Price Variability and Financial Risk for Sugar Beet Growers

By

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Abstract

This paper develops a portfolio framework to characterize and analyze the impact of price risk faced by sugar beet growers in the Red River Valley and derives implications for capital markets. Other sources of risk incorporated in the analysis are yields and production cost. Results from stochastic simulation analysis reveal that sugar beet growers incur significant price and financial risk. The hypothesis that the loan rate for sugar truncates the distribution of net returns and protects growers against declining beets prices was not validated.

Key Words: Financial risk, total risk, price variability, stochastic simulation of net return, default risk.

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Introduction

Sugar beet growers in the Red River Valley have enjoyed many years of exceptional profits. In the last couple of years, however, the price of sugar has been declining and the effects are being felt by both the sugar beet growers and the credit institutions that support them. The price of sugar has been falling since 1996. In 1999, the American Crystal Sugar Company announced to their growers that there would be a $1 per ton pay cut for their 1998 beets due to poor winter storage conditions. This pegs the average payment per ton at $35 in 1998 compared to $43.32 in 1996. Average payments for the 2000 crop are projected by American Crystal to decrease even further (ND & MN FBME, 1999, AgWeek April 10, 2000).

Sugar beet growers in the Red River Valley belong to sugar cooperatives and receive payment for their sugar beet crop through the cooperative. Declining beet prices may affect growers in two ways. Growers may lose a portion of their profits from lower sales as well as a portion of their patronage refunds from the cooperatives. The cooperative on the other hand may only experience economic losses due to decreased throughput (Black, Barnett, and Hu, 1999). The cooperative will maintain profit as long as it processes a consistent volume of beets; however, the lower price of sugar translates to a lower price paid per ton and lower returns to the sugar beet grower. Decreased profit to sugar beet growers due to a decrease in beet prices implies growers may need to make financial adjustments to balance risks in their operations.

Credit institutions are particularly interested in the effects of lower beet prices primarily because of increased bankruptcy risk and whether appropriate measures are needed to mitigate their risk by increasing servicing costs such as interest rates. The hypothesis that will be tested in this paper is that price risk associated with production of sugar beets is an important economic issue from the beet growers and credit institutions perspective. Although considerable research has been done on risk exposure and management of cooperatives (Black, Barnett, and Hu, 1999; Zeuli, 1999; and Sporleder, 1999), very limited consideration and analysis has been given to growers. The risks faced by individual growers are different from those faced by the cooperatives especially in the case of sugar beet growers who must contract and sell only to the cooperatives and have no alternative markets. This paper develops a framework to analyze financial risk faced by sugar beet growers in the Red River Valley of the United States. The model developed incorporates price uncertainty and is used to derive implications for capital markets.

Sources of Price Variability for Sugar Beet

Although there has been no economic analysis on factors contributing to the declining sugar beet prices in the United States, the literature has identified potential causes. Variability in beet prices have been attributed to weather conditions, government regulations and trade issues, shifts in farm production patterns, narrowing profit margins in agricultural production, and internal management of cooperatives. Weather conditions play a role in declining prices of sugar beets, especially in the Red River Valley. In 1997 alone, net farm income declined by $290 million in North

Dakota due to adverse weather conditions and diseases (Koo et al., 1998). Typically, the Red River Valley is ideal for outside storage of sugar beets due to the cold winter climate. Higher than average temperatures have introduced concerns especially in the Red River Valley region, regarding additional sugar losses from sugar beets stored in the piles (Haley et al., 1999). A significant reduction in the quantity and quality of sugar beets harvested resulted from adverse weather conditions, disease and other factors. The decrease in harvested sugar beets increased per unit processing costs, decreased sugar production, and had adverse financial consequences (American Crystal Sugar, 1997).

