THE PRACTICALITY IN THE USE OF MOTAD FOR EFFICIENT CROP MIXTURES UNDER RISK

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I. Introduction

Risk is widely recognized as a key factor in farm enterprise choice. Thus, the inclusion of risk in farm planning has been considered desirable in many theoretical discussions. The tradeoff between expected return and income variability is at the heart of the enterprise choice under risk. An efficient frontier provides information concerning the tradeoff between expected return and risk in the enterprise choice decisions. The frontier is particularly useful when the risk among enterprise varies substantially and large amounts of scarce resources are committed to the enterprises.

The MOTAD model that was suggested by Hazell(1971), is one of mathematical programming models that has been widely used in deriving out the efficient frontier. The MOTAD approach is an approximation to mean-variance(E-V) efficiency approach whose efficient set is identical to the second stochastic dominance (SSD) efficient set. The MOTAD model has been applied successfully to several different types of farm enterprise choice decision problems in the past (Mapp, *et al.*, 1979).

Although the efficient frontier driven out from the MOTAD approach is useful in farm enterprise choice decisions under risk, it does not provide information about near-optimal enterprise combinations. Schurle and Erven(1979) argued that since the optimum solutions in linear programming need not be optimum for other criteria, and farmer's utility functions cannot be completely specified in terms of risk and returns, decision makers should be interested in farm plans slightly different from those on the frontier in terms of risk and return levels. They further claim that the usefulness and uniqueness of frontier as a decision aid would be reduced substantially if these near optimal solutions included substantially different enterprise combinations. The analysis of frontier sensitivity would serve one way to address this problem. The efficient frontier must be useful in farm enterprise decisions under uncertainty or risk. At the same time, it would be important to incorporate frontier sensitivity analysis to improve the practical usefulness of the efficient frontiers for the farmers.

The objectives of this paper are :

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1. To derive efficient frontier(E-A) with risk-retutn tradeoff and associated crop mixture as an aid in farm planning under risk, with the data for an assumed representative farm situation in Southwestern Oklahoma in the United States and,

2. To examine the practical applicability of the E-A frontier through frontier sensitivity analysis.

This paper first defines an assumed representative farm in Caddo County in Southwestern Oklahoma and describes data requirements. Then, MOTAD model is presented. The efficient sets of farm enterprise combination with E-A frontier and the analysis of frontier sensitivity follow. Finally, summary and limitations are provided.

Ⅱ. The Farm Situation and Data Requirement

A representative family farm situation for Caddo County in Southwestern Oklahoma was assumed for the analysis. The farm contatins 1,200 acres of dry cropland and $60,000 of own operating capital. It also has 3,000 man hours of family labor availability per year which are equally distributed over four quarters in a year. Neither capital borrowing nor labor hiring was assumed. Crop activities include wheat, cotton, sorghum for grain, oats for grain, barley for grain, and alfalfa. Peanuts, one of the major crops in this area was not included due to its data deficiency. Livestock activities were not considered to facilitate the analysis. The MOTAD model requires data on yield, product price and production cost. Historical data for 1975-1984 were obtained from Oklahoma Agricultural Statistics(yield and product price) and Oklahoma State University Farm Budgets Generator(production cost) for each activity in the models. Agricultural technologies were assumed constant over the period. Product storage and marketing cost were not considered in the analysis.

Current product prices were used in calculating gross revenue (production quantity x current product prices). The Index of Prices paid by farmers was used to obtain the production cost series at current value from 1984 back to 1975 for each activity. Alfalfa cost was inflated by 30 percent to improve the precision of the estimate with the recommendation of the Officer in the Budget Generator Office at Oklahoma State University.

Then, nominal gross margins for each activity were calculated by subtracting the variable cost of production during each year from the appropriate gross revenue in that year. Again, gross margin was deflated by Index of Prices received by farmers that gave deflated gross margin expressed in 1977 value. The estimated deflated gross margins for crops are presented in Table 1. The deflated gross margin correlation was positive between most of the crops with exception of wheat, sorghum, oats, cotton to alfalfa(Table 2).

