cash rent arrangement was computed. Similarly, the bonus split or base cash rent needed to make the certainty equivalent of net returns to land for the flexible cash lease arrangement equal to or higher than that of the fixed cash rent lease arrangement was computed.

Expected net return and risk for combinations of the lease arrangements were examined with a downside risk model. The Target MOTAD model maximizes expected income subject to a constraint or limit on the total negative deviations measured from a fixed target or target income (Tauer, 1983; Watts, Held, and Helmers, 1984). The Target MOTAD model focuses on the downside risk that occurs when the net return to land falls below a target level. As with other portfolio models, tradeoffs between risk, as measured by the total negative deviations below a target income, and expected income are examined. The solution of the model that identifies the maximum expected income also has the highest level of total negative deviations below the target income. In other words, this is the profit maximizing solution. As the total negative deviations below the

target income become more constrained, risk and expected income decline. A target income or net return to land of $200 per acre is used for the analysis in this paper. This target income is similar to the lowest average net return to land for the leasing arrangements examined in this paper. This target income can be thought of as the long-term average net return to land.

FARM SETTING

Net returns to land from 1996–2018 from a landowner perspective were computed for a case farm in west central Indiana that utilized a corn/soybean rotation. Lease arrangements examined included a crop share lease, a fixed cash rent lease, and a flexible cash lease.

With the crop share lease, the landlord received 50% of all revenue (crop revenue, government payments, and crop insurance indemnity payments). In addition to providing the land, the landowner paid 50% of seed, fertilizer, and chemical (herbicides, insecticides, and fungicides) expenses, as well as 50% of crop insurance premiums. The case farm participated in crop insurance and government programs.

Fixed cash rents were obtained from the annual Purdue Farmland Value Survey (e.g., Dobbins, 2019). Specifically, cash rents for average productivity land in west central Indiana were used. The flexible cash lease arrangement used a base cash rent that was 90% of fixed cash rent. In addition to the base case rent, the landowner received a bonus of 50% of the profit if the revenue exceeded non-land cost plus base cash rent. The profit is calculated as the gross revenue above non-land cost plus base cash rent. Gross revenue included crop revenue, government payments, and crop insurance indemnity payments. All cash and opportunity costs, except those for land, were included in the computation of non-land cost.

Table 1 presents the annual net return to land per acre for the fixed cash rent, flexible cash, and crop share leasing arrangements. All net returns in Table 1 were adjusted for inflation using the implicit price deflator for personal consumption expenditures and are expressed in real 2018 dollars. Figure 1 also conveys annual net return information for the three lease arrangements. The flexible cash lease arrangement had a higher net return to land than the fixed cash rent lease arrangement in 1996, 2007, 2008, and from 2010–2012. Bonuses were paid in 1996, 1997, 2000, 2002, 2006–2013, and 2018. The largest bonuses were paid in 2007–2008 and 2010–2012. During the period often referred to as the ethanol boom (i.e., 2007–2013), the average bonus per acre was approximately $58. The crop share lease arrangement

had a higher net return to land than the fixed cash rent lease arrangement in 1996 and from 2007–2012. Essentially, the flexible cash lease arrangement exhibits some of the upside potential of the crop share lease arrangement, while protecting net returns on the downside. Although net return to land for the flexible cash lease arrangement was not as high as that for the crop share lease arrangement during several of the ethanol boom years, it did a good job of mitigating the drop in net return to land from 2003–2005 and from 2013–2017.

RESULTS

The minimum, maximum, average, standard deviation, and coefficient of variation of net return to land per acre for each leasing arrangement are presented in Table 2. The flexible cash lease arrangement had a higher average net return over the 1996–2018 period than the other two lease arrangements. However, the standard deviation of net returns and the coefficient of variation, a measure of relative risk, were relatively lower for the fixed cash rent lease arrangement.

Table 3 summarizes the certainty equivalent of net return to land for each leasing arrangement using relative risk aversion levels of 0, 1, 3, and 5. Risk neutral landlords (i.e., $r = 0$) would prefer the flexible cash lease arrangement. Slightly risk averse, moderately risk averse, and strongly risk averse landlords (i.e., $r = 1$, $r = 3$, and $r = 5$) would prefer the fixed cash rent arrangement. Note that the difference in the certainty equivalent between the fixed cash and flexible cash lease arrangements increases as decision-makers become more risk averse. This result suggests that the flexible cash lease arrangement is relatively risky compared to the fixed cash rent arrangement, resulting in a relatively faster increase in the cost of risk for the flexible cash lease.