Government regulation also plays a role in the commodity prices received by growers. The Federal Agriculture Improvement and Reform Act (FAIR) of 1996 removes the link between income support payments and farm prices for many commodities. This is done by providing seven annual fixed but declining production flexibility contract payments, where participating producers may receive government payments which are independent of farm prices. Under this act, the raw sugar cane loan rate is fixed at $0.18 a pound, and the refined beet sugar loan rate is frozen at the 1995 crop level of $0.229 per pound (Lord, 1997). The 1996 FAIR Act made dramatic changes to U.S. sugar policy by reducing government intervention, increasing risk to farmers, and creating a more market oriented culture in sugar beets. This resulted in fewer, but more efficient growers and more competition between sugar refiners (Haines, 1998).

Trade issues in the sugar beet market have been a main focus for the sugar industry, and will likely continue to be an issue. The North American Free Trade Agreement (NAFTA) and the Uruguay Round GATT (UR GATT) agreements have had significant effects on the prices of sugar beets due to import quotas. The NAFTA agreement is nearing year seven in 2000. This means that Mexico may be able to increase the sugar exportation to the US from 25,000 metric tons to 250,000 tons tariff free in 2000 (American Sugar Alliance). With a flood of cane sugar being placed into the US market and the world market, sugar prices are declining sharply in the US. This is a probable reason why beet prices for 2000 are projected by American Crystal to be lower in the Red River Valley. Governments of all sugar producing countries intervene in their production, consumption and/or trade of sugar, which makes sugar one of the most heavily subsidized and distorted markets in the world (USDA, 1998). The "world price" for sugar is essentially meaningless, reflecting a relatively small residual of highly subsidized sugar. About 75 percent of the world's sugar production is not traded on the open market which allows for the remaining 25 percent to be sold below U.S. cost of production on what is commonly called the "world sugar market" (American Sugar Alliance). Due to the nature of the world market, sugar is the world's most volatile commodity market. In the past two decades, world sugar prices have soared above 60 cents per pound and plummeted below 3 cents per pound. Because it is a relatively thinly traded market, small shifts in supply or demand can cause huge changes in price (Johnson, 1999).

In addition to the aforementioned effects of declining prices, the world supply must be considered. Total world sugar trade is projected to increase by 11.7% from 25.7 to 28.7 million metric tons for 1999-2008 (Koo et. al., 1999). Except for the European Union (EU), Brazil, Mexico, and South Africa, trade of sugar in most countries will increase for 1999-2008. EU exports decrease mainly because of reductions in EU subsidies under the World Trade Organization (WTO). This will make EU sugar production less competitive. India and South Africa are expected to decrease their exports of sugar mainly because of increases in domestic consumption. Sugar consumption in India and South Africa is expected to increase faster than production.

What does the above information mean to sugar beet growers and financial institutions lending to growers? Can growers be affected by declining sugar beet prices given the price-risk mitigating role of their cooperatives and a loan rate program that in essence serves as a price floor? These are the fundamental issues addressed in this paper. First, we will evaluate cost and risk sharing between growers and their cooperatives. Finally, an analysis of growers' financial risks and risk balancing factors, and evaluate implications for capital markets.

Cost and Risk Sharing between Beet Growers and their Cooperatives

It is important to understand the uniqueness of the sugar beet cooperatives compared to other cooperatives before discussing cost and risk sharing between growers and cooperatives. There are three closed (or membership is limited to growers), new generation cooperatives processing beets in the Red River Valley of eastern North Dakota and South-Western Minnesota. American Crystal has six

processing plants. Min-Dak and Southern Minn have one processing plant each. The cooperatives are the only firms in the region that process sugar beets. Beet growers have no secondary markets other than the coops to sell their beets. There have been costly renovations done by these cooperatives in recent years and with difficult economic times it is likely that these costs are been trickled down to its members.

There are very few studies on cost and risk sharing between new generation coops and their members. Black, Barnett, and Hu (1999), suggest that growers' overall risk exposure extends beyond production risks and includes risks related to storing, processing, and marketing or pricing. They suggested that these risks be analyzed from a systems perspective. Nevertheless, the cooperative is paid a fixed amount per unit processed by the growers. The fixed payment is independent of market prices. So long as there is sufficient volume or throughput, the cooperative will continue to operate profitably. The growers are paid the difference of market price of processed beets less all expenses and throughput processing and spoilage.