TABLE 1. **Estimated Deflated Gross Margins for Selected Crops. Caddo County, Southwestern Oklahoma(1977=100)**

$/ACRE

Year	Wheat	Barley	Sorghum	Oats	Cotton	Alfalfa
1975	48.32	30.48	68.00	12.88	34.54	68.93
1976	29.36	58.26	21.67	22.38	81.14	121.09
1977	40.43	18.54	34.04	25.25	117.03	68.62
1978	49.59	5.03	57.38	9.91	88.68	61.58
1979	118.33	44.91	74.65	28.61	156.03	85.01
1980	39.33	8.80	13.69	5.91	48.18	66.05
1981	50.15	12.63	46.25	18.73	67.05	76.01
1982	52.14	7.79	49.64	1.45	17.85	80.76
1983	54.12	33.20	56.17	26.97	45.98	70.63
1984	38.31	16.40	45.07	−2.81	19.63	109.02
MEAN	52.01	23.61	46.66	14.93	67.52	80.77
STANDARD DEVIATION	23.28	16.75	18.24	10.56	41.92	18.55
C. V.	0.45	0.71	0.39	0.71	0.62	0.23

TABLE 2. **Correlation Coefficients of Crop Enterprise Deflated Gross Margins**

	Wheat	Barley	Sorghum	Oats	Cotton	Alfalfa
Wheat	1.0000	0.2644	0.6887	0.4118	0.6057	−0.1422
Barley		1.0000	0.0950	0.6358	0.3871	0.5771
Sorghum			1.0000	0.1907	0.1814	−0.2507
Oats				1.0000	0.7276	−0.0790
Cotton					1.0000	−0.0673
Alfalfa						1.0000

Ⅲ. Model Formulation and Procedure

Initially, a LP model that did not consider risk was constructed as follows :

Maximize $\sum_{j=1}^{6} C_j X_j$.

Subject to

$\sum_{j=1}^{6} a_{ij} X_j \leq b_i$ for all i resources

$X_j \geq 0$

where

C_j = gross margin to unpaid resources per unit for the j^{th} crop activity,

X_j = level of the j^{th} crop activity

b_i = the amount of i^{th} unpaid resources, and

a_{ij} = the amount of the i^{th} resource required per unit of the j^{th} crop activity (technical coefficients).

In the rows b_i includes land, capital, labor for January-March, labor for April-June, labor for July-September, and labor for October-December. In the columns, six crop activities are included : wheat, barley for grain, oats for grain, sorghum for grain, cotton, and alfalfa. The LP matrix including the values of C_j, a_{ij} and RHS is presented in the input tableau in Appendix 1.

Then, the MOTAD model was constructed. The MOTAD model used in this analysis assumes a utility function :

$$U(Z)=a+bz+c[Z-E(z)]$$

where

a, b and c are positive constants and

z is the random variable.

The form of the model is :

Minimize Ld^-

Subject to

$AX \leq B$

$DX+Id^- \geq 0$

$C'X= \lambda$

and

$$X,\ d^-,\ \lambda \geq 0$$

where

L =a 1 by 10(s) vector where 10 is the number of years considered.

d^-=a 10 (s) by 1 vector of yearly negative income deviation from mean income which is the mean of gross margin series

A =a 6 (m) by 6 (n) matrix of technical coefficients, where 6 (m) is the number of constraints and 6(n) is the number of activities

X =a 6 (n) by 1 vector of activity levels

B =a 6 (m) by 1 vector of resource levels or constraints

D =a 10 (s) by 6 (n) matrix of income (gross margin) deviation

I =a 10 (s) by 10 (s) identity matrix

C' =a 1 by 6 (n) vector of expected income(gross margin)

λ =a scalar used to represent the income constraint.

In this MOTAD model, we minimize Ld^- which represents the summed total negative deviations over all years, subject to those constraints above. The rows and colums consistent with the model is presented in the input tableau in Appendix 2. The efficient frontier is developed by parameterizing λ from zero to its maximum value. The maximum λ value was obtained from the solution of the above initial LP model that did not consider risk. The tradeoff occurs between expected return(mean gross margin) and risk(negative income deviation).