Sensitivity analysis was conducted to determine the flexible cash lease and crop share parameters needed for these alternatives to have the same or a higher certainty equivalent of net return to land as that for a landlord who utilizes the fixed cash rent arrangement and is slightly risk averse (i.e., $r = 1$). For the flexible cash lease arrangement to have the same or higher certainty equivalent, either the bonus needs to increase to 54% with the 90% base rent or the base rent needs to increase to 91% with the bonus staying at 50%. For the crop share arrangement, the share of revenue and expenses would need to increase to 55% for the certainty equivalent for this arrangement to be the same or higher than the certainty equivalent for the fixed cash rent arrangement. This 55% crop share is considerably higher than the traditional crop share (i.e., 50%) utilized in the study region.

Using the Target MOTAD model, the tradeoffs between risk—as measured by the total negative deviations below the target income of $200 per acre—and expected income or net return are illustrated in Table 4 for scenarios or levels of risk. The expected net return to land, the total amount of negative deviations below the target income or net return, and the optimal mix of leasing arrangements is presented for each scenario. The total negative deviations represent the sum of the negative deviations over the 23-year period.

The scenario that maximizes expected net return (i.e., scenario 1) had the highest risk level and utilized the flexible cash leasing arrangement. Scenario 7 had the lowest risk level, the lowest expected income, and utilized the fixed cash rent leasing arrangement. The other scenarios utilized a combination of the fixed cash rent and flexible cash leasing arrangements. The crop share leasing arrangement did not appear in any of the scenarios in Table 4. Given its relatively low average net return to land and relatively high standard deviation of net returns to land, it was not surprising to find that this leasing arrangement was not part of the optimal mix for any of the scenarios. To provide some information as to how risky the crop share arrangement is, the Target MOTAD model was solved for the situation in which the crop share arrangement was utilized. For this scenario, expected net return was $200.57 per acre and total negative deviations below the target income or net return were $548.12 or an average of $23.43 per year. In contrast, the average deviations per year for the fixed cash rent and flexible cash leases were $11.65 and $16.83, respectively. Obviously, the deviation levels for the crop share leasing arrangement are substantially higher than those presented in Table 4.

It is evident from the results in Table 4 that deviations below the target income or net return can be reduced rather substantially with small reductions in expected net return to land. For example, going from scenario 1 to scenario 3 reduces expected net return to land by only $0.41 per acre but reduces negative deviations below target income by 9.6%. Similarly, going from scenario 1 to scenario 5 reduces expected net return to land by $0.98 per acre and reduces negative deviations below the target income by 22.5%. Scenario 7 has an expected net return to land that is $1.52 lower than the net return to land for scenario 1 and $0.54 lower than the net return to land for scenario 5. Negative deviations below the target income for scenario 7 are 30.8% and 10.7% lower than those for scenarios 1 and 5, respectively.

Figure 2 presents the annual net return to land for the fixed cash rent arrangement (i.e., scenario 7) and the combination of the fixed cash rent and flexible cash lease arrangements for scenario 5 (labeled as CR/FR Combination in Figure 2), along with the target income. Interestingly, scenario 5 has higher negative deviations than scenario 7 from 1997–2006, in 2009, and from 2013–2018. However, its net return to land is substantially higher in 2007, 2008, and from 2010–2012.

SUMMARY AND CONCLUSIONS

This article compared the net return to land for crop share, fixed cash rent, and flexible cash leases. The net returns to land from a landowner perspective were similar for the fixed cash and flexible cash leases. The crop share lease had a relatively lower average net return to land. The flexible cash lease mimicked the ups and downs of the crop share lease. However, the upward and downward spikes for the flexible cash lease were less pronounced than those for the crop share lease. Choosing among the leases depends on a landowner's desire to capture improvements in crop share revenue and ability to withstand downside risk. The crop share and flexible cash leases allow landowners to more fully capture annual improvements in crop revenue but also increase the probability of significant downward movements in annual net returns.