Therefore, some growers may be in deep financial distress while other growers and the cooperative are sound financially. For example, data from the MN and ND FBME publication indicate that net returns for 1999 for the 50th (mean) , 20th, and 80th percentile of beet growers in the Red River valley were negative $30.90, negative $154.72, and $142 respectively.[2] Since 1996 the bottom 20% (20th percentile) of sugar beet growers have incurred negative net returns. Alternatively, the financial performance of the beet coops has been good. Sugar beet coops have

[2] The MN and ND FBME publication provide data for about 850 out of about 3000 beet growers in the Red River Valley.

continuously sold sugar above the loan rate and reported good performance data in their annual reports.

While cooperatives strive to return earnings to members, this can't be done on a transaction by transaction basis. Rather, cooperatives usually charge market prices for supplies and services furnished to members and competitive prices for products delivered for further processing and marketing. Normally, this allows them to generate sufficient income to cover costs and meet continuing needs for operating capital. After the fiscal year is over, the cooperative computes its earnings on business conducted through the given sugar cooperative structure (USDA, 2000). This approach exposes the growers to costs and price variability they incur and receive.

The loan rate program and other government insurance like the Actual Production History (APH) have not protected sugar beet growers from price variability. Black and Hu (1999), discussed that farmers are very concerned about the risks of storing and processing throughput loss after beets leave their fields. The APH serves as a protection for production risk and indirectly protects the cooperatives rather than the growers. The financial performance and risk borne by the growers and the coops are very different. For example, if market price for refined sugar is lower than the loan rate, the coops can default on their loans and sell to the government at the loan rate.[3] Some propositions have been made by Zeuli (1999) on

[3] The loan rate has consistently been lower than market price, except for the year 2000 when current market prices are at about 21 cents per pound and the loan rate for the Red River Valley is 22.73 cents per pound. Although this translate to about $82./ton, farmers currently receive only $33.44/ton for their beets (using a refine sugar rate of 18%, and the average per acre yields of 18 tons). At the loan rate, the coops will receive 1.46 times for overhead as compared to what the growers receive. Internal management decision strategies may have substantial impact on how much returns goes back to the growers in the form of retained earnings.

how coops can hedge against price risks by using the stock market or develop insurance protection plans for their members, but currently, growers bear all the price risk. The issue of whether the loan rate is a break-even rate that protects growers from price risk is questionable in the case of sugar beet coops. The analysis of price variability and financial risk in this paper will continue to characterize the risks borne by sugar beet growers and derive implications for capital markets.

Model Development

An equilibrium portfolio framework that maximizes beet growers expected utility is used to analyze business and financial risk under conditions of price uncertainty and derive implications for capital markets and risk balancing. The model is built on the hypothesis that declining beet prices cause business risk (BR) to increase and subsequently total risk (TR), financial risk (FR), and default risk (DR). Modeling and Analysis in this paper are adopted for a characteristic sugar beet grower in a stochastic simulation framework.

It is important to first discuss the definitions, measurement, and arguments of these risks as a foundation for subsequent analysis. In theory, BR arises from the variability of returns caused by prices or production to the investors' risky assets. Financial risk arises from the composition and terms of financial claims on the assets. In this paper we will use the multiplicative approach used by Barry, (1983) to model BR and FR. Following the multiplicative approach, TR is a product of BR and FR. TR is given by, the ratio of standard deviation on equity and the expected return on equity or the coefficient of variation of equity.