In the MOTAD model. risk is measured as linear deviations from the mean. Implicitly, risk is undesirable, and hence is minimized(Watts, 1984). The E-A frontier inherent in MOTAD is often used as a substitute for the E-V frontiers since the linear programming codes required to solve MOTAD formulations are more widely available, better understood and more dependable than the quadratic programming codes required to implement the E-V frontier. Johnson and Boehlje(1981) have provided theoretical support for the MOTAD by arguing that it can be used to maximize expected utility when the outcome distributions are symmetric and the utility function is quadratic, negative exponential or logarithmic.

Ⅳ. Results

The initial standard LP with the data for Caddo County resulted in the objective value of $68,882(Appendix 1). This is the maximum attainable gross margin with given resources constraints and crop activities. At this solution, crop mix was 839 acres of wheat, 295 acres of cotton and 65 acres of alfalfa. However, this solution does not consider risk involved with crop activites.

The MOTAD model was applied to the same farm data for Caddo County in Southwestern Oklahoma. To derive out efficient sets, the mean gross margin was varied in $2,000 intervals at less than $67,000 mean gross margin and $300 intervals at more than $67,000 up to $68,882, the maximum attainable gross margin. The resulting efficient frontier(E-A frontier) and crop combinations associated with points on the frontier are illustrated in Figure 1. For simplicity, some selected farm plans are shown in Table 3. The table also shows the coefficient of variation which is obtained, following Hazell's formula :

$$MAD \times \left[\frac{\pi * S}{2(S-1)}\right]^{\frac{1}{2}}$$

where

MAD is the mean aboslute deviation in the gross margin and

S is the number of years in the data.

The enterprise combinations appear to be consistent with those expected, based on the level and variability of individual crop gross margins and correlation of crop gross margin. Six different crop combinations were observed at different risk-return levels. Crop combinations changed along the frontier. Most acreage was committed to wheat, cotton and alfalfa at higher risk-return levels. As the levels decreased, the crop mixes changed to wheat-barley-alfalfa, then to wheat-barley-oats-alfalfa, to wheat-oats-cotton-alfalfa, to wheat-sorghum-oats-cotton-alfalfa, and finally to sorghum-oats-cotton-alfalfa at the lower risk-return level. In general, more diversified crop mixes were observed at lower risk-return levels above $25,000 return.

Acreage tradeoff between crops did not occur below $25,000 return. The tradeoff between risk and return was captured by the coefficient of variation. As the gross margin decreased, the coefficient of variation was reduced which showed that risk per dollar of expected gross margin was reduced.

TABLE 3. **Tradeoff between Risk and Expected Return and Associated Crop Mixes**

Mean Gross Margin	Negative Deviation from Mean Income	CROP MIXES						
		Wheat	Barley	Sorghum	Oats	Cotton	Alfalfa	C.V.
66,882	88,557	839	0	0	0	295	65	0.33
67,000	69,874	1,032	0	0	0	2	162	0.27
57,000	55,496	823	4	0	0	0	173	0.25
47,000	41,215	587	12	0	42	0	174	0.23
35,000	24,138	278	0	0	139	11	163	0.18
27,000	15,424	44	0	45	198	48	143	0.15
25,000	14,219	0	0	67	188	53	143	0.15

V. Frontier Sensitivity

The E-A frontier has shown the minimum risk-efficient frontier under risk with given resource constraints and alternative crop activities. However, the E-A frontier did not provide information about the near optimal crop mixes which might be important to farm decision makers. Thus, we need to examine the frontier sensitivity from which we want to know if there exist crop mixes substantially different from those in Table 3 for each level of gross margin which have inconsequential increases in risk. Following the Schurle and Erven approach, the frontier sensitivity was investigated by restricting the MOTAD model to the selection of enterprises in different subsets of all the enterprises considered. Each subset, formed by exlcuding one enterprise, resulted in a separate frontier. The frontiers are shown with original frontier in Figure 1.

Each new frontier fell to the right of the original minimum risk-efficient frontier, indicating increased risk due to the different crop mixes on the new frontier. Three frontiers, for "no oats," for "no barley," and for "no cotton" remained closely together with the original frontier. However, "no wheat" and "no alfalfa" frontiers drifted away substantially from other frontiers. "No sorghum" frontier converged to the original frontiers as risk increased.

