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Risk Costs and the Choice of Market Return Index

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Six measures of returns are used to estimate the most "appropriate" market index for southeast Kansas farms. Results suggest that localized indices are more appropriate than state indices for use as the market index. The appropriate index was used to estimate systematic and nonsystematic risk and risk costs for farm planning. Estimated risks depend on the choice of market index, whereas risk costs depend on the index choice and the risk aversion level. Rankings of enterprises change when risk costs and risk aversion are considered. More risk-averse specialized farmers are not completely compensated for risk.

Key words: risk costs, single index model, systematic risk.

Farm income variability is a problem farm businesses deal with each year. Farm diversification is one method that can be used to reduce income risk. However, it is difficult for farmers to understand and plan for risk because of the various sources of risk and because farmers often do not understand the risk-return tradeoffs based upon correlations, means, standard deviations, and risk-aversion coefficients. Mean-variance techniques used to derive efficient diversification strategies usually do not consider an individual enterprise's contribution to the risk of the farm. In order for a farmer to make decisions more wisely, improved information about risk associated with individual farm enterprises is necessary. Including risk cost information in enterprise budgets will allow farmers to begin to see some of the risk-return tradeoffs that occur when comparing alternative enterprises. Considering risk costs may change the preferred ordering of enterprises.

The objective of this study is to determine the levels of systematic and nonsystematic risk and corresponding costs for a selection of farm enterprises in southeast Kansas using enterprise budgets from actual farm data. In addition, this article considers whether the results will differ using alternative definitions of the market portfolio. Nonsystematic risk is reduced as a farm diversifies, while systematic risk is not. If a farm is fully diversified, nonsystematic risk is zero. A risk cost can be estimated from systematic and nonsystematic risks of an enterprise and can be subtracted from the budgeted returns. By estimating the risk costs of different enterprises, farm managers can use this risk information in the selection of efficient portfolios.

The single index model (SIM) has been used in finance and agriculture to simplify the information needs of mathematical programming models (Sharpe; Collins and Barry; Turvey, Driver, and Baker). It provides estimates of risk that represent the variance–covariance structure of enterprise returns. Several studies have used the SIM either to provide risk information and derive optimal enterprise combinations or to determine the risk costs (Collins and Barry; Turvey and Driver; Turvey, Driver, and Baker; Gempesaw et al.; Sharpe and Baker).

The problem of market index choice has been considered *ex post* in the finance literature (Frankfurter). Frankfurter found that on an *ex post* basis, some index measures performed as well as others. However, Frankfurter argued that better efforts should be made to determine the appropriate market index. Several SIM applications in agriculture have used state enterprise extension budgets and various measures of the market index. Collins and Barry used deflated averages of enterprises to form the market index. Turvey, Driver, and Baker chose nominal averages of individual enterprises for the market index. Gempesaw et al. used deflated detrended averages of individual enterprises for the market index. Sharpe and Baker chose real Indiana net farm income and a rate of return on assets as possible indices. Thus, their indices

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were weighted by production in the state of Indiana. Unlike the previous studies, which used data from extension budgets for returns, this study uses actual farm enterprise records from farmers. In addition, this study compares local weighted averages with state weighted averages in examining diversification in a smaller geographic area. Local market indices more likely will meet the SIM assumptions than state indices because of the local nature of many production risks. This type of data likely would be more appropriate for extension economists and farm managers to use in decision making.

Analytical Framework

The basic assumption underlying the SIM is that enterprise returns are correlated to a market index, m, as follows:

(1) $$R_{ij} = \alpha_i + \beta_i R_{mj} + e_{ij},$$

where R_{ij} is the net return of the ith enterprise for the jth time period, R_{mj} is the market return, α_i is the fixed component of R_{ij} which is independent of R_m, β_i is a measure of responsiveness of enterprise i to changes in R_{mj}, and e_{ij} is a random factor with mean zero and variance σ^2_{ei}. Two further assumptions characterize the SIM approximation of the variance–covariance structure: (a) the error term is uncorrelated with the index return, $\text{cov}(e_{ij}, R_{mj}) = 0$; and ($b$) the error terms are not correlated across equations, $\text{cov}(e_{ij}, e_{kj}) = 0$ for $i \neq k$. The first hypothesis (a) is tested using the Wu–Hausman test, and the second hypothesis (b) is tested using the Lagrange Multiplier (LM) test.[1]

Enterprise and portfolio variances are derived as follows (ignoring the time subscript), based on the single index model assumptions:

(2) $$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2, \qquad \text{and}$$

(3) $$\sigma_p^2 = \left(\sum_{i=1}^{n} x_i \beta_i \right)^2 \sigma_m^2 + \sum_{i=1}^{n} x_i^2 \sigma_{ei}^2,$$

where σ_p^2 is the farm portfolio variance and σ_m^2 is the market portfolio variance. Portfolio standard deviation can be obtained by taking the square root of equation (3).