(1) $TR = (BR)(FR)$

(2) $TR = \sigma_e / \bar{r}_e$

$= \sigma_a P_a / [\bar{r}_a P_a - iP_d]$

P_a and P_d are the proportions of the grower's assets and debt in his/her portfolio. The interest on debt is i. The standard deviation on equity and asset are σ_e and σ_a, and $\bar{r}_e$ and $\bar{r}_a$ are the mean returns on equity and assets. Business risk is defined as a ratio of the standard deviation of returns over mean returns or the coefficient of variation for returns on risky assets. The sources of risk in this paper will be price and production cost variability.

(3) $BR = \sigma_a / \bar{r}_a$

FR is derived by, dividing TR by BR. It is an indication of the claims on the grower's assets.

(4) $FR = \bar{r}_a P_a / [\bar{r}_a P_a - iP_d]$

The expected return on assets is derived from an equilibrium stochastic portfolio model where sugar beet growers seek to maximize the expected utility of returns under price and cost uncertainty. The stochastic returns are used to estimate FR, and

derive implications for default risk. The model assumes that sugar beet growers have the objective to maximize their expected returns on invested wealth.

(5) $\text{Max } EU(e_1)$

Where, $e_1 = (1 + r_e)e_0$ or end-of period wealth, r_e is the stochastic return on equity, and E_0 is the beginning period wealth. A Taylor series approximation of equation 5 is used to derive a mean-variance formulation that expresses the risk-return tradeoff by λ. The objective function in equation 5 can therefore be expressed as:

(6) $\text{Max } Y_{CE} = E(e_1) - (\lambda/2)\sigma^2(e_1)$

Y_{CE} is the desired certainty equivalent from the growers' investment, λ is the degree of risk aversion or the relative risk aversion coefficient evaluated at initial wealth, and $E(e_1)$ and $\sigma^2(e_1)$ are expected value and variance respectively of the grower's end of period wealth from sugar beet production.[4]

(7) $E(e_1) = E[(1 + r_e)e_0]$

[4] Equation 6 is a standard equilibrium formulation adopted from Barry and Robinson (1986). Tobin pointed out that all choices in a portfolio problem consisting of a risky and risk free asset will always be mean-variance efficient. Thus, consistency between EV and EU model is assured in this context. Meyers generalized Tobin's observations by pointing out that the condition is also satisfied when the assets satisfy the location parameter consistency conditions. Since both Meyer's and Tobin's sufficiency conditions are satisfied, a maximizing certainty equivalent expression can be formulated that is consistent with any particular EU maximizing choice (Robinson and Barry, 1986).

The return equity (r_e) is = $r_a P_a - i P_d$, which is the return on sugar beet investment less the interest paid on debt. Sugar beet growers have delivery obligations that equates the volume of beets growers supply to the coop to the number of shares they own. One share gives the grower the right and obligation to deliver one acre of beets or a proportion that varies from year to year. This is extremely important for two reasons: 1) expected returns and variance of beets and stocks should be modeled jointly as a portfolio, and 2) inferences and implications of declining beet and stock prices should incorporate the fact that lower stock prices make it attractive to buy beet stocks and therefore produce sugar beets under conditions of price uncertainty.[5] The returns from beet production and stocks is therefore, $r_a = r_b P_b + r_s P_s$. Where r_b and r_s are the stochastic returns on beets and beet stock and P_b and P_s are the proportion of assets invested in beet production and beet stocks in the growers portfolio. The net returns from beet production is given by, $r_b = PQ - ñ$. Where Q is the yield and P and ñ are stochastic price and cost. Therefore equation 7 can be written as:

$$E(e_1) = E[(1 + ((PQ - ñ)P_b + r_s P_s)P_a - i P_d))e_0]$$

$$= (1 + ((\bar{p}Q - \bar{c}) P_b + \bar{r}_s P_s)P_a - i P_d))e_0$$

(8) $$\sigma^2(e_1) = (D_0 + e_0)^2 \sigma^2_a$$

[5] There are delivery obligations with owning beet stock. A grower may rent the stocks, but they must deliver proportionately to their stock holdings.