Crop mixes for each of the frontiers at three different return levels were examined : $45,000 for medium return, $65,000 for high return, and $25,000 for low return. Table 4 shows the crop mixes for each of the frontiers at the $45,000 return level. Substantial differences were observed among crop mixes. Wheat varied from 334 to 548, barley from 14 to 593, oats from 0 to 52, sorghum from 52 to 420, cotton form 0 to 167 and alfalfa from 168 to

FIGURE 1. E-A Frontier Sensitivity in Different Subsets at All Enterprises

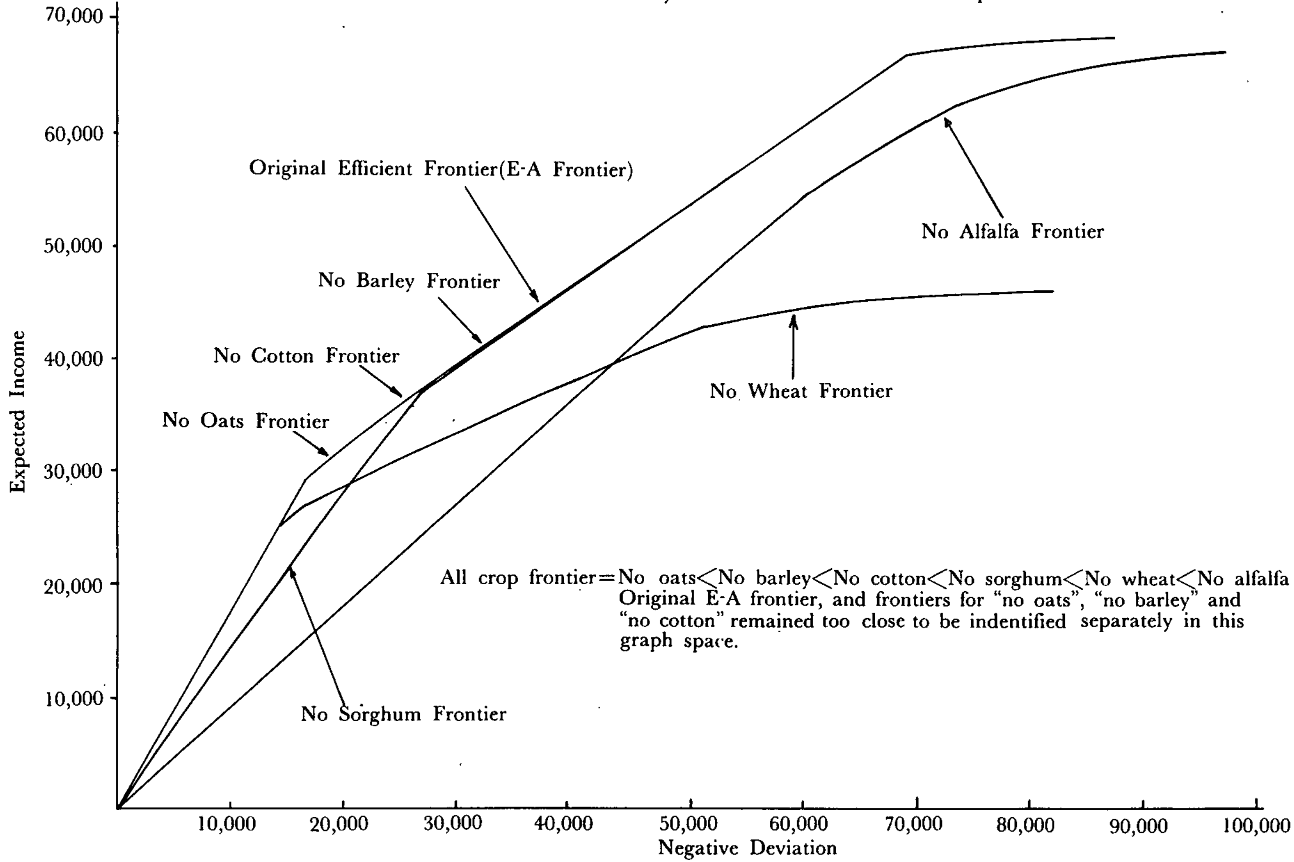

TABLE 4. **Crop Mixes That Generated $45,000 of Gross Margin**

Enterprise Restriction	Wheat	Barley	CROP Oats	MIXES Sorghum	Cotton	Alalfa	C. V.
				Acres			
None	540	14	52	0	0	174	0.22
No Wheat	0	593	0	420	167	0	0.38
	(−540)	(+579)	(−52)	(−420)	(−167)	(−174)	
No Barley	527	0	0	76	5	168	0.22
	(−13)	(−14)	(−52)	(−76)	(−5)	(−6)	
No Oats	540	14	0	52	0	174	0.22
	(0)	(0)	(−52)	(−52)	(0)	(0)	
No Sorghum	548	72	0	0	0	182	0.22
	(+8)	(+58)	(−52)	(0)	(0)	(+8)	
No Cotton	540	14	0	52	0	174	0.22
	(0)	(0)	(−52)	(+52)	(0)	(0)	
No Alfalfa	334	262	0	223	162	0	0.29
	(+106)	(+248)	(−52)	(−223)	(−162)	(−174)	

Numbers in parentheses indicate change of acreage from acreage on original frontier.

TABLE 5. **Crop Mixes That Generated $65,000 of Gross Margin**

Enterprise Restriction	Wheat	Barley	CROP Oats	MIXES Sorghum	Cotton	Alalfa	C. V.
				Acres			
None	990	0	0	0	2	164	0.27
No Wheat	–	–	–	–	–	–	–
No Barley	990	0	0	0	2	164	0.27
	(0)	(0)	(0)	(0)	(0)	(0)	
No Oats	990	0	0	0	2	164	0.27
	(0)	(0)	(0)	(0)	(0)	(0)	
No Sorghum	990	0	0	0	2	164	0.27
	0	(0)	(0)	(0)	(0)	(0)	
No Cotton	969	8	0	0	0	165	0.27
	(−21)	(+8)	(0)	(0)	(0)	(+1)	
No Alfalfa	784	0	0	184	230	0	0.27
	(−185)	(0)	(0)	(+184)	(+228)	(−164)	

Numbers in parentheses indicate change of acreage from acreage on original frontier.

182. The large variation of crop mixes were caused by "no wheat" and "no alfalfa." Thus, if the farmer wants to change crop mixes from those on the original frontier, say, to exclude wheat or alfalfa from crop mixes because of his own managerial consideration, then he has to face higher risk. The coefficient of variation increased from 0.22 to 0.38 for "no wheat" crop mix and 0.29 for "no alfalfa" mix at $45,000 return level. Meanwhile, there were situations where changes in crop mixes did result in little risk. For example, sorghum and cotton could be included in farm plan in place of barley and oats with little increase of risk, or only sorghum could replace oats in "no oats" and "no cotton" frontiers with little risk increase.