Sharpe and Baker define the marginal standard deviation for the ith enterprise being added to a well diversified portfolio (nonsystematic risk = 0) as:

(4) $$\frac{\partial \left(\lim_{n \to \infty} \sigma_p \right)}{\partial x_i} = B_i \sigma_m,$$

which is just the marginal systematic risk of the ith enterprise. The systematic risk does not change whether or not the portfolio is diversified. If the portfolio is not well diversified (n is small), the addition of a marginal unit of one enterprise increases the portfolio risk by its standard deviation (σ_i) and increases the nonsystematic component of risk. The systematic portion of risk does not change:

(5) $$\partial \sigma^{NS} / \sigma x_i = \partial \sigma_p / \partial x_i - \beta_i \sigma_m.$$

Derivation of the Risk Costs

The mean standard deviation model of portfolio selection is formulated as follows:

(6) $$\text{Max } Z = \sum_{i=1}^{n} x_i R_i - \Theta \sigma_p,$$

where Z is the utility function, Θ is the risk aversion coefficient, and $\Theta \sigma_p$ is the portfolio risk cost. Sharpe and Baker have shown that the addition of a marginal unit of enterprise i changes the utility function as much as $(R_i - \Theta \sigma_i)$, the first derivative of Z with respect to x_i. Multiplying the systematic and nonsystematic risk by theta will convert the risk cost into certainty equivalents.

The Wu–Hausman Test

The Wu–Hausman test can be used to test independence between stochastic regressors and disturbances, $cov(e_i, R_m) = 0$ (Wu; Hausman). This assumption allows the enterprise variance to be written as it is in equation (2). The independence assumption between the market portfolio and the error term may be violated in previous applications of the single index model. Using an unweighted average as the market index would cause equation (1) to be rewritten as:

$$R_{ij} = \alpha_i + \beta_i N^{-1} \sum_{i=1}^{N} R_{ij} + e_{ij}, \tag{7}$$

where N represents the number of enterprises, and the rest of the variables are as defined above.[2] The R_{ij} variable appears on both sides of equation (7). Sharpe and Baker propose using state indices instead of averages to avoid the endogeneity problem encountered above. Although an enterprise at a county or farm level may be a much smaller proportion of the state average, the potential problem of endogeneity still exists.

The Wu–Hausman test can be used to determine the magnitude of this potential problem. The Wu–Hausman test uses instrumental variables to test whether the difference between the OLS estimates[3] and the instrumental variables estimates is large (Thurman 1986). If the distance is not large, the null hypothesis of exogeneity cannot be rejected. Formally, the Wu–Hausman test statistic is as follows:

$$T = (b_{OLS} - b_{IV})'[V(b_{OLS} - b_{IV})]^{-1}(b_{OLS} - b_{IV}), \tag{8}$$

where b_{OLS} represents the OLS parameter estimates, b_{IV} represents the instrumental variable parameter estimates, and V is the variance. The test statistic T is distributed as a chi square with degrees of freedom equal to the number of estimated parameters (Thurman 1987).

The Lagrange Multiplier Test

The Lagrange Multiplier (LM) test can be used to test the second assumption of the SIM (Sharpe and Baker). The analysis involves testing whether the off-diagonal elements of the error variance–covariance matrix are zero. The null hypothesis for the LM test is that the variance–covariance is diagonal. The LM statistic is constructed as follows:

$$LM = N \sum_{i=1}^{k} \sum_{j=1}^{i-1} r_{ij}^2 \tag{9}$$

with: $$r_{ij} = N^{-1}(\sigma_{ei}^2 \sigma_{ej}^2)^{-1/2}(E_i' E_j),$$

where σ_{ei}^2 is the estimated variance of e_i, E_i is a vector of error terms e_i, K is the number of enterprises, and N is the number of observations. The LM statistic is distributed chi square with $(K/2)(K - 1)$ degrees of freedom (Breusch and Pagan). Indices that violate the assumptions of the single index model are not appropriate for use in single index applications because they do not reflect the true variance–covariance structure.