The flexible cash lease had the highest average net return to land; thus, this leasing arrangement would be preferred by a risk neutral landowner. Slightly risk averse, moderately risk averse, and strongly risk averse landowners preferred the fixed cash rent leasing arrangement. Landlords do not necessarily have to use the same leasing arrangement for all of their land tracts. To accommodate this fact, a portfolio model that focuses on downside risk was utilized. Results show that choosing a combination of leasing arrangements can allow landowners to better capture annual improvements in crop revenue but also reduce the probability of downward movements in annual net returns. Downside risk for the flexible cash leasing arrangement was higher than it was for a combination of the fixed cash rent and flexible cash leasing arrangements. The decrease in net return to land resulting from adding the fixed cash rent arrangement to the flexible cash lease rent arrangement was negligible. By utilizing a combination of the fixed cash rent and flexible cash lease arrangements, rather than just utilizing the flexible cash lease arrangement, landowners could achieve a large reduction in downside risk with little change in net return to land.

This paper utilized historical net returns to examine leasing arrangements. Since 1996, there have been periods in which the net return to land was relatively stable regardless of the leasing arrangement, as well as a boom and bust period (i.e., 2007–2018). Choice of leasing arrangements also depends on a landowner's expectations regarding commodity prices. Landowners who are expecting stable commodity prices and net returns may be better off using a fixed cash rent leasing arrangement rather than using a portfolio approach. Landowners who are concerned about what may occur if we have another boom and bust period would find the portfolio approach or an arrangement other than the fixed cash rent leasing arrangement more attractive.