At the higher return level($65,000) crop mixes on different frontiers were almost the same with the original one except "no wheat" and "no alfalfa" frontiers. "No wheat" frontier did not reach the $65,000 retrun level. "No alfalfa" caused significant change in crop mix but with higher risk. Thus, if the farmer wants to include sorghum and cotton in place of alfalfa due to his own managerial preference at the $65,000 return level, then he has to meet their risk. The coefficient of variation increased from 0.27 to 0.33 at this situation. If the farmer wants to exclude wheat, then he could not get the $65,000 return. At higher risk-return level the original frontier remained stable.

At the lower return level($25,000), there existed substantial differences among the crop mixes. Wheat varied from 0 to 256, barley from 1 to 145, oats from 24 to 124, sorghum from 109 to 183, cotton from 46 to 90, and alfalfa from 127 to 146. Except "no alfalfa" frontier, significant changes in crop mixes were observed with little increase in risk. For example, wheat could be substituted for cotton or for oats while maintaining alfalfa acreage at current level closely with no risk increase. Sorghum acreage could be increased while decreasing oats at the same risk-return level.

As a whole, the efficient frontier remained stable at high risk- return level. "No wheat"frontier did not reach the high return level($65,000)under consideration. The restriction placed on three crops(no barley, no oats, and no sorghum)at high return level did not change the crop mix from the original risk efficient frontier which made risk comparison impossible. At medium($45,000)and low($25,000)return level, there were many situations where crop mixes could be changed considerably with little risk increase. This result with Caddo data is consistent with the study of Schurle and Erven(1979) who questioned possible data problem of his own as one of the reasons that might cause the result above that reduced the reliability of E-A frontier.