Data

The net returns to operators' unpaid labor and management are collected for six enterprises from 1976 through 1989. Data on crop and livestock returns are obtained from the Kansas Farm Management Association farmer enterprise data program. Crop net returns are gross income from the operators' share of the production plus government payments and other incomes, minus the total costs. Total costs include all cash expenses, depreciation on equipment, buildings, and storage facilities, real estate taxes, an interest charge on capital, and rental rate. Livestock returns are obtained by subtracting total costs from the gross income; gross income from livestock is the value of livestock sales income minus purchase costs plus miscellaneous income.[4] All returns on the farm enterprises are measured in 1989 constant dollars.[5] All returns are from southeast Kansas (table 1). The mean returns to all enterprises except the beef enterprise were positive from 1976 to 1989 based on actual farm records.

The following six variables were selected as possible market indices: (*a*) Kansas gross farm income before inventory adjustment, *GFI*; (*b*) Kansas net income after inventory adjustment, *NFI*; (*c*) total net farm income in Kansas, *TFI*; (*d*) net farm income for southeast Kansas Farm Management Association

Table 1. Real Enterprise Income for Southeast Kansas Farm Enterprises, 1976-89

Year	Sorghum	Wheat	Soybeans	Beef	Dairy	Swine
	($/acre)			($/head)		
1976	125.38	−8.05	77.04	−81.31	353.54	32.33
1977	56.71	33.37	94.37	−53.17	383.26	43.39
1978	16.51	31.83	94.56	104.72	711.39	72.74
1979	79.12	98.83	63.28	75.28	808.50	7.38
1980	−34.30	65.15	−1.89	−81.25	661.42	11.08
1981	−2.71	6.01	26.18	−256.90	58.73	6.54
1982	14.68	−6.96	−8.05	−203.65	216.25	54.26
1983	−46.50	7.86	7.49	−184.33	−40.90	13.76
1984	−54.59	1.13	−70.66	−159.71	178.82	16.50
1985	8.38	−19.36	−4.19	−224.51	−114.75	16.24
1986	2.26	−34.46	7.25	−115.98	85.99	12.18
1987	14.99	11.08	4.02	32.56	212.66	8.97
1988	68.48	54.07	54.12	82.29	242.79	4.87
1989	34.58	27.74	41.94	−17.22	251.62	1.24
Mean	20.23	19.16	27.53	−81.66	286.38	21.53
Std. Dev.	50.01	35.72	46.20	115.02	276.35	21.25

Note: Income is in 1989 constant dollars.
Source: Kansas Farm Management Association.

farms, *NFIS*; (*e*) rate of return on net worth for southeast Kansas Farm Management Association farms, *RNWS*; and (*f*) gross farm income for southeast Kansas Farm Management Association farms, *GFIS* (table 2). *GFI, NFI, NFIS,* and *GFIS* are measured on a per-farm basis.

Net return enterprise data are used to analyze longer run farm enterprise mix decisions. Because of fixity in assets and resource constraints, the ability to change mix dramatically from year to year is limited.

Table 2. Possible Choices for the SIM Market Index, 1976-89

Year	*GFI* ($/farm)	*NFI* ($/farm)	*TFI* ($ mil.)	*NFIS* ($/farm)	*RNWS* (%)	*GFIS* ($/farm)
1976	102,212	12,664	988	25,710	−4.77	193,170
1977	108,793	11,603	894	46,953	−6.78	214,498
1978	113,305	10,507	798	53,218	−4.12	209,163
1979	148,756	17,991	1,349	66,427	−2.64	243,482
1980	124,329	−2,690	−202	−1,138	−15.10	167,020
1981	114,639	4,474	336	3,705	−14.73	178,354
1982	118,634	13,635	1,023	14,965	−11.45	188,474
1983	111,205	6,030	452	7,499	−11.57	163,272
1984	117,312	13,260	981	801	−13.30	166,817
1985	112,468	18,652	1,343	431	−14.70	159,490
1986	110,369	23,879	1,672	21,392	−7.39	172,307
1987	115,421	26,252	1,838	50,693	−0.99	197,447
1988	121,712	24,042	1,659	59,597	2.23	210,732
1989	111,297	15,739	991	38,291	−3.41	184,143
Mean	116,461	14,003	1,009	27,753	−7.77	189,169
Std. Dev.	10,818	8,050	559	24,287	5.71	24,034

