Whole-Farm Risks of Producing Sugarbeets in the Red River Valley

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Sugarbeets are an important crop to farmers and communities in the Red River Valley of North Dakota and Minnesota. In 1987, sugarbeets were produced on 392,000 acres by about 1,395 farming units (Minnesota and North Dakota Agricultural Statistics Service). The economic contribution of the industry is $986 million annually (Coon and Leistritz). Other benefits resulting from the industry include employment for 2,175 plant, 14,898 support-industry, 5,500 migrant, and 5,800 transportation workers.

To individual farms, sugarbeets can be a highly profitable crop. As shown in Table 1, net income above direct costs from the production of sugarbeets is substantially higher than that of competing small grain, feedgrain, and oilseed crops. However, the variability of sugarbeet income is also greater than competing crops. Even though the coefficient of variation is less than competing crops, this level of variation coupled with higher levels of input costs per acre create sizable business and financial risks for farms that choose to produce sugarbeets. In addition, sugarbeets require specialized harvesting equipment and intensive crop management practices. Thus, sugarbeets may not be a desirable enterprise in all Red River Valley farms due to unique labor, capital, and other resource constraints that exist across individual farms.

This study analyzes the profitability and risk consequences of producing sugarbeets from a whole farm perspective. The study simulates and compares the economic performance of a representative farm in the Red River Valley that contains varying acreage of sugarbeets and levels of debt. Incorporated in the whole farm analysis are the financial, tax, insurance, and commodity program effects resulting from alternative farm plans. Superior plans are determined by a risk analysis of annual accrual returns to equity after capital gains and contingent tax liabilities. The following sections discuss business and financial risk, describe the characteristics of the representative farm, and present the study's results.

BUSINESS AND FINANCIAL RISK

Risk is an important aspect of managing modern, capital intensive farms. Overall, farmers are generally considered to be risk adverse, although degrees of risk aversion differ considerably among individual farmers (Robison et al.). This implies farmers are sensitive to both the level and variability of income arising from alternative farm enterprises.

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Table 1. Returns over direct costs, Red River Valley.

Year	Barley	Wheat	Sugarbeets
	---------- dollars per acre ----------		
1988	-4.92	8.30	131.17
1987	37.03	64.00	362.00
1986	35.47	42.21	228.62
1985	30.21	83.44	205.85
1984	18.64	67.70	177.66
1983	21.55	11.18	138.93
1982	-2.79	40.87	182.88
1981	33.66	38.12	-4.03
1980	31.49	11.65	302.97
1979	35.27	34.03	116.58
Average	23.56	40.15	184.26
Std. dev.	14.84	24.32	96.47
C.V.	.62	.60	.52

Source: North Dakota Farm Management Annual Report, Valley Average

Business risk is the inherent uncertainty within a firm that is independent of the way it is financed (Boelhje and Eidman). Even if the firm contained no debt, net income would be difficult to predict due to uncertainties involving weather, insect infestations, commodity prices, government policies, and machine reliability. In order to reduce business risk, farmers diversify crop enterprises, purchase insurance, and contract market prices.

Financial risk is defined to be the added variability of rates of return to equity that occurs with usage of debt capital. Debt capital can increase returns to equity through leverage. However, leverage also magnifies losses as payments of principal and interest on debt are a fixed commitment. Overall then, risk serves to compound business risk and overall uncertainty of the firm.

A number of decision criteria have been advanced which rank alternative management responses to risk (Boehlje and Eidman). Some criteria require probability assessments as to the likelihood of alternative outcomes while others do not. This study will employ the stochastic dominance criterion to eliminate actions that are always less preferred. The criterion selects the most risk-efficient strategy by comparing the cumulative probability distributions of possible returns from each activity under consideration. Although stochastic dominance requires probabilistic information, such data do not

have to be normally distributed. SARA, a computer software package based on the stochastic dominance criterion of assessing risk (Gustafson, 1988), is used to judge the efficiency of alternative farm plans and trade-offs between expected returns to equity and the dispersion of outcomes.