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Watts, M.J., L.J. Held, and G.A. Helmers. 1984. "A Comparison of Target MOTAD to MOTAD." *Canadian Journal of Agricultural Economics* 32: 175–186.
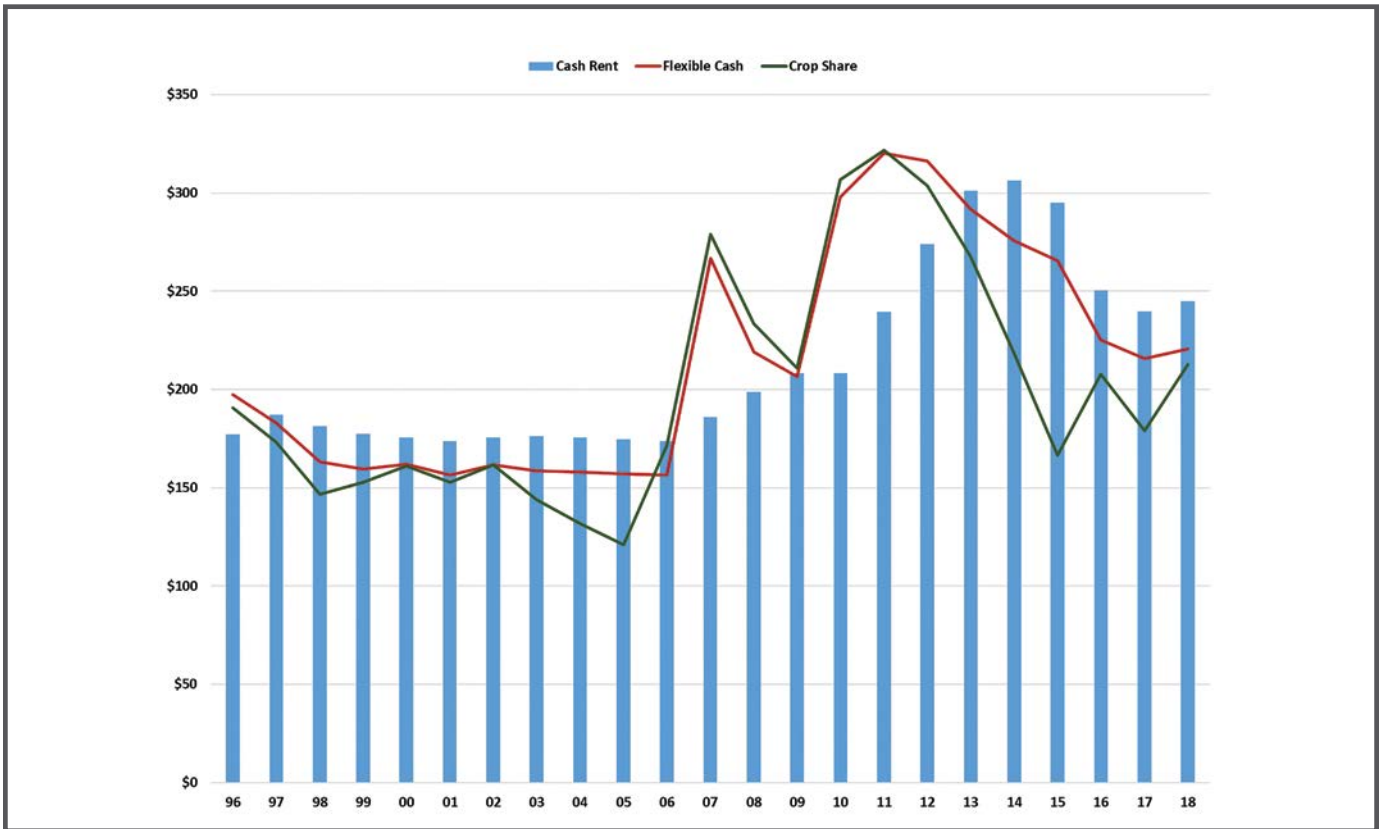
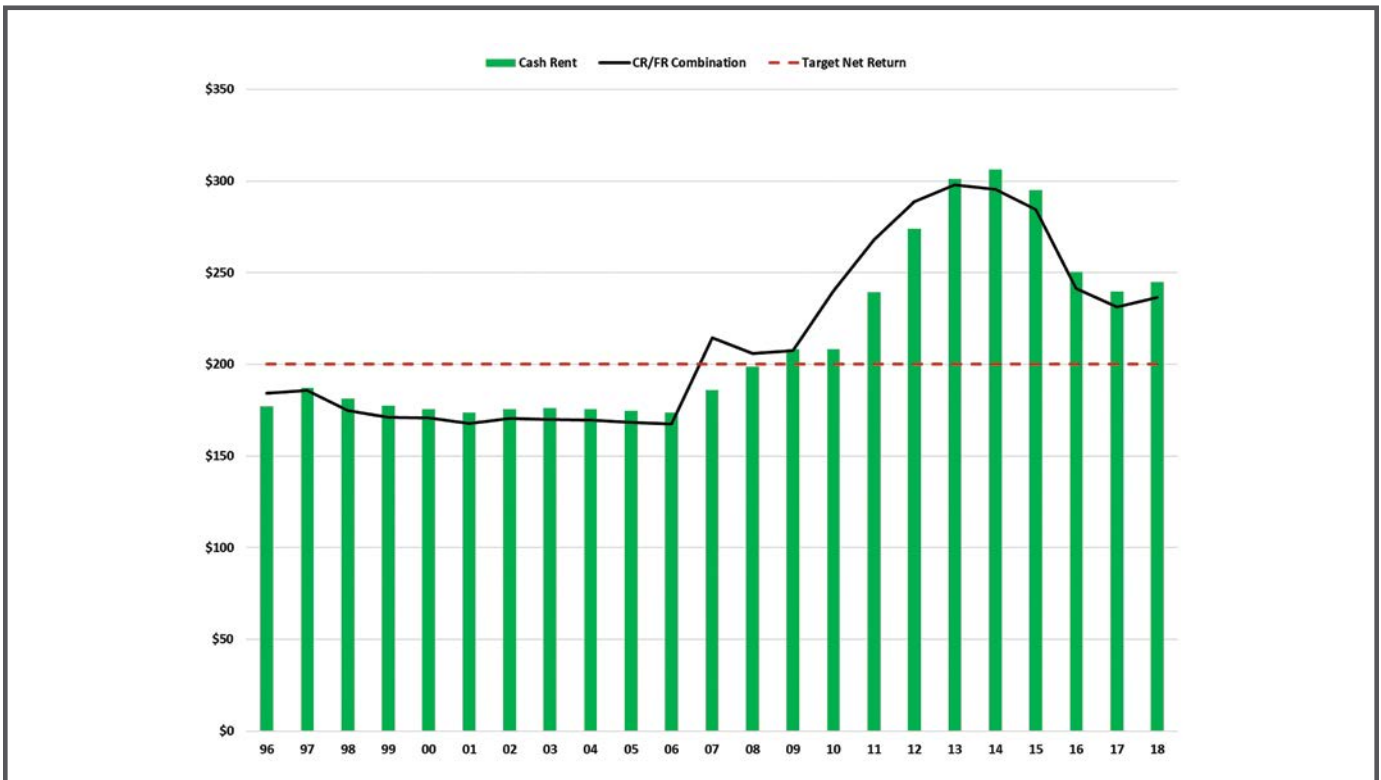Figure 1. Real Net Return to Land for Alternative Leasing Arrangements (Source: Table 1)