Note: Estimates are in 1989 constant dollars.
Sources: Kansas State Board of Agriculture: Kansas gross farm income before inventory adjustment (*GFI*), Kansas net farm income after inventory adjustment (*NFI*), and Kansas total net farm income (*TFI*). Kansas Farm Management Association: net farm income for southeast Kansas Farm Management Association (*NFIS*), rate of return on southeast Kansas farm net worth (*RNWS*), and gross farm income for southeast Kansas Farm Management Association (*GFIS*).

Table 3. Wu-Hausman Independence Test Statistic Results

Enterprise	*GFI*	*NFI*	*TFI*	*NFIS*	*RNWS*	*GFIS*
Sorghum	.06	2.05	2.00	1.59	.41	1.76
Wheat	2.47	2.02	2.14	.23	.02	.62
Soybeans	2.16	.21	.15	.38	.19	1.69
Beef	.76	.23	.24	1.64	1.32	1.41
Dairy	2.52	1.73	1.79	.66	.20	1.69
Swine	1.37	.60	.65	.62	.43	1.21

Note: The 95% level of confidence test value is 5.99. For definitions of the variables, see note to table 2.

In the finance literature, portfolio theory is based on the assumption that markets are efficient. An individual security may have an above-normal return from year to year; however, the market will adjust to drive it down if it persists. Because abnormal returns will not persist in the market, portfolio models assume a longer run planning horizon. If the efficient markets hypothesis holds, as many studies in finance suggest, then the buy-and-hold strategy outperforms switching the portfolio mix from year to year. Thus, using the single index model to examine the long-term enterprise mix, where substantial year-to-year changes are not expected, is not all that different from its use in finance applications.

Estimation Procedures

The first step in the estimation process is to conduct the Wu–Hausman test to check for endogeneity. Lagged returns and lagged indices are chosen to be used as instrumental variables. However, this set of instruments would rapidly exhaust the degrees of freedom, if all were used. Principal components are used to narrow the set of instruments to three. The three principal components explain 87% of the variation. The three principal components are chosen as the set of instruments to use in the Wu–Hausman test. The results of the Wu–Hausman test are found in table 3. The results suggest that, in all cases for each index, the hypothesis of exogeneity cannot be rejected. That is, the first assumption of the SIM (cov(R_m, e_i) = 0) cannot be rejected for any of the indices.

Results

Real returns, R_i of the ith farm activity, are regressed separately on each of the six farm indices included in this study. The OLS estimates of β_i are found in table 4. The *GFI* and the *NFI* indices have autocorrelation present in three of the six estimated equations, but autocorrelation is inconclusive in two of the six equations. Autocorrelation is found in four of the six equations, with another equation inconclusive for the *TFI* index. The *RNWS* has autocorrelation present in two of the six equations, with another equation being inconclusive. Autocorrelation is not found in any of the six equations for the *NFIS* and the *GFIS* indices although the test is inconclusive in two of the six equations for the *NFIS* index.

Table 4. Estimated Beta Coefficients for Individual Enterprises Using Alternative Market Indices

Enterprise	*GFI*	*NFI*	*TFI*	*NFIS*	*RNWS*	*GFIS*
Sorghum	.0015	.0025	.0365	.0014*	5.153*	.0014*
Wheat	.0026*	−.0009	−.0123	.0008*	2.529	.0010*
Soybeans	.0004	.0002	.0034	.0013*	4.445*	.0013*
Beef	.0043	.0048	.0681	.0042*	8.608*	.0036*
Dairy	.0173*	−.0074	−.0972	.0061	16.572	.0078*
Swine	−.0005	−.0005	−.0047	.0001	−.134	.0002
LM-statistic	51.63	65.46	64.69	25.62	39.47	19.60
LM-probability[a]	0.00	0.00	0.00	4.22	0.05	18.77

Note: An asterisk indicates the coefficient is significantly different from zero at the 5% confidence level with the t-test. For definitions of the variables, see note to table 2.
[a] The probability that the calculated statistic is less than the theoretical value; that is, the confidence level at which the null hypothesis of zero correlation among error terms is not rejected (%).