Where D_0 and E_0 are initial period debt and equity, σ^2_a is the variance of returns, the mean price per ton of beets is $\bar{p}$, $\bar{c}$ is mean cost, and $\bar{r}_s$ is the mean returns on beet stocks. In the analysis we use the distributions of these stochastic variables rather than their mean. The variance is defined as $\sigma^2_a = \sigma^2_b P^2_b + \sigma^2_s P^2_s + 2cr\sigma_b\sigma_s P_b P_s$ where *cr* is the correlation between the returns from beet production and stocks, and σ_b and σ_s are the standard deviation of returns from beet production and stocks respectively. If we substitute equations 7 and 8 into 6 we get equation 9.

$$(9) \qquad \text{Max } Y_{CE} = (1 + ((\bar{p}Q - \bar{c})P_b + \bar{r}_s P_s)P_a - i\,P_d))e_0 - (\lambda/2)(D_0 + e_0)^2(\sigma^2_b P^2_b + \sigma^2_s P^2_s + 2cr\sigma_b\sigma_s P_b P_s)$$

From equation we can show using comparative statics that

a) $\delta Y_{CE}/\delta p > 0$,

b) $\delta Y_{CE}/\delta c < 0$, and

c) $\delta Y_{CE}/\delta r_s > 0$, for all production levels and asset holdings.

As prices and stock values decrease the certainty equivalent of net return decreases and vise versa, but the interaction of prices, stock returns and cost may yield different results. The empirical analysis using equation 8 simulates net returns from sugar beets under price, stock return, and production cost uncertainty. Simulated returns are used to derive FR and implications for capital markets with a default risk model that explicitly incorporates price variability will be explored. Estimates of FR gives an indication on the claims of the growers assets but do not

incorporate other necessary performance data.[6] The default risk model provides a bigger picture of growers' financial risk and addresses the concerns of financial institutions of whether sugar beet growers can meet overall financial obligations under declining prices.

Default risk is a major concern of credit institutions. It provides a more explicit financial risk analysis of the growers. Default risk is the amount of risk associated with a borrower not making a payment according to the terms of the loan or note to the credit institution. The models frequently used to analyze default risks are common linear and multivariate logit and probit models. Although these models provide a good framework to separate high and low risk borrowers, a linear discriminant model by Altman (1985) was chosen because prior studies by Turvey (1991) show it gave the best prediction accuracy over the logit and probit model. It also has a list of significantly tested variables.[7] The model with explicit representation of price risk is given by equation 11.

(10) $$Z = \sum \beta_i X_i + \mu_i$$

$$= \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \mu_i$$

[6] In general growers buy crop insurance to compensate for losses due to low prices and yields. Price analysis that does not incorporate this fact may result to type one or two errors. Incorporating other financial performance data in a linear discriminant model provide a complete picture of financial risks faced by beet growers under conditions of price uncertainty.

[7] The standard Altman's discriminant function is calculated in the following manner: $Z=1.2X_1+1.4X_2+3.3X_3+0.6X_4+1.0X_5$. According to Altman's credit scoring model, any firm with a Z score of less than 1.81 should be placed in the high default risk region (Turvey, 1991) based on the given set of data for the calculation. Explicit representation on how to estimate the discriminant model, include variables other than those analyzed by Altman, and measure the significance of estimated parameters is discussed by Turvey.

Where;

X_1 = Working Capital/Total Assets Ratio,

X_2 = Earned Equity/Total Assets Ratio,

X_3 = Earnings Before Interest and Taxes/Total Assets Ratio,

X_4 = Market value of Equity/Book Value of Long-term Debt Ratio,

X_5 = Sales/Total Assets Ratio,

X_6 = Price,

X_7 = Standard deviation of prices, and

μ_i = the error term

Z is the overall measure of the default risk classification of the borrower being analyzed. The larger the value of Z, the lower the chance that the borrower is going to default and vice versa. The proceeding section presents the data used for the analysis in this study.