Figure 2. Comparison of Fixed Cash Rent and Combination of Fixed Cash Rent and Flexible Cash Lease Arrangements (Source: Target MOTAD results). Note: CR/FR Combination represents a combination of the fixed cash rent and flexible cash lease arrangements (i.e., scenario 5 in Table 4.)

Table 1. Real Net Return to Land per Acre for Cash Rent, Flexible Cash, and Crop Share Leasing Arrangements, West Central Indiana ($ per Acre)

Year	Fixed Cash Rent	Flexible Cash			Crop Share
		Base Rent	Bonus	Total	
1996	177.07	159.37	37.88	197.25	190.63
1997	187.10	168.39	14.76	183.14	173.12
1998	181.30	163.17	0.00	163.17	146.53
1999	177.22	159.50	0.00	159.50	152.67
2000	175.69	158.12	3.69	161.82	161.09
2001	173.74	156.36	0.00	156.36	152.85
2002	175.50	157.95	3.72	161.67	161.62
2003	176.10	158.49	0.00	158.49	143.83
2004	175.66	158.09	0.00	158.09	131.73
2005	174.54	157.09	0.00	157.09	120.99
2006	173.56	156.20	0.23	156.43	171.34
2007	185.83	167.25	99.48	266.73	278.84
2008	198.81	178.93	40.09	219.02	233.32
2009	208.19	187.37	19.10	206.47	210.80
2010	208.08	187.27	110.60	297.88	306.86
2011	239.33	215.40	104.63	320.03	321.75
2012	273.82	246.44	69.80	316.24	303.72
2013	301.15	271.04	20.84	291.87	267.53
2014	306.17	275.55	0.00	275.55	218.07
2015	294.91	265.42	0.00	265.42	166.44
2016	250.24	225.21	0.00	225.21	207.75
2017	239.78	215.80	0.00	215.80	179.04
2018	245.00	220.50	0.10	220.60	212.53

Table 2. Summary Statistics for Real Net Return to Land per Acre for Cash Rent, Flexible Cash, and Crop Share Leasing Arrangements, West Central Indiana ($ per Acre)

	Fixed Cash Rent	Flexible Cash	Crop Share
Minimum	173.56	156.36	120.99
Maximum	306.17	320.03	321.75
Average	212.99	214.51	200.57
Standard Deviation	45.75	57.44	59.20
Coefficient of Variation	0.215	0.268	0.295

Table 3. Certainty Equivalent of Net Return to Land for Each Leasing Alternative Under Four Relative Risk Average Assumptions ($ per Acre)

Relative Risk Aversion	Fixed Cash Rent	Flexible Cash	Crop Share
$r = 0$ (risk neutral)	212.99	214.51	200.57
$r = 1$ (slightly risk averse)	208.73	207.57	192.88
$r = 3$ (moderately risk averse)	201.61	195.60	179.88
$r = 5$ (strongly risk averse	196.35	186.80	170.18

Table 4. Expected Net Return to Land and Total Negative Deviations Below Target Income ($ per Acre)

Scenario	Expected Net Return	Negative Deviations	Fixed Cash Rent	Flexible Cash	Crop Share
1	214.51	387.00	0.000	1.000	0.000
2	214.38	375.00	0.089	0.911	0.000
3	214.10	350.00	0.275	0.725	0.000
4	213.81	325.00	0.461	0.539	0.000
5	213.53	300.00	0.647	0.353	0.000
6	213.23	275.00	0.845	0.155	0.000
7	212.99	267.89	1.000	0.000	0.000