SIMULATION OF A RED RIVER VALLEY FARM

The representative Red River Valley farm was based upon averages of accounting records maintained by cash grain farmers in the area (Helt) and recently collected survey data (Johnson and Clow). The base farm consisted of 1,120 acres and produced 585 acres of wheat, 334 acres of barley and 200 acres of soybeans. Cash operating expenses and capital asset structure reflect farm averages. Crop yields are random sample observations that are representative of the area (Pederson). All crops are protected by multi-peril crop insurance. The farm enrolls in government commodity programs. In 1989, set aside acreage for both wheat and barley is 10 percent. In following years, set aside acres for both crops is assumed to be 5 percent.

Current and intermediate assets of the farm total $138,351 and $205,058, respectively, and are valued on a current market basis. Annual gross investment in nonreal estate assets was obtained from record information and assumed to be $36,275 per year. The simulation farm's land is of average productivity and has a current market value of $750 per acre. All of the land is assumed to be owner-operated, although prior research shows alternative cash and share rental strategies have greater risk-efficiency in some circumstances (Gustafson, 1989).

Based upon record data, the farm household is assumed to consist of four members and requires $22,715 per year for family living. Residual farm profits are taxed at both state and federal levels according to 1989 provisions. After-tax earnings are first used to pay down debt and then invested in market securities that earn 10 percent interest annually.

Once constructed, the financial performance of the representative farm is simulated over a four-year horizon (1989 to 1992) using the Farm Financial Simulation Model (FFSM) developed by Schnitkey, Barry, and Ellinger. FFSM is a computerized spreadsheet of coordinated financial statements which are capable of modeling the profitability, liquidity, solvency and financial position of the farm.

In this analysis, two alternative cropping plans reflecting greater acreages of sugarbeets were considered. The first alternative was similar to the base plan but contained 200 acres of sugarbeets instead of soybeans. The second alternative involved 485 acres of wheat, 234 acres of barley, and 400 acres of sugarbeets.

Production of sugarbeets requires a number of specialized resources. In terms of machinery and equipment, sugarbeet production requires a row crop planter, beet thinner, row crop cultivator, more sophisticated spraying equipment, defoliator, beet harvester, and possibly a larger truck. In 1986, farmers who belonged to the North Dakota Farm Management Association and produced between 100 to 300 acres of sugarbeets owned, on average, $56,230 more farm machinery than farmers who did not raise sugarbeets. Further, production of sugarbeets requires ownership or rental of cooperative stock in a sugarbeet processing facility. At present, one share of sugarbeet stock can be purchased for $800 and is necessary for every 1.1 acres of sugarbeets planted. Also, the financial performance of the farm was evaluated at four initial debt-to-asset positions, 0, 20, 40, and 60 percent for each level of sugarbeet production. Levels of current, intermediate, and long-term debt vary with indebtedness. Higher levels of indebtedness reflect more recent purchases of farmland by owners. Therefore, outstanding mortgage balances are larger and repayment periods longer (i.e. 0, 10, 15, and 20 years for each debt-to-asset ratio, respectively). All loans are financed at prevailing 1989 North Dakota Farm Credit System variable interest rates.

The micro nature of the study and availability of government commodity programs implies crop prices are independent of yields. Thus, three alternative commodity price scenarios were developed for the simulation period and based upon a Delphi survey of agricultural marketing economists (Gustafson, 1989). Input prices and inflation are assumed constant. Land values change over the simulation period with a one-year lag in direct proportion to variations in net income.

The three levels of sugarbeet acreage and four respective levels of financing yield 12 management strategies for farmers. Each strategy is simulated under 12 alternative commodity yields and price environments. The 12 environments represent unique draws from the multivariate yield distributions. One of the three commodity price scenarios is then randomly assigned to each environment so as to determine government commodity program participation and gross revenues.

RESULTS

The average level and standard deviation of returns to equity from the various sugarbeet acreage/financing arrangements is shown in Table 2. In all situations, returns to equity increase directly with sugarbeet acreage when the debt-to-asset ratio is held constant. However, at low levels of financing, the variability of those returns also increases with greater sugarbeet acreage. For example, with no debt, the standard deviation of these returns rises from 2.90 to 2.92 when 200 acres of sugarbeets are added to the farm.

Table 2. Statistical analysis of returns to equity from alternative sugarbeet acreages and debt financing levels.