Table 5. Systematic and Nonsystematic Risk Measured in Standard Deviation for Southeast Kansas Enterprises by Index

	Systematic Risk		Nonsystematic Risk	
Enterprise	*GFIS*	*NFIS*	*GFIS*	*NFIS*
	($)			
Sorghum	33.54	33.18	16.47	16.83
Wheat	23.98	19.39	11.74	16.33
Soybeans	31.93	32.40	14.27	13.80
Beef	86.70	101.55	28.32	13.47
Dairy	186.96	148.12	89.39	128.23
Swine	4.63	2.81	16.62	18.44

Note: *NFIS* = net farm income for southeast Kansas Farm Management Association; *GFIS* = gross farm income for southeast Kansas Farm Management Association.

Systematic risk is a component of the total risk of an enterprise's return when the corresponding beta coefficient is significantly different from zero. Total risk is diversifiable, to the extent that not all risk is systematic. Results differ by index as to whether systematic risk represents part of or none of the total risk of the farm enterprise (table 4). The *NFI* and *TFI* indices suggest the risks on all enterprise returns are nonsystematic. The *GFIS* and *NFIS* indices suggest a large systematic risk component for most enterprises. The *GFI* and *RNWS* indices imply that about half the enterprises have systematic risk and thus the risk on most enterprises is diversifiable. The choice of index determines the risk components of enterprise total risks.

The LM test results also are presented in table 4. The number of degrees of freedom for the LM test with six enterprises is 15. Two indices, *GFIS* and *NFIS,* satisfy the LM test results at the 1% significance level (table 4). The *GFIS* index satisfies the LM test results at the 5% level of significance.

The *GFIS* and the *NFIS* indices were used to derive systematic and nonsystematic risk components because they conform "best" to the SIM assumptions. Given the local nature of many production risks, it is not surprising that local market indices better conform to the SIM assumptions than the aggregate indices. Market indices must be chosen so they are representative of the farmer's own portfolio risks and returns.

Systematic risk is determined by multiplying each β_i by σ_m for each index. Nonsystematic risk is obtained by subtracting estimated systematic risk from the total risk for each enterprise. Systematic risks generated by the *GFIS* are greater than those generated by the *NFIS* for four of the six enterprises. Systematic risk is consistently greater than nonsystematic risk with both indices for all enterprises studied, except for swine (table 5). These results are consistent with the findings of Turvey and Driver, and Sharpe and Baker. Collins and Barry, and Gempesaw et al. found nonsystematic risk was larger than systematic risk for most enterprises. However, Gempesaw et al. showed that soybeans, wheat, and corn had larger components of systematic risk than nonsystematic risk, as this study also demonstrates. The choice of index has some (but not a large) impact on estimated risk measures, because the LM results are approximately the same for both indices. The rankings of enterprises by systematic risk do not change with the use of either index.

Risk Costs and the Gain to Diversification

Risk cost information is important for choosing among alternative production possibilities in order to maximize farm income while reducing risk. Systematic risk costs are a function of the farm sector index. Farmers can do nothing to reduce them. These costs are inherent to farming and occur whether each enterprise is produced separately or in combination with others. Nonsystematic risk costs can be reduced by diversifying into alternative enterprises. Brink and McCarl estimated an average risk coefficient of .23 with a range from zero to 1.28 for a group of Corn Belt farmers. These values are used as an approximation of Kansas farmers' risk preferences to derive the risk costs (table 6). These costs are proportional to risk, and the proportion of systematic and nonsystematic risks is maintained with respect to the costs. The risk costs are larger for more risk-averse farmers.