Ⅵ. Summary and Limitation

E-A frontier is widely recognized as a decision aid in efficient crop mixes under risk. With the application of MOTAD to farm data for an assumed representative farm in Caddo County, Southwestern Oklahoma, an E-A frontier was driven out. The frontier demonstrated the tradeoff between risk and return at all levels of risk-return level. Six different crop mixes were observed. As risk decreased, crop diversification was evident. Since farmers may be interested in crop mixes on near optimal frontier due to their managerial preference or consideration, frontier sensitivity was examined. Closely following Schurle and Erven(1979) approach originating from Levy and Sarnat method(1970), the sensitivity was investigated by restricting the model to the selection of crops in different subsets of all the crops considered. Each subset, formed by excluding one crop, resulted in a near optimal separate frontier. From the sensitivity analysis, it was generally observed that, with the exception of "no wheat"and "no alfalfa" frontiers, crop mixes could be changed substantially with little risk increase. This may be important to the farmers in practical usefulness of the frontier since they could have quite different point of views on crop mixes in managerial consideration among themselves.

Some limitation in this analysis deserves to be mentioned. Government commodity programs were not considered. They may influence the gross margin of the commodities under consideration. Peanuts, one of the major crops in Caddo County, was eliminated from the analysis due to data deficiency. Inclusion of this crop may result in changes in crop mix patterns and efficient frontier shape. With MOTAD model, risk could be reduced only with reduction in expected return. However, farmers may have many alternative risk management strategies such as insurance, hedging, sequential marketing, forward contracting, etc. with which risk may be reduced without substantial decrease in return. Profit maximization was assumed to be farmer's only goal in deriving out E-A frontier. Farmers may have many other goals which reduces the effectiveness of E-A frontiers. The near optimal frontiers may supplement the effectiveness of original E-A frontiers. The near optimal frontiers may supplement the effectiveness of original E-A frontier in this respect, by showing different crop mixes for the same return at similar risk level. This paper is not conclusive about the general reliability of MOTAD frontier in planning under risk but careful consideration is recommended in the practical applicability.

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APPENDIX 1. **Initial Standard LP Tableau (All Crops)**

Initial Tableau

Motad	Maximize	B	Wheat	Barley	Oats	Sorghum	Cotton	Alfalfa
C		(RHS)	52.01	23.61	14.93	46.66	67.52	80.77
LAND	L	1200	1	1	1	1	1	1
CAPITAL	L	60000	30.13	27.31	29.4	19.61	34.65	11.99
JMLABOR	L	750	0.06	0.06		0.33	0.14	0.06
AJLABOR	L	750	0.18	0.29	0.33	0.87	1.26	3.45
JSLABOR	L	750	0.2	0.36	0.3	0.26	0.52	0.25
ODLABOR	L	750	0.16	0.28	0.28		1.81	1.24

Solution

OPTIMAL

Function Value:68882.42

				Barley	Oats	Sorgham	Land	AJ/Labor	OD/Labor
				23.61	14.93	46.66	0	0	0
Returns	Name	Type	Level	real	real	real	slack	slack	slack
52.01	Wheat	real	839.0721	0.92303	0.91764	0.98986	1.10711	0.13478	0.51784
67.52	Cotton	real	295.0840	0.05448	0.05448	0.29992	0.07774	0.25537	0.77321
80.77	Alfalfa	real	65.84379	0.01227	0.02788	0.31007	0.02936	0.39015	0.25537
0	Capital	slack	23704.62	2.88980	0.47053	3.53975	30.3113	8.23168	8.12740
0	JM/Labor	slack	654.3932	0.00517	0.06435	0.29399	0.05378	0.02043	0.06185
0	JS/Labor	slack	412.2809	0.13858	0.08117	0.14047	0.17365	0.06221	0.23465
Z				53.36635	53.65675	56.27570	49.95952	7.259984	4.648010
Shadow	Price			29.75635	38.72675	9.615707	49.95952	7.259984	4.468010