Debt-to-asset Ratio	Sugarbeet Acreage	Rate of Return to Equity	
		Mean	Std. Dev.
		--------- percent ---------	
.00	0	3.59	2.09
.00	200	5.12	2.92
.00	400	6.94	2.91
.20	0	2.82	4.27
.20	200	4.95	3.43
.20	400	7.06	3.49
.40	0	-0.04	7.28
.40	200	4.44	4.75
.40	400	7.33	4.61
.60	0	-13.91	22.01
.60	200	1.24	10.24
.60	400	7.46	7.17

Similarily, variability increases when sugarbeet acreage increases from 200 to 400 acres on the farm with a 20 percent debt-to-asset ratio. In these situations, sugarbeets led to higher but riskier farm income. Whether the increase in income compensates farm managers for the additional risk depends on the distribution of those returns — in particular the probability that returns fall below average.

Holding sugarbeet acreage constant at zero and 200 acres, returns to equity decrease and become more variable with greater levels of financing. Only when 400 acres of sugarbeets are planted does greater use of debt lead to higher levels of farm income. In this situation too, incomes become more variable as financing increases.

In order to jointly analyze the tradeoffs between the level and variability of returns to equity for each of these management strategies, a stochastic dominance analysis is performed. Results of the analysis are shown in Table 3.

Under this criterion, farm plans involving greater acreage of sugarbeets always dominate those of lesser acreage when debt financing is held constant. The higher profit potential of sugarbeets warrants their inclusion in the representative farm's cropping plan.

Interestingly though, it would not be efficient from a risk perspective for farms without sugarbeets and debt at the present to enter sugarbeet production if such as activity necessitated high levels of financing. Consider the farm plans that do not include sugarbeets at the present and have either zero or .20 debt-to-asset ratio. As shown in Table 3, these plans dominate alternative plans that include sugarbeets and 60 percent debt financing.

Based on this analysis, it is only risk efficient to expand sugarbeet acreage when additional debt financing can be minimized. For example, the economic performance of a farm with 200 acres of sugarbeets and .20 debt-to-asset ratio is superior to a farm without sugarbeets and zero debt, but inferior to a farm with 200 acres of sugarbeets that must be financed with a .60 debt-to-asset ratio. Hence, financial risks associated with greater debt usage do not offset higher crop returns from sugarbeets.

As expected, the stochastic dominance analysis indicates that farm plans with less debt are superior when sugarbeet acreage is held constant. Even with a highly profitable crop such as sugarbeets, the benefits from financial leverage as minimal.

SUMMARY

This study identifies conditions under which alternative acreages of sugarbeets and levels of financing are preferred by farmers in the Red River Valley of North Dakota. Although both alternatives can lead to higher farm income, production of sugarbeets entails greater business risk while increased usage of debt heightens financial risk. As a consequence, this study has found that a farmer's preference for each is highly contingent on their present farm situation. In general, expansion of a sugarbeet enterprise can be profitable for many farms if external financing requirements are minimal.

Relationships developed in this study are based primarily on historical data. However, the future operating environment of farms in this area is highly uncertain. In particular, government policies regarding sugar import quotas and wheat/barley price supports directly affect the economic

Table 3. Risk analysis results.

Superior Activities		Dominating	Inferior Activities	
Debt-to-asset Ratio	Sugarbeet Acreage		Debt-to-asset Ratio	Sugarbeet Acreage
.00	0		.20	0
			.40	0
			.60	0
			.60	200
.00	200		.00	0
			.20	0
			.20	200
			.40	0
			.40	200
			.60	0
			.60	200
.00	400		.00	0
			.00	200
			.20	0
			.20	200
			.40	0
			.40	200
			.60	0
			.60	200
.20	0		.40	0
			.60	0
			.60	200
.20	200		.00	0
			.20	0
			.40	0
			.40	200
			.60	0
			.60	200
.20	400		.00	0
			.00	200
			.20	0
			.20	200
			.40	0
			.40	200
			.60	0
			.60	200
.40	0		.60	0
.40	200		.20	0
			.40	0
			.60	0
			.60	200
.40	400		.00	0
			.00	200
			.20	0
			.20	200
			.40	0
			.40	200
			.60	0
			.60	200
.60	0		None	None
.60	200		.60	0
.60	400		.20	0
			.40	0
			.40	200
			.60	0
			.60	200

performance and riskiness of these farms. However, continued deregulation of financial markets and the availability of a secondary market for farm mortgages provides these farmers with greater investment and borrowing opportunities. Therefore, the attractiveness of sugarbeet production in the future needs to be continually evaluated.

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