A farmer in southeastern Kansas having average risk preferences[6] (Θ = .23) has a systematic cost of $7.71 per acre and a nonsystematic cost of $3.79 per acre for growing sorghum (table 6). Nonsystematic risk cost can be partially reduced or totally eliminated, depending on the degree of diversification. For each farm enterprise, this cost should be added to the systematic risk cost when that enterprise is produced

Table 6. Systematic (Syst) and Nonsystematic (Nons) Risk Costs at Various Risk Aversion Levels

	Risk Aversion Coefficient					
	.01		.23		1.25	
Enterprise	Syst	Nons	Syst	Nons	Syst	Nons
Sorghum ($/acre)	.34	.16	7.71	3.79	41.93	20.59
Wheat ($/acre)	.24	.12	5.52	2.70	29.98	14.68
Soybeans ($/acre)	.32	.14	7.34	3.28	39.91	17.84
Beef ($/head)	.87	.28	19.94	6.51	108.38	35.40
Dairy ($/head)	1.87	.89	43.00	20.56	233.70	111.74
Swine ($/head)	.05	.17	1.06	3.82	5.79	20.78

individually, but represents the potential gain from efficient diversification with other enterprises in a portfolio. If a farmer is more risk averse[7] ($\Theta = 1.25$), the systematic risk cost for grain sorghum production is $41.93 per acre, whereas the nonsystematic risk cost is $20.59 per acre. If a farmer is less risk averse ($\Theta = .01$), the systematic and nonsystematic risk costs are 34¢ and 16¢, respectively.

For all enterprises with a mean greater than zero, the sum of the systematic and nonsystematic risk costs is less than the mean, if the risk aversion coefficient is .01 or .23. If the risk aversion coefficient is 1.25, the sum of the nonsystematic and systematic risk costs is greater than the mean return in all cases. Thus, the certainty equivalent is negative, and doing nothing is preferred to specialized farming. However, the systematic costs of the dairy and the swine enterprises are less than the mean return, indicating that combinations of these enterprises in a diversified portfolio are appropriate choices for the more risk-averse farmer.

Systematic cropping risk costs are highest for sorghum and lowest for wheat. Soybeans are the most profitable crop, after considering systematic risk costs for low ($27.21/acre) and average ($20.19) risk-averse farmers. Sorghum is the second most profitable crop ($19.89/acre), after considering systematic risk costs for the low risk-averse farmer, and wheat is third ($18.92). However, for the average risk-averse farmer, wheat is the second most profitable crop ($13.64/acre), and sorghum is third ($12.52). The preceding examples illustrate some of the tradeoffs that may occur when risk costs are considered in enterprise budgets.

Conclusion

Six farm indices are tested in this study for use in estimating systematic and nonsystematic risks for southeast Kansas farm enterprises. Using the Wu–Hausman test and the Lagrange Multiplier test, the southeast Kansas gross farm income and southeast Kansas net farm income indices better approximate the single index model (SIM) assumptions. Results of this study suggest that in this application of the SIM, localized farm indices are more appropriate than statewide indices for the market index, probably because of the localized nature of many risks (weather, disease, etc.). Thus, when choosing a market index for SIM applications, it is more appropriate to use local indices because these indices are more representative of a farmer's own risks and returns.

These indices are used to derive the risk components. Systematic risks are larger than nonsystematic risks for four of the six enterprises studied. Similarly, systematic risk costs are greater than nonsystematic risk costs for most enterprises. In southeast Kansas, systematic risk costs are less than the mean return for dairy and swine enterprises for even the most risk-averse farmers. Systematic cropping risk costs are highest for grain sorghum and lowest for wheat. Some changes in the ranking of crop enterprises occur when systematic risk costs are considered for alternative risk-aversion levels. In each case when direct comparisons could be made, systematic and nonsystematic risk costs are larger than those found by Sharpe and Baker in Indiana. This may be due partly to Kansas agriculture being riskier than Indiana agriculture and partly to the use of actual enterprise data from farms rather than data from extension budgets.

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Notes

[1] Sharpe and Baker were the first to apply the Lagrange Multiplier test to the single index model in an agricultural context.

[2] A weighted average index also would be inherently biased. N^{-1} could be replaced in equation (7) with the weighting used in the weighted average index to see this.

[3] The OLS estimates are obtained from estimation of equation (1) under the assumption that endogeneity is not a problem.

[4] Other and miscellaneous incomes are included to record such income items as insurance proceeds, expense refunds, patronage dividends, etc. These items usually account for less than 5% on average.

[5] The deflated data were tested to check for trends. The results suggested that no positive trends were present in the data. Thus, the data were not detrended.

[6] Average is used because .23 is the average risk-aversion coefficient for a group of Corn Belt farmers.

[7] The risk-aversion coefficient of 1.28 is the maximum observed in the Brink and McCarl study.

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