Data

The Minnesota and North Dakota FBM (1999) publication has historic data for average, low, and upper 20% of sugar beet costs, net returns on beets, and prices for growers in the Red River Valley. These data, in a stochastic simulation framework, are used to estimate the certainty equivalent of net profits for a characteristic grower in the Red River Valley. The stochastic simulation framework enables us to project net returns for price ranges as low as $30 per ton. BestFit software is used to determine the distribution of price, production costs, and the

certainty equivalent of net profits for risk levels ranging from 0 to 0.2.[8] The distributions for price, output, production cost, and net returns per acre are Beta(0.95, 1.2)*16.52+29.09, Beta(1.08, 1.08)* 1.81e+2+5.25e+2, and Normal(16.73, 1.21e+2) respectively. The reason why distributions are used rather than actual numbers is because the growers do not know the price, output levels, and production costs at the beginning of the season when production decisions are made. These variables vary widely with weather conditions, spoilage, shrinkage, and other logistics factors. @Risk is used to simulate net returns and FR for a characteristic farmer.

Performance data with return on beet stocks for equations 9 and 11 are simulated from 30 beet growers. Five years performance data were provided by a financial institution for 30 beet growers in the Red River Valley. This data was used to simulate 3000 observations for a characteristic farmer for all variables in equation 11. The sample size of 3,000 observations was also simulated because the discriminant model requires large data size to ensure efficiency of estimated parameters (Turvey, 1991) and this is the approximate number of sugar beet farmers belonging to sugar beet cooperatives in the Red River Valley. The distribution for each variable is presented in Table 1.

[8] The range of the risk premium represents the degree of risk aversion of the farmers with zero resenting risk neutrality and higher values representing higher levels of risk aversion. The range for

Table 1: Distribution of Variables from BestFit.

VARIABLE	DISTRIBUTION
Z Score	Lognormal(7.67,26.48)+-.17
Working Capital/TA	Logistic(-7.33e-3,9.01e-2)
Earned Equity/TA	Logistic(6.67e-4,2.69e-2)
EBIT/TA	Logistic(2.17e-2,3.00e-2)
Equity/LL	Lognormal(14.26,92.64)+-.25
Sales/TA	Chisq(1.00)
Price	Beta(0.95,1.20)*16.52+29.09
Std. of Price	Beta(0.47,0.37)*6.65+ -4.01

To be representative of the 30 farmers in the sample, the 3,000 simulations needed to be correlated. Correlation between variables was estimated for the original 30 observations and utilized to correlate draws from distributions used for the simulation.[9] This procedure is very useful to generate a consistent sample of 3000 observations. Equation 11 is then estimated using the 3000 observations. All data were collected and simulated for a characteristic grower.[10] Overall two models were estimated. The first model had price and the standard deviation of price and the second model had only the significant variable identified by Altman.

the risk premium is adopted from Barry and Robinson.

[9] The correlation matrix of variables was squared to obtain the variance covariance matrix which is plugged into the @RISK spreadsheet using the RISKCORRMAT command to correlate the distributions from Table 1.

[10] According to the FBM E publication and information from capital markets, a characteristic sugar beet grower in the Red River Valley has approximately 59% equity and 41% debt. Using the relationship A/E –L/E = 1, this implies Pa =1.41 and Pd = 0.41. The average interest on debt is 9% and average acreage of sugar beet grown is 179.29 for 1999. The average family living expense is $82,300.

Results

Simulated net returns decrease significantly as prices decrease and are negative for prices below $33 per ton for a characteristic grower. Figure 1 and Table 2 show simulated net returns, BR and FR for different price levels. These results show that a beet price less than $36 per ton could be potentially hazardous to a farmer's ability to generate sufficient profit to cover capital debt, living expenses, and other miscellaneous expenses. The model also showed that the break-even price for a

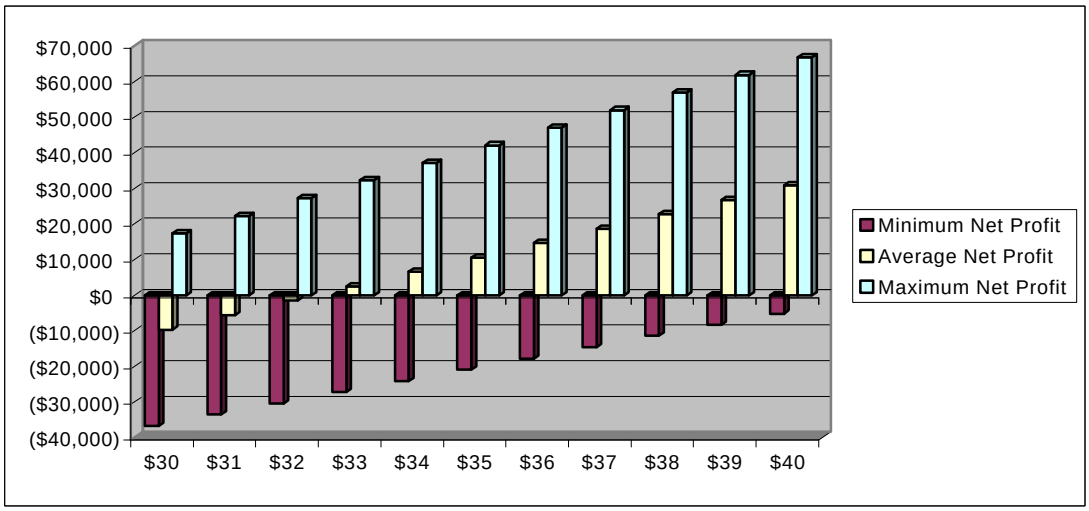

Figure 1: Net Profit Ranges and Price Variability

characteristic grower is approximately $32.4 per ton (A break-even price is one where revenue minus expense of production equals zero). Current payments by the sugar cooperative are nearing the break-even point as they have decreased from the past payments received. Price levels lower than $33 per ton serves as an indication for sugar beet growers to consider growing alternative crops or engage in equipment sharing and other cost cutting activities.

Business and financial risk increase significantly as prices decrease. These results show that as the beet price falls below $32.4 per ton, holding beets in a grower's portfolio becomes very risky. The coefficient of variation of returns on asset or BR is very high (12) and the claims on the firm's asset or FR estimates are very high (11.87) for prices, $33 per ton or less. It becomes financially infeasible for the average grower to produce beets at prices lower than $33 per ton.[11] The simulated net returns also indicate that some growers may incur negative net returns even at a higher price ton of $40. The probability of negative returns increases significantly as prices decrease.

Table 2: Net Returns, Business, and Financial Risk with Decreasing Prices

BEET PRICE	MINIMUM NET PROFIT	AVERAGE NET PROFIT	MAXIMUM NET PROFIT	Business Risk(BR)	Financial Risk (FR)
$30	$-36,675	$-9,675	$17,325	*	*
$31	$-33,525	$-5,625	$22,275	*	*
$32	$-30,375	$-1,575	$27,225	*	*
$33	$-27,225	$2,475	$32,175	12	11.8725
$34	$-24,075	$6,525	$37,125	4.689655	1.69854
$35	$-20,925	$10,575	$42,075	2.978723	1.340044
$36	$-17,775	$14,625	$47,025	2.215385	1.224717
$37	$-14,625	$18,675	$51,975	1.783133	1.167805
$38	$-11,475	$22,725	$56,925	1.50495	1.133895
$39	$-8,325	$26,775	$61,875	1.310924	1.111386
$40	$-5,175	$30,825	$66,825	1.167883	1.095356

* Infeasible

These results are consistent with FBME data for net returns by sugar beet growers in the Red River Valley. Since 1998, average and low 20% sugar beet growers who own or rent land have experienced high variability on their gross and net returns and at times incurred negative net returns with price levels below $33 per ton. The big question therefore, is why do growers continue to grow beets with potential price levels below $32 per ton? This question has been addressed partly by incorporating stock returns and variability of production costs in the simulation model.[12] More insight to this question is provided by default risk analysis. The linear discriminant results analyze whether growers may have some intangible incentives to sustain or reduce financial risk as prices decrease.[13] Results from the default risk analysis incorporate other performance measures not used in portfolio simulation model. The results are presented in Table 3.

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[11] The results did not change significantly as the premium for beet increased to about 0.1.

[12] But returns on stocks are currently low and negative for some growers. There are some cost sharing among growers with expensive equipment. This is a tool used by growers to compensate for low prices but needs further investigation and research.

[13] Growers are owners of the coops and will have retained earnings at some point in time. Other crops in the grower's rotation can sustain low beet prices. The growers anticipate that conditions may change or is the right time to buy beet stocks because prices are low. This will all be captured by the 5 years panel data used in the discriminant analysis.

Table 3: Coefficients and Default Score with and without Price Variability

Variables	Coefficients of Restricted Model	Coefficients of Unrestricted Model
Intercept	10.901*	10.041*
Working Capital/TA	0.338	-1.808
Earned Equity/TA	7.086**	25.955***
EBIT/TA	1.525*	8.156**
Equity/LL	-0.004	0.038
Sales/TA	-0.038	-0.315
Price	0.251	0.372*
Std. of Price		0.793
Z Score	2.824	-3.145
F-Significance	0.006	0.005
R^2	49.75%	60.53%

*, ** imply significant at the 10% and 5% level of significance respectively. The test for significance for the discriminant model is done using the F-test (Turvey, 1991).

The signs of the significant variables are as expected. Although the two models have good fit with very significant F statistics, the unrestricted model with price variability has a better fit with a higher R^2. The R^2 was 60.53% as compared to 49.75% for the restricted model. Price becomes significant as we incorporate price variability into the discriminant model. As price decreases the Z score decreases and sugar beet growers have a greater probability to default on their loans. Incorporating other performance data did not contradict the fact that declining beet price has adverse financial implications for beet growers.

Overall, the default risk is low with the restricted model and becomes very high as we incorporate price variability into the model. The Z score for the restricted model is below the standard 1.81 recommended by Altman. What is really interesting is the change in Z score from 2.824 to negative 3.145 as price variability is added to the model. Growing sugar with current price uncertainty increases the risk of the grower's portfolio and may result in subsequent loan rejection. This model shows that sugar beet price does affect the probability of default risk. If the model shows high probability of default, a person analyzing the credit would be signaled to take a more in depth look at all the factors affecting the particular credit. With a result of low default risk, the analyst may be more at ease with the credit.

Conclusion

Results from the stochastic simulation model showed that $32.4 per ton is the break even beet payment for growers in the Red River Valley. Growers with a significant investment in sugar beets may have significant difficulties to cover production costs and meet family living expenses when beet prices fall below $36 per ton. Also, growers may have trouble obtaining working capital and other bank loans at this price level. With this information, it can be concluded that both the sugar beet growers and the financial institutions landing to growers are experiencing a time of great volatility. Results from all the models indicate sugar beet growers and lending institutions should be more proactively involved in strategies that reduce the impact of declining beet prices. These strategies maybe to advise growers to switch to alternative crops, engage in equipment sharing and other cost-cutting activities, and encourage their cooperative develop price-risk management strategies.

Implications for Crop Revenue Insurance

Growers in the Red River valley continue to incur high insurance premiums and insurance coverage will be more and more required by financial institutions. Coops and growers have to develop price-risk management strategies like hedging or some form of price insurance that growers can use to protect themselves against declining sugar beet prices. The loan rate and other farm insurance programs like APH provide limited price protection for the growers. Although there are risks associated with belonging to a cooperative, the farmer's primary incentive for joining a cooperative is to shield them from some business and financial risk. In the case of sugar beets, the cooperatives can convert the raw product, sugar beets, and sell into a market where prices can be characterized as being more stable whereas the grower does not have access to a secondary market with the delivery contract obligation.

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