APPENDIX 2. **Initial MOTAD Tableau (All Crops)**

Initial Tableau

MODEX	Minimize	B	Wheat	Barley	Oats	Sorghum	Cotton	Alfalfa	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
C		(RHS)	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
LAND	L	1200	1	1	1	1	1	1										
CAPITAL	L	60000	30.13	27.31	29.4	19.61	34.65	11.99										
JMLABOR	L	750	0.06	0.06		0.33	0.14	0.06										
AHLABOR	L	750	0.18	0.29	0.33	0.87	1.26	3.45										
JSLABOR	L	750	0.2	0.36	0.3	0.26	0.52	0.25										
ODLABOR	L	750	0.16	0.28	0.28		1.81	1.24										
T1	G	0	−3.69	6.88	−2.05	21.34	−32.98	−11.84	1									
T2	G	0	−22.65	34.65	7.46	−24.99	13.61	40.52		1								
T3	G	0	−11.58	−5.06	10.32	−12.62	49.51	−12.15			1							
T4	G	0	−2.41	−18.58	−5.02	10.72	20.28	−19.19				1						
T5	G	0	66.32	21.31	13.68	28	88.51	4.23					1					
T6	G	0	−12.68	−14.8	−9.02	−32.96	−19.34	−14.72						1				
T7	G	0	−1.86	−10.97	3.8	−0.41	−0.48	−4.76							1			
T8	G	0	0.13	−15.82	−13.48	2.99	−49.68	−0.01								1		
T9	G	0	2.11	9.6	12.04	9.51	−21.55	−10.14									1	
T10	G	0	−13.7	−7.2	−17.73	−1.59	−47.89	28.25										1
AVGM	E	68882	52.01	23.61	14.93	46.66	67.52	80.77										

APPENDIX 3. **Tradeoff between Risk and Expected Return, and Associated Crop Mixes. Caddo County, Southwestern Oklahoma(All Crops)**

Mean Gross Margin	Negative Deviation from Mean Income	CROP COMBINATION						
		Wheat	Barley	Sorghum	Oats	Cotton	Alfalfa	C. V
68882	88557	839	0	0	0	295	65	0.33
68582	82008	872	0	0	0	245	82	0.31
68282	77607	905	0	0	0	195	98	0.30
67982	75525	939	0	0	0	145	115	0.29
67682	73443	972	0	0	0	95	131	0.28
67382	71360	1006	0	0	0	45	148	0.28
67000	69874	1032	0	0	0	2	162	0.27
65000	66996	990	0	0	0	2	164	0.27
63000	64118	948	0	0	0	2	166	0.26
61000	61240	907	0	0	0	2	169	0.26
59000	58361	865	0	0	0	2	171	0.26
57000	55496	823	4	0	0	0	173	0.25
55000	52639	777	7	0	6	0	174	0.25
53000	49783	729	8	0	15	0	174	0.24
51000	46927	682	10	0	24	0	174	0.24
49000	44071	635	11	0	33	0	174	0.23
47000	41215	587	12	0	42	0	174	0.23
45000	38359	540	14	0	52	0	174	0.22
43000	35503	493	15	0	61	0	174	0.21
41000	32647	445	16	0	70	0	174	0.21
39000	29791	398	18	0	79	0	174	0.20
37000	26934	350	19	0	88	0	175	0.19
35000	24138	278	0	0	139	11	163	0.18
33000	21553	215	0	7	160	22	156	0.17
31000	19052	164	0	25	162	29	154	0.16
29000	16764	100	0	8	177	49	148	0.15
27000	15424	44	0	45	196	48	143	0.15
25000	14219	0	0	67	188	53	143	0.15
23000	13081	0	0	62	173	49	132	0.15
21000	11944	0	0	57	158	44	120	0.15
19000	10806	0	0	51	142	40	109	0.15
17000	9669	0	0	46	127	36	97	0.15
15000	8531	0	0	40	112	32	86	0.15
13000	7394	0	0	35	97	27	74	0.15
11000	6256	0	0	29	82	23	63	0.15
9000	5119	0	0	24	67	19	51	0.15
7000	3981	0	0	19	52	14	40	0.15
5000	2843	0	0	13	37	10	28	0.15
3000	1706	0	0	8	22	6	17	0.15
1000	568	0	0	2	7	2	5